Random drug testing in Australia, analogies with RBT, and likely effects with increased intensity levels

Max Cameron
Monash University Accident Research Centre

Abstract

Background
Roadside oral fluid tests (ROFTs) of proscribed impairing drugs are now common practice in all Australian jurisdictions to detect and deter drug-driving. These tests are usually performed at bus-based random breath test (RBT) stations, thus providing a suitable environment for the secondary oral fluid test (if necessary) and safe storage of saliva samples. While not all randomly-selected drivers are required to provide an initial oral fluid test, usually following a preliminary breath alcohol test, the process of conducting ROFTs in conjunction with RBT results in what is essentially random drug testing (RDT).

Aim
This paper aims to develop an analogy between RDT and the early years of RBT in Australia when intensity levels were low. This analogy is used to predict the likely effects on drug-driving among killed drivers as the number of random drug tests is increased.

Method
Relationships between the annual number of RDTs conducted in Victoria during 2005 to 2009 and the percentage of killed drivers with drugs in their bloodstream (either a proscribed drug [THC, MA or MDMA] or any impairing drug) were able to be calibrated. The calibrated relationships were then used in conjunction with an estimate of the cost per random drug test to determine the cost-effectiveness of RDT.

Results
Diminishing-returns type relationships were found between the annual number of RDTs and the presence of impairing drugs in killed drivers. Although the ROFT equipment and associated Police testing time is currently expensive per test, the calibrated relationships suggested that current RDT rates per licensed driver could be increased to at least 10% per year before cost-effectiveness is in doubt.

Discussion and conclusions
RDT has the potential to achieve significant general deterrence of drug-driving in a similar way as that achieved by best-practice RBT. While RDT is highly cost-effective at the modest levels of intensity that it is currently operated at in Australia, the analogy with RBT developed in this paper suggests that it will remain cost-effective if testing rates per licensed driver are increased up to 10% of drivers per year. However, to remain cost-effective at even higher testing rates per year, the cost per random drug test must be substantially decreased.

Background to the drug driving problem
There are numerous drugs, both licit and illicit, that are thought to impair driving alone and in combination (including combined with alcohol) and are associated with increased risk of road crashes and trauma. Unlike alcohol in the driver’s blood stream, whose effects on driving increase with blood alcohol concentration, the mere presence of some drugs is impairing and the effect is not necessarily immediate or when the drug concentration is at its highest.
The presence of each drug has been measured among driver casualties (killed and/or injured) and among drivers on the road, in various years and in various jurisdictions. However, because of the rapidly changing availability and consumption patterns of illicit drugs, and prescription patterns of therapeutic drugs, their presence among drivers varies rapidly with geography and time.

However, the comparison of drug presence rates among driver casualties and among drivers on the road provides valuable information about the relative risks of road crashes associated with specific drugs and drug combinations. Australian crash-based studies have estimated the relative risks associated with various drugs, drug combinations and alcohol, albeit using a different basis for measuring drug presence among on-road drivers (“culpability analysis”). The estimated crash risks associated with each drug or drug combination may be relatively immune from the changing patterns of licit and illicit drug consumption.

**Incidence of drugs among driver casualties in Australia**

Drummer et al (2003) examined trends in the incidence of drugs and alcohol presence among 3398 killed drivers in Victoria, NSW and WA during 1990-1999. During the period, there was a trend for reducing presence of BAC over 0.05% and for increasing presence of impairing drugs (rising from 20% to 27%) in killed drivers. Over the full decade, the most common impairing drugs were cannabis (13.5%, of which THC 8.5%), opioids (4.9%), stimulants (4.1%), benzodiazepines (4.1%) and other psychotropic drugs (2.1%). This same data was the subject of culpabil analysis described below (Drummer et al 2004).

**Incidence of drugs among drivers on the road in Australia**

Davey and Freeman (2009) screened oral fluid samples from 2657 drivers stopped at RBT stations in urban and rural areas of Queensland during 2006-2007. They detected 3.8% of the sample with one or more illicit drugs, of which the most common drugs were MDMA (1.99%), THC (1.73%), amphetamines (0.86%) and cocaine (0.22%). The drink driving detection rate was only 0.8%, suggesting that drug driving was much more common than drink driving in Queensland.

Chu et al (2012) measured drugs present in 853 roadside oral fluid tests from Victorian drivers found positive on drug screening tests during 2009/10. At least one proscribed drug was present in 96% of drivers, and the most common were MA (77%), THC (42%), MDMA (17%) and all three combined (4%). Other drugs detected were opioids (14%), cocaine (8%, often combined with MA), and benzodiazepines (8%). Combinations of drugs were common.

**Risks associated with drugs present in drivers**

Collecting information on drugs present in drivers on the road in a way that is directly comparable with information on drugs present in driver casualties in the same jurisdiction and time period is very difficult and expensive. For this reason, estimates of crash risk in Australia have relied on methods of culpability analysis. In this approach, the distribution of drug presence in drivers considered non-culpable (or not responsible) for a crash is considered to represent the distribution of drugs among all drivers on the road. Analysis comparing the distributions of drug presence among the culpable and non-culpable drivers allows the ratio of the odds of crashing for the culpable driver relative to the non-culpable driver to be estimated. This is known as the Odds Ratio (OR) and is close to representing the relative risk of crashing for the drug-affected driver relative to a drug-free driver.
Risk of fatality associated with drugs in Australian drivers

Drummer (1994) was one of the first to use methods for assigning culpability or responsibility for each crash after he collected crash details for 1045 killed drivers. Culpability was determined according to mitigating factors (independent of drug analysis), and drivers were classified as culpable, contributory, or not culpable. The mitigating factors used in the analyses were the condition of the road and vehicle, driving conditions, type of accident, witness observations, road law obedience, difficulty of the task involved, and level of fatigue (Robertson & Drummer, 1994). The proportion of culpable drivers was calculated for each drug type condition. The large majority (73%) of drivers in the sample as a whole were culpable, while 18% were not culpable. The relative risks for each drug type and drug combination were estimated by the Odds Ratio (OR) described above.

Alcohol was the most prevalent drug found in these killed drivers (36%). The highest OR for any drug alone was found for alcohol (6.0), then opiates (2.3). ORs were considerably higher for the following drugs when present in combination with alcohol: benzodiazepines (9.5), stimulants (8.7) and cannabis (5.6).

Drummer et al’s (2003) data on 3398 drivers killed during 1990-1999 were subjected to culpability analyses in a subsequent publication, and ORs were calculated for various drug combinations (Drummer et al 2004). The presence of THC was associated with increased crash risk for both car drivers (OR 2.7) and motorcyclists (OR 2.4). Of those drivers positive for THC only, the majority (84%) had THC levels > 5 ng/ml. THC > 5 ng/ml was significantly associated with increased culpability (OR 6.6), which was similar to the OR associated with BAC positive cases over 0.05%. Drivers positive for THC and who had a BAC over 0.05% were 2.9 times more likely to be culpable than drivers who were BAC positive only, which suggests that THC does enhance impairment associated with alcohol.

Risk of serious injury associated with drugs in Australian drivers

Blood samples were collected from 2500 non-fatally injured drivers in South Australia in 1995-1996 (Longo et al, 2000a, b). Alcohol was the most prevalent drug in these samples, being present in 8.6% of cases. The next most prevalent drugs were cannabis (THC) alone (7.1%), cannabis and alcohol (3.0%), benzodiazepines only (1.8%), and stimulants alone (0.8%). As for the risk of a fatal crash, alcohol was the most dangerous drug in terms of the percentage of injured drivers found culpable with one drug alone. Culpability was increased for drugs in combination with alcohol. Culpability analysis suggested that there were significantly increased injury crash risks associated with combinations of THC and alcohol (OR 5.4), benzodiazepines and alcohol (OR 13.4), and benzodiazepines alone (OR 2.0).

Ogden et al (2011) obtained blood samples taken from drivers presenting at hospitals in Victoria. Commencing December 2008, the samples of 1801 injured drivers were screened for alcohol and drug presence, and subjected to culpability analysis in the same way as Drummer et al (2004). The analysis suggested that serious injury crash risk increases with the number of drugs present compared with a drug-free driver: one drug (OR 4.5), two (OR 11.4), three (OR 37.5), four or more (higher OR, but indeterminate). Very high risks associated with alcohol in combination with THC (OR 62.0) or with benzodiazepines (OR 20.2) were confirmed. High risks were associated with benzodiazepines alone (OR 3.1), benzodiazepines in combination with other drugs (OR 8.9), and even higher for the benzodiazepines, other drugs and alcohol combination (OR 27.0). Ogden et al’s (2010) earlier analysis of the first 837 injured drivers had found high risks associated with MA (OR 5.4) and MDMA (OR 5.1).
Roadside oral fluid tests for drug enforcement

An important development in drug driving enforcement in Australia was the introduction of legislation allowing roadside oral fluid testing (ROFT) and its potential use to randomly test drivers in a similar way to RBT. Victoria was the first State and apparently worldwide to enact such legislation in December 2004. Since its inception, over 100,000 drivers have been screened for drugs on the roadside in Victoria. All Australian States and Territories now conduct similar testing to Victoria (Boorman and Owens 2010, Chu et al 2012). Random ROFT is known as “random drug testing” (RDT).

The Victorian legislation initially allowed for random ROFT of only MA and THC. New legislation added MDMA to the framework in September 2006. Drivers are initially tested at the roadside by a tongue swipe using the Securetec Drugwipe TWIN. If this test is positive to one or more of the proscribed drugs, oral fluid is collected from the driver and tested using a second device, the Cozart Rapiscan. If this test is also positive, the driver is banned from driving for 24 hours and an oral fluid sample is sent for confirmation by laboratory analysis. Where the driver is unable to provide sufficient oral fluid, he or she is required to provide a blood sample for laboratory analysis. It is understood that very similar procedures and drug screening devices are used for RDT in the other Australian jurisdictions.

The number of drivers screened by RDT in Victoria has increased each year from 13,158 in 2005 to 27,883 in 2009. The detection rate of proscribed drugs fell from 2.3% to 1.0% during the same years (Boorman 2010). Figure 1 shows that the percentage of killed drivers found to have an impairing drug in their blood has fallen during the same period. Figure 1 also shows that the percentage of killed drivers with drugs present generally increased during 2001 to 2005. A reversal of that trend was associated with the increase in RDT.

**Figure 1: Trends in percentage of killed drivers with target drugs (THC, MA or MDMA), or any impairing drug, versus number of drivers screened and detected at RDT in Victoria**

![Figure 1: Trends in percentage of killed drivers with target drugs (THC, MA or MDMA), or any impairing drug, versus number of drivers screened and detected at RDT in Victoria](image-url)
The relationship between the annual number of ROFTs and the annual percentage of killed drivers with at least one of the proscribed drugs is shown in Figure 2. An even stronger relationship is apparent between the number of ROFTs and the percentage of killed drivers with any impairing drug (including the three proscribed drugs). This suggests an association between random drug testing (RDT) and the deterrence of both proscribed and non-proscribed impairing drugs taken by drivers.

**Figure 2: Relationships between percentage of killed drivers with proscribed drugs, or any impairing drug, versus number of drivers screened by ROFTs at RDT in Victoria**

*Analogy with RBT*

These types of “diminishing returns” relationships have been found to apply to levels of traffic enforcement generally (Elvik 2001) and to random breath testing (RBT) in particular (Henstridge et al 1997, Koornstra et al 2002, Elliott and Broughton 2005, Cameron 2013). Most ROFTs in Victoria were carried out at bus-based testing stations (Drug/Booze Buses) in conjunction with RBT and usually following an initial preliminary breath alcohol test. The strategic principle behind this type of operation was general deterrence of drug-driving, i.e. to raise the perceived risk of an illegal drug-driver being caught for this offence, not necessarily to detect illegal drug-driving on a large scale that could be achieved by targeted drug-driving enforcement operations. This is the same strategic principle as applied to RBT in Australia.

For the above reasons, it was concluded that there is a reasonable analogy between RDT and RBT. From this, it was considered appropriate to use the relationships illustrated in Figure 2 to predict the likely effects on driver fatalities as RDT levels are increased. This approach has precedents in the economic analysis of the effects of RBT and other drink-driving enforcement operations on their cost-effective levels (Cameron 2008, 2013; Elvik et al 2012).
Economic analysis of levels of RDT

The economic analysis estimated the value of the savings in road trauma victims from increased drug-driving enforcement and compared that with the cost of providing the additional enforcement. Based on Elvik (2001) and the findings from Victoria in Figure 2, it was assumed that a diminishing returns relationship with the power function form applies to estimate the reduction in killed drivers with impairing drugs at each level of RDT.

Costs of additional roadside oral fluid tests (ROFTs)

Recent analysis (Cameron 2013) in an Australian State had estimated a unit cost of $18.37 to conduct a preliminary breath test (PBT) at a bus-based testing station where ROFTs are also administered to a sub-sample of drivers. The initial Securatec ROFT device returns a result in six minutes (Woolley and Baldock 2009), during which the officer must remain with the driver. If this test is positive (6.2% of tests), the driver is given the Cozart test which may take up to 30 minutes, at least part of which must be attended by the initial testing officer. In contrast, a PBT can take one minute if negative.

It was estimated that the testing cost per ROFT is about five times the cost per PBT, namely 5 times $18.37 equals $91.84 per ROFT. To this unit cost must be added the equipment costs of a Securatec preliminary tester ($38.00), a Cozart secondary tester ($41.40) applicable in 6.2% of ROFTs, and oral fluid sample analysis at a central laboratory ($200) applicable in 5.4% of ROFTs. In total, it was estimated that the average cost per ROFT is $143.28 per test.

Valuation of road trauma savings due to increased enforcement

The unit social cost, using the “willingness to pay” method, was used to value the savings in all victims involved in fatal crashes with killed drivers who had impairing drugs in their blood stream. The value assigned to each killed driver was $6.657 million (in 2010-2011), based on NSW Roads and Traffic Authority (2008) estimates. This value was supplemented by the unit costs reflecting the injury profile of all victims involved in crashes with killed drug-impaired drivers during 2010 and 2011. The unit social cost of each crash involving a killed driver with impairing drugs was estimated to be $7.532 million in 2010-2011.

Savings in driver fatalities and crash costs compared with the cost of additional tests

From a base level of 0.54 ROFTs per 100 licensed drivers in the specific Australian State, the function in Figure 2 was used to estimate the proportion of driver fatalities with impairing drugs at each drug testing level, the number and percentage of driver fatalities saved, and the saving in social costs of the road trauma to all victims in the fatal crashes involving the saved drivers (Table 1). This was compared with the cost of providing the additional ROFTs in the State based on the unit total cost per ROFT of $143.28. The benefit-cost ratio (BCR) at each level of the expanded program (measured by the ROFT rate per licensed driver) was calculated by dividing the annual saving in social costs of the crashes by the annual cost of the additional ROFTs. The marginal BCR was calculated from the incremental social cost saving due to 1,000 increase in ROFTs per annum and the increment in the program cost of the extra 1,000 ROFTs.

Table 1 indicates that RDT is highly cost-effective at current modest levels of testing (about 1.2% of licensed drivers per annum in Victoria). There is uncertainty about the extrapolation of the fitted function in Figure 2 to the higher levels of ROFTs per annum. For this reason the
estimates of the program and marginal BCRs at higher levels of testing should be treated with caution, and only BCRs of at least two accepted as an indicator of a cost-beneficial investment in RDT. On this basis, the marginal BCRs in Table 1 suggest that a ROFT testing rate of up to 10% of licensed drivers per year could invested before the cost-benefit of a drug-driving enforcement program of this magnitude is in doubt.

### Table 1: Economic analysis of reduction in driver fatalities with impairing drugs (including proscribed drugs, THC, MA and MDMA) due to increased ROFTs per year

<table>
<thead>
<tr>
<th>ROFTs per licensed driver per annum (%)</th>
<th>Estimated proportion of driver fatalities with impairing drug(s)</th>
<th>Fatalities saved per annum (above base level)</th>
<th>Percentage of total driver fatalities saved</th>
<th>Social cost of fatal crashes saved p.a. ($000s)</th>
<th>Cost of additional ROFTs p.a. ($000s)</th>
<th>Expanded program BCR (above base level)</th>
<th>Marginal BCR</th>
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<tbody>
<tr>
<td>0.54%</td>
<td>0.480</td>
<td>0.0</td>
<td>0.0%</td>
<td>0</td>
<td>-</td>
<td>NA</td>
<td>NA</td>
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<td>1.24%</td>
<td>0.386</td>
<td>19.8</td>
<td>15.2%</td>
<td>149,217</td>
<td>1,623</td>
<td>91.97</td>
<td>49.28</td>
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<tr>
<td>2.49%</td>
<td>0.322</td>
<td>30.2</td>
<td>23.2%</td>
<td>227,142</td>
<td>4,888</td>
<td>50.61</td>
<td>16.53</td>
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<td>3.73%</td>
<td>0.290</td>
<td>34.7</td>
<td>26.7%</td>
<td>261,291</td>
<td>7,354</td>
<td>35.53</td>
<td>8.98</td>
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<td>4.98%</td>
<td>0.269</td>
<td>37.4</td>
<td>28.8%</td>
<td>281,188</td>
<td>10,219</td>
<td>27.58</td>
<td>5.88</td>
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<td>6.22%</td>
<td>0.254</td>
<td>39.3</td>
<td>30.2%</td>
<td>295,995</td>
<td>13,085</td>
<td>22.62</td>
<td>4.25</td>
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<td>7.47%</td>
<td>0.242</td>
<td>40.7</td>
<td>31.3%</td>
<td>306,593</td>
<td>15,951</td>
<td>19.22</td>
<td>3.27</td>
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<tr>
<td>8.71%</td>
<td>0.233</td>
<td>41.8</td>
<td>32.2%</td>
<td>314,932</td>
<td>18,816</td>
<td>16.74</td>
<td>2.62</td>
</tr>
<tr>
<td>9.96%</td>
<td>0.225</td>
<td>42.7</td>
<td>32.9%</td>
<td>321,734</td>
<td>21,682</td>
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<td>43.5</td>
<td>33.4%</td>
<td>327,431</td>
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<td>1.84</td>
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<td>12.45%</td>
<td>0.212</td>
<td>44.1</td>
<td>33.9%</td>
<td>332,302</td>
<td>27,413</td>
<td>12.12</td>
<td>1.58</td>
</tr>
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</table>

### Conclusion

RDT has the potential to achieve significant general deterrence of drug-driving in a similar way as that achieved by best-practice RBT. While RDT is highly cost-effective at the modest levels of intensity that it is currently operated at in Australia, the analogy with RBT developed in this paper suggests that it will remain cost-effective if testing rates per licensed driver are increased up to 10% of drivers per year. However, to remain cost-effective at even higher testing rates per year, the cost per random drug test must be substantially decreased.

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