**Alcohol and Transport Safety — Analysis of the Options**

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**INTRODUCTION**

It is necessary to begin by recognising a general point: the enormous inertia of the system we are dealing with. The alcohol-associated accident is a by-product of excessive drinking and this is a by-product of the deeply imbedded custom of drinking alcoholic liquor in this and many other countries.

The production and sale of alcohol in this country is a two thousand million dollar business. Consumption of alcoholic liquor as an essential part of the good life is relentlessly promoted.

The per capita consumption of alcohol in this country has been steadily rising for a number of years (Table I).

**TABLE I Consumption of Alcoholic Beverage in Australia**

<table>
<thead>
<tr>
<th>Year</th>
<th>Beer (litres per head)</th>
<th>Wine</th>
<th>Spirits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1958-59</td>
<td>103.2</td>
<td>5.0</td>
<td>0.8</td>
</tr>
<tr>
<td>1971-72</td>
<td>127.5</td>
<td>9.0</td>
<td>1.1</td>
</tr>
<tr>
<td>1972-73</td>
<td>131.5</td>
<td>9.9</td>
<td>1.3</td>
</tr>
<tr>
<td>1973-74</td>
<td>141.3</td>
<td>11.2</td>
<td>1.3</td>
</tr>
<tr>
<td>1974-75</td>
<td>142.7</td>
<td>12.5</td>
<td>1.2</td>
</tr>
</tbody>
</table>

The distribution of individual consumption is skewed to the high end — in fact, it approximates a lognormal curve. This is not just a statistical oddity. It means that the percentage of the population who drink to excess (defined as an average daily consumption in excess of 100 gms of pure alcohol) does not rise in parallel to the average per capita consumption, but faster. In consequence, any small improvements made by existing countermeasures are likely to be offset by increased liquor consumption.

If we consider what indices or figures of merit are available to measure the influence of alcohol on a traffic system, the only statistic which seems free from the biasing effect of enforcement and other factors is the percentage distribution of BAC in fatally injured car drivers — provided a large representative sample (ideally 100%) of such drivers is regularly obtained.

Data of this kind are available in this country for Brisbane and Melbourne (Figure 1). The influence of alcohol is unchanged over the period of eleven years, during which blood alcohol legislation was introduced, and over the 1600 kilometres between Brisbane and Melbourne. Thus, the influence of alcohol on the traffic system is extremely stable.

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For reasons outlined above, it is unlikely that any simplistic countermeasure will have a significant, persistent effect.

Countermeasures of one kind or another do not, however, lack advocates and this advocacy is given prominence in the media. But these advocates, sometimes persons eminent in fields other than transport or traffic safety, seldom state the assumptions on which the countermeasure is based, nor do they indicate the mechanism or process by which it is intended to operate, nor give consideration to factors which may degrade this process.

A review paper of several years ago lists 107 'countermeasures' that have been suggested at one time or another. Many of these are actually fragmentary details of countermeasures, such as No. 9, 'provide for implied consent for chemical tests', or proposals for investigation such as No. 15, 'determine locations and time of day of accidents involving drinking pedestrians'. No. 52 is breathtaking in its simplicity, it reads: 'establish national prohibition effectively enforced'.

This paper will attempt no more than to suggest simplified models of the main strategies, with an explicit statement of assumptions. It borrows from papers in this country by quite a number of people: Birrell, Raymond, Tonge, Jamieson, Robertson, Ots, Rankin, Wilkinson, Santamaria, Henderson, Simpson, Vinson and others, besides the overseas literature. The strategies have recently been described in some detail by Johnston.

ASSUMPTIONS

There are certain assumptions, almost truisms, which I suggest are based on substantial evidence and virtually no conflicting evidence:

(1) a substantial fraction of the more severe accidents is associated with impairment of the driver by alcohol;

(2) the bulk of the impairment, associated with accidents, is at BACs substantially in excess of the prescribed limits;

(3) the relative risk of accident is an accelerating direct function of increasing BAC;
alcoholic impairment is substantially confined to male drivers. All subsequent remarks apply to male drivers.

There are a number of further assumptions, not as well established as the first four, but reasonable deductions from certain evidence.

Most drivers with BACs above prescribed limits are excessive drinkers, defined by an average daily intake of 100 g or more of alcohol (it is, of course, possible for persons with smaller average daily intakes to achieve BACs above the limit, but such events will be infrequent per driver per year).

Drivers who are excessive drinkers constitute less than 8% of the driver population and perhaps not more than 5% (the Prahran study showed those with a daily average of 80 g or more were 8% of the male population surveyed).

Excessive drinkers are at risk of becoming alcoholics.

Drinking habits are mostly established by the time early adult life has been achieved.

Impaired drivers (defined as drivers with BACs substantially in excess of the legal limit) are mostly in this condition frequently — perhaps every day or regularly on certain days of each week.

COUNTERMEASURES

Consideration of countermeasures is restricted to those that are directly related to road traffic and its management. More embracing countermeasures may be possible (with a bonus for traffic safety). For example, in this country, one might be to revise the excise laws to permit — and perhaps encourage — the sale of an alternative beer with about half the alcohol content of the regular brew.

Objectives of a Countermeasure:

To reduce the number of impaired drivers on the road per day; (more correctly to reduce exposure — fewer drivers or fewer kilometres) or to reduce the average BAC of impaired drivers, or any combination of these two, it being understood that the value of the reduction is approximately weighted by the relative risk factor of the BAC.

Let us look at possible strategies that have been seriously considered to achieve these objectives. The first is: prevent impaired would-be driver from gaining effective access to a vehicle.

The second is: alter the behaviour of excessive drinking driver by threat of apprehension and punishment, so that fewer will drive when impaired, or will drive at lower BACs.

Specific deterrence, i.e. the above mechanism applied to a convicted driver, or prevention by temporary disqualification of convicted drivers, is disregarded on the grounds that any such effect is likely to be small in relation to the population of excessive drinker drivers. To the extent that these effects occur, they are small bonuses from the breathalyser laws.

The third strategy is to reduce the population of excessive drinkers who are also drivers, by converting some of them to non-excessive drinkers or non-excessive drinking drivers. This strategy is dependent on certain additional assumptions.

The fact of conviction on a drunk-driving charge is virtually diagnostic of excessive drinking. This is a re-statement of Assumption 5.

It is possible to convert a not-insignificant proportion of such convicted drivers to responsible drinkers (or even to non-drinkers) by appropriate remedial/educational/therapeutic means.
The relevant parts of the criminal justice system can be modified to establish a channel from diagnosis (i.e. conviction) to 'treatment', by suitable sentencing procedures.

A substantial proportion of convicted drivers will act co-operatively in this procedure.

THREE STRATEGIES

I will call Strategy I Preventive, II Deterrent and III Remedial. The strategies are not mutually exclusive — all or any combination of the three can be employed. These strategies have been recently discussed in some detail by Johnston.3

Preventive

For the first, preventive strategy, yet a further assumption is required: that an interlock device to prevent the car being started can be made sufficiently tamper-proof and sufficiently discriminating.

In the form in which I last saw it described, the device was most interesting and had just about the characteristics needed6. The task the intending driver had to perform before the car would start was like driving — using the driving wheel and an available instrument, such as the ammeter, as the indicator that had to be controlled. The task was unlearnable. It was reliably sensitive to alcoholic impairment.

It is necessary to reflect on the unhappy fate in the United States of a much, much simpler interlock, that which depended on seat belts being fastened. Without going into the reasons for this piece of history, I can only say that it seems to cast doubt on the practicability of the interlock strategy for general use. Its use for convicted drunk-drivers is a variation of Strategy III.

General Deterrence

Strategy II was general deterrence. More assumptions are needed:

Legislators and the judiciary believe firmly in the efficacy of deterrence.

Deterrence (altered behaviour) is related to perceived risk of apprehension and conviction, and perceived risk is (except in the short run) directly related to actual risk of apprehension and conviction.

The probability of detection during one impaired trip in Melbourne was, in 1972, about 1 in 1000. This probability of detection is too low for significant deterrence.

The probability of detection per trip is a function of resources available for enforcement (police on traffic duty, breathalyser squads) and of enforcement policy, that is, the specific provisions of the laws with regard to breath-testing and the policies, both formal and informal, of the police with regard to their practical implementation.

The level of enforcement needs to be raised, not by a percentage, but by a factor of 2, 3, 5 or whatever it may be.

Although the degree of utilisation of current resources (e.g. breathalyser squads) is not known, a large increase in detection will require substantial increase in resources to be deployed.

A key statistic is the enforcement rate, which is defined as the number of positive breath-tests obtained per 10 000 drivers per year. I suggest that this rate is a suitable measure of enforcement and of the relative risk of a drunk-driver being apprehended. This rate, for N.S.W., for 1972, was 0.7 per 10 000 drivers per annum.11 For Victoria, in 1974, about 3 per 10 000 drivers.
At the present enforcement rate (whatever it is) breath tests carried out in the various States have a high yield (data reported by Robertson5) as shown in Table II.

**TABLE II  YIELD FROM BREATH TESTS IN VARIOUS STATES**

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Tests</th>
<th>False + %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qld</td>
<td>1970-71</td>
<td>2384</td>
<td>4.15</td>
</tr>
<tr>
<td>N.S.W.</td>
<td>1969</td>
<td>6642</td>
<td>15.3</td>
</tr>
<tr>
<td>Vic.</td>
<td>1969</td>
<td>8552</td>
<td>3.77</td>
</tr>
<tr>
<td>Tas.</td>
<td>1970-71</td>
<td>1761</td>
<td>(&lt;.08)</td>
</tr>
<tr>
<td>S.A.</td>
<td>1967-69</td>
<td>2373</td>
<td>5.5</td>
</tr>
<tr>
<td>W.A.</td>
<td>1969</td>
<td>442</td>
<td>9</td>
</tr>
</tbody>
</table>

These data have the deficiencies of being rather ancient history, and the population of drivers exposed to testing cannot be defined. The N.S.W. false-positive rate is spuriously high, because of the transfer of many cases just above 0.08 to below 0.08, and W.A. has a small total. With these reservations, it is clear that the false-positive rate is low except in Tasmania. For that state, the average BAC suggests that testing has been carried out more widely than in other States, i.e. the enforcement rate is much higher.

The yield from tests (100 minus the false-positive rate) is an important consideration, because the cost of testing is substantial (estimated five years ago at $20 per breathalyser test) and each false-positive test (one which turns out to be below the prescribed level) is, so to speak, wasted.

It might be expected that there will be a trade-off between enforcement rate and false positive rate, as in Figure 2. It is most important to determine what this relationship is, and it is a matter for great regret that the available statistics are so deficient.

*Figure 2  Hypothetical relationship between enforcement rate and false positive breathalyser rate.*
It might be added that in accounts of practices in the Scandinavian countries, which are said to have achieved some success in drunk-driving countermeasures, it is usual to find descriptions of the law, of the legal limit, of punishment, but never of the enforcement rate.

Remedial

The last strategy I have called the remedial. In addition to the assumptions made earlier, a simplified ‘natural history’ for an excessive drinker is shown in Figure 3. The probability associated for each of the arrows is not known.

Figure 3  Simplified natural history of the excessive drinker.

"BIRTH"

NEW YOUNG XS DRINKERS

OLDER DRIVERS BECOMING XS DRINKERS

"DEATH"

LITERAL DEATH

REMOVAL FROM DRIVER POPULATION BY ILL HEALTH, PERMANENT DISQUALIFICATION, ETC.

CONVERSION TO NON-XS DRINKER (OR NON-XS ★ DRINKING DRIVER)

Figure 4  Input to and output from the population of excessive drinker-drivers.
The excessive drinker-driver population is in a dynamic state, as shown in Figure 4. It is not necessarily in equilibrium.

The remedial process, which is to be linked to the sentence associated with conviction for drink-driving, is supposed to augment the process marked with a star in Figure 4. Calculations from available data suggest (for the State of N.S.W.) an input of 3000 per year.

The number convicted per year in N.S.W. (1972) is 15 736 and this would be the maximum additional output (those leaving the drunk-driver population) obtainable, assuming 100% conversion efficiency and assuming that none of these convicted drivers would convert unassisted.

However, the actual output achieved by the starred process would be the input number factored by (a) the proportion of convicted drivers that the courts would actually refer for (compulsory) treatment, supposing facilities were available for all, by (b) the conversion efficiency of this 'enforced' treatment, (c) the proportion not converting unassisted.

The number of new cases qualifying for entry to the therapeutic situation (assuming 100% coverage) is large. Data for N.S.W. are shown in Table III.

<table>
<thead>
<tr>
<th>TABLE III</th>
<th>Drivers Convicted (N.S.W.) 1972</th>
</tr>
</thead>
<tbody>
<tr>
<td>all above 0.08 BAC</td>
<td>15 736</td>
</tr>
<tr>
<td>all &lt; 25 yr, &gt;0.08 BAC</td>
<td>5 077</td>
</tr>
<tr>
<td>all &lt; 25 yr, 0.15 BAC</td>
<td>1 569</td>
</tr>
</tbody>
</table>

It is clear that the resources to be deployed on this countermeasure would need to be quite considerable. The strategy, even if successful as a remedial process, does not seem likely to have a large effect on the population of excessive drinker-drivers. However, it may well be justifiable, if showed to be successful, because a share of its costs could be charged to reduction in non-traffic costs of alcoholism and excessive drinking.

It is clear that to go further, much better numerical information is needed about the kinetics of the system I have sketched. Most of all, we need information as to the effectiveness of therapeutic processes in converting convicted drivers from carefully designed and controlled studies. It is particularly important, in comparing 'treated' and 'untreated' groups that these be alike in composition and that the comparison not be confounded by an additional variable such as selection or self-selection.

CONCLUSIONS

What I have been doing is to state — or restate — some assumptions on which a model of the impaired driver-road system need to be based. I have also commented very briefly on the three main classes of countermeasures that are suggested by the model.

It is not my intention to advocate any specific countermeasure or disparage any.

However, I would stress the need to obtain numerical data so that parameters of the model can be estimated.

Finally, to those who advocate particular countermeasures, I would recommend:
- that they state, explicitly, the assumptions on which the countermeasure is based;
- that they indicate — with numbers — the processes by which the countermeasure is expected to have its effect;
- and, by no means least, that they take careful account of the factors that can be expected to degrade or interfere with the operation of the countermeasure they support.
REFERENCES