Rural Indepth Crash Investigation

McLean AJ, Baldock MRJ and Kloeden CN.
Road Accident Research Unit, Adelaide University 5005

ABSTRACT
The Road Accident Research Unit has investigated 236 crashes to which an ambulance was called in rural areas. This paper reports on the design and conduct of the study, which was sponsored by Transport SA. The main findings relating to the causation and consequences of the crashes are presented and illustrated with reference to specific cases.

KEYWORDS
rural, crashes, in-depth, seat belts, alcohol, roadside hazards

INTRODUCTION

The Adelaide University Road Accident Research Unit (RARU) was funded by Transport SA in 1998 to conduct in-depth investigations into rural road crashes in South Australia to provide information on factors which contribute to crash and injury causation. The data collection phase of the study ran for two years from 1 March 1998 to 29 February 2000.

METHOD

Vehicle crashes eligible for inclusion in the study were those to which an ambulance was called and which occurred on public roads outside the metropolitan area but within 100 km of Adelaide. Notification of crashes was obtained by monitoring ambulance radio frequencies and also by pager notification from the South Australian Ambulance Service. At the request of Transport SA, crashes in rural towns were included in the study.

RARU staff members were available on call to attend crash scenes during the day seven days per week and Thursday and Friday nights. These two nights, and during the day on Saturday and Sunday, were selected as on-call periods following an examination of the time of day and day of week distribution of calls for an ambulance to attend vehicle accidents in the study area during the previous year.

The on-call team attempted to reach the scene of the crash before the vehicles involved were moved. As we neither requested, nor desired, permission to exceed posted speed limits when travelling to a crash scene it was not possible to achieve this aim in many cases. Occasionally, further investigation of a crash was abandoned if there was not sufficient evidence available at the scene. Some fatal cases were able to be investigated on the day following the crash if the scene had been marked up by the Police Major Crash investigators. This enabled the inclusion in the study of some crashes that occurred outside the on-call periods.

The “ambulance called” criterion for admission of a case into the study did not always mean that a participant in the crash was injured seriously enough to be transported to hospital by ambulance. At the other end of the injury outcome scale, the sample of crashes studied was biased towards fatal cases, for the reason noted at the end of the previous paragraph.

The information collected on each case included:

- photographs of the crash scene and vehicles involved
- video record of the crash scene and vehicles in selected cases
- examination of the road environment, including traffic control measures
- a site plan of the crash scene and vehicle movements in the crash
- examination and measurements of the vehicles involved
- interviews with crash participants, witnesses and police
- information on the official police report
- information from Coroner’s reports
- injury data on the injured crash participants

RESULTS

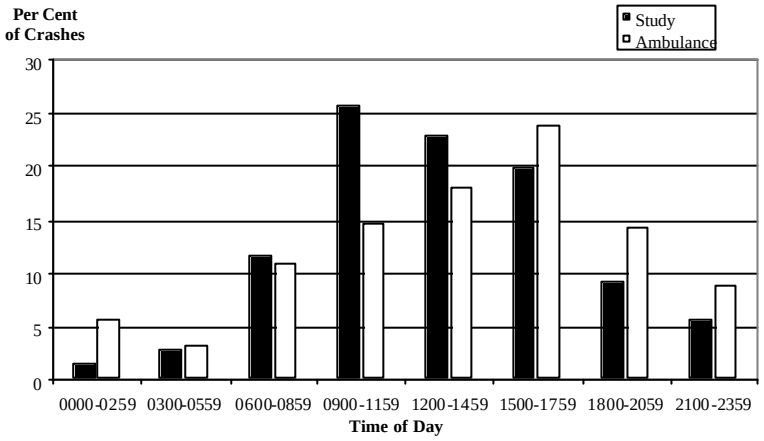
During the course of the study a total of 236 rural crashes to which an ambulance was called were investigated. Over 55 per cent resulted in injuries severe enough to be fatal or require hospital admission for one or more of the vehicle occupants involved. One in every 10 vehicle occupants died as a result of injuries sustained in the crashes and one in every four was admitted to hospital. There was some sampling bias towards more severe crashes, particularly those resulting in a fatality.

Crash Characteristics

The most common type of crash, comprising over 44 per cent of the sample, involved a single vehicle. Of those crashes in which more than one vehicle was involved, the most common crash types were those in which one of the vehicles was executing a right turn, and those in which the vehicles were involved in a head on collision. Many of the "head on collision" cases resulted from one vehicle running onto the unsealed shoulder on the left and then yawing back across the road out of control.

The crashes investigated were not representative by day of week of rural crashes in general, with weekdays, particularly Fridays, over represented and weekend days under represented, as a consequence of the distribution of on-call times. Figure 1 shows the time of day distribution of the crashes investigated and compares it with the ambulance call outs for rural road crashes during the study period. Due to the distribution of on-call times by time of day, an under representation of crashes between 6pm and 6am was apparent in the study sample.

Figure 1
Time of Day of Rural Crashes



The severity of the crashes investigated is shown in Table 1 in terms of the maximum severity of injury to any participant in the crash.

Table 1
Maximum Severity of Injury

Injury Severity	Number	Per cent
Fatal	54	22.9
Hospital Admission	76	32.2
Hospital Treated	66	28.0
Private Doctor	6	2.5
Minor Injury	12	5.1
No Injury	22	9.3
Total	**236**	**100.0**

As noted previously, there was a trend towards the inclusion of more serious crashes in the study. The private doctor, minor injury and non injury cases were included because an ambulance was called to the scene but no ambulance transport to a hospital was actually required.

Road Characteristics
Most of the crashes in this study (67%) happened on rural highways (defined here as main rural roads under the control of Transport SA) with a significant proportion on minor rural roads and national highways and a small number on local rural town roads. The great majority of the crashes occurred on two-lane sealed roads.

Over 58 per cent of the crashes happened on straight sections of road. In the remaining crashes, the involvement of a right hand bend was far more common than a left hand bend (from the point of view of the driver who initially lost control, experienced difficulty or was travelling straight through an intersection).

In this study, a crash was classified as an intersection collision only if it involved vehicles that approached, or turned into, different roads. Using this definition, about two thirds of the crashes in the study were non-intersection crashes. Among the intersection crashes, those that occurred at cross roads and T-junctions were nearly equally represented. Over half of the intersection collisions investigated had no signs or signals relevant to any of the vehicles involved. In most of the no control cases the priority of vehicles was designated by the road layout and road rules. However, two of the crashes involved vehicles approaching an uncontrolled intersection from intersecting roads. The most common traffic control that was present and relevant was a Give Way sign.

More than 40 per cent of the non-intersection crashes on sealed roads occurred on roads with no edge lining of the side of the road. Approximately ten per cent of these roads with no edge lining were in rural towns (speed limit less than 80 km/h). Very few of the crashes on mid-block sections of road occurred on roads with a sealed shoulder. While this is mainly a reflection of the small proportion of roads in the study area with sealed shoulders, unsealed shoulders were found to be one of the major contributing factors to rural road crashes.

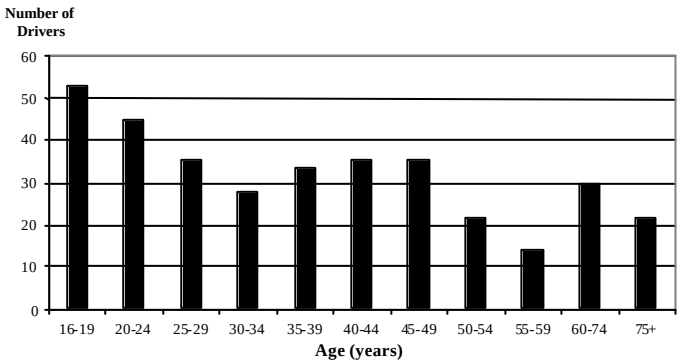
In most of these cases (65%) the speed limit at the site of the crash was 100 km/h or greater, as would be expected in a study of rural crashes. The lower speed limit cases are those crashes occurring in or near rural towns or in the Adelaide Hills. Over 17 per cent of the crashes occurred on sections of road with an Advisory Speed sign indicating a speed lower than the legal speed limit.

Vehicle Characteristics
Cars and car derivatives (station wagons, utilities and panel vans) accounted for three quarters of all of the vehicles involved in this set of rural road crashes. Four wheel drive vehicles accounted for 9 per cent and, apart from 14 (3.8%) motorcycles and one tandem pedal cycle, the remaining vehicles were all trucks of various types.

More than half of the vehicles involved in these rural road crashes were 10 or more years old. This is generally reflective of the South Australian vehicle age profile.

Driver Characteristics
Sixty two per cent of the drivers in this sample of rural crashes were male.

Figure 2
Age of Drivers



The distribution of the ages of the drivers in these crashes shows that the highest levels of involvement were for those in their teens, gradually decreasing until a plateau was reached extending from the thirties to the mid fifties. Lower levels of involvement occurred after that age range, with only 19 per cent of drivers being over 54 years of age (Figure 2). The age of one driver involved in a single vehicle crash remained unknown (the driver

was taken from the scene by the police for an evidentiary breath test, and there was no police report for the crash).

The age distributions of male and female drivers were very similar given the limitations of small numbers at this level of breakdown.

All of the motorcycle riders were male, and six of the 14 riders were under the age of 25.

Blood alcohol readings were available for three quarters of the 374 drivers and riders and 7.5 per cent of the known cases were at or above the legal limit of 0.05 gm/100mL. Most (57%) of those with an illegal BAC were at or above 0.15.

Fifteen per cent of the drivers or riders were operating on a Learner's Permit or a Provisional Licence and in 8 cases (2.1%) the driver or rider did not have a valid licence.

Information on the driver's familiarity with the road at the crash site was available in just under half of the cases. Almost 80 per cent of them reported that they used the road either "daily" or "regularly". However, this information was difficult to obtain for drivers who lived in another state or overseas, and so the percentage listed here is probably an over-estimate of that for the whole sample of drivers and riders.

Seat Belt Use

Judgement of seatbelt use was determined by a combination of marks on the seatbelt webbing from impact loading, observation of belt use for those still in the crashed vehicle when investigators arrived and reports from police and the Coroner. While most of the occupants were judged to have been wearing their seatbelts, 13 per cent were not (Table 2).

Table 2
Seatbelt Use by Occupants of Vehicles

Seatbelt Use	Number	Per cent
Yes	421	86.6
No	65	13.4
Unknown	95	-
Total	**581**	**100.0**

SUMMARY OF SOME CHARACTERISTICS OF RURAL CRASHES

The analysis of single vehicle crashes revealed an over representation of right curved sections of road, young, inexperienced drivers and drunk drivers. With regard to crash causation, an unsealed shoulder contributed to half of this group of crashes, particularly when the vehicle ran off to the left on a straight road or on right curves. In many cases, the driver attempted to steer the vehicle back onto the road but overcorrected and lost control. Other common factors involved in the causation of single vehicle crashes included problems with the road surface (either a deterioration of the surface or the presence of foreign material), a lack of edge lining, and problems with the layout (including unsealed road aprons located on the outside of right curves on sealed roads).

The second most common type of crash was a midblock collision. Curved roads and young, inexperienced drivers were again over represented. Head on collisions were the most severe crashes in this group and also the most common, comprising over half of the sample. In these head on collisions, the contributing factors tended to resemble those in single vehicle crashes, as would be expected given that head on collisions were mostly precipitated by one driver or rider losing control of their vehicle. Again, crashes were caused by unsealed shoulders, particularly on curved sections of road, and problems with the road surface. In rear end collisions, U-turn collisions and crashes involving vehicles entering or leaving driveways, sight restrictions for one of the drivers involved were the most common factor to have contributed to the causation of the collision.

Crashes at intersections not controlled by signs or traffic signals occurred mostly during daylight hours, suggesting that a contributing factor was likely to be the failure of one driver or rider to see another vehicle, given that at night, headlights on vehicles improve their chances of being detected by other motorists. Unlike single vehicle and midblock collisions, which tended to involve young, inexperienced drivers and riders, crashes at uncontrolled intersections were more likely to involve elderly drivers. The most common factor contributing

to this type of crash was a sight restriction at the intersection, often caused by vegetation or crests. These sight restrictions were often the result of poor road layout (eg the location of T-junctions next to curves or crests).

Crashes at sign controlled intersections shared many of the characteristics of those at uncontrolled intersections. One difference was that the sample of sign controlled intersections crashes included intersections featuring higher density traffic, thus necessitating the sign control. Often the use of Stop Signs rather than Give Way Signs would appear to be advisable.

Other intersection crashes, in which a vehicle turning was struck by another vehicle travelling on the same road (and in the majority of cases, in the opposite direction), also shared many of the characteristics of crashes at uncontrolled or sign controlled intersections. However, these crashes also revealed the importance of the conspicuity of vehicles on rural roads, and also how the conspicuity of vehicles is affected by the road environment. In particular, roadside trees are not only a hazard when struck by vehicles that have run off the road but they are also hazardous because they camouflage vehicles on the road both with the shadows they cast and the dark backdrop they create.

When only those crashes precipitated by one driver or rider's loss of vehicular control were considered, it was found that the consequence of loss of control on rural roads was most commonly a collision with a tree. The next most common result was a vehicle rollover, followed in order of frequency by a collision with another vehicle, a collision with a fence, a collision with an embankment and a collision with a utility pole. Rollovers also tended to involve impacts with other roadside hazards. The most severe crashes, in terms of injuries, were those with trees and utility poles.

CONCLUSIONS

In light of the frequency with which unsealed shoulders contributed to the causation of single vehicle crashes, and multiple vehicle head on collisions, there appears to be strong justification for the shoulders of all highways and major rural roads to be sealed to a width of at least half a metre, with priority given to sealing the shoulders on the outside of curves and with edge lining introduced in conjunction with the shoulder sealing. Additionally, given that drivers or riders overcorrected the steering of their vehicles in many cases, the feasibility of a public education campaign concerned with control of a vehicle in the event of dropping a wheel onto an unsealed shoulder be investigated.

Given the occurrence of a number of crashes resulting from hazardous road surfaces, in some cases after road works had been conducted, a formal procedure for the investigation of reports of poor road surfaces would be beneficial, together with a procedure to ensure that the road surface is inspected at sites at which road works have recently been undertaken. The sealing of aprons of unsealed roads adjoining sealed roads would assist in preventing loose material from spreading over the sealed surface of the major road. This is particularly important on unsealed road aprons forming T-junctions with sealed roads on the outside of curves.

Crashes were investigated at locations where there were reasons to believe that the use of a Stop Sign rather than a Give Way sign may have prevented the collision, as noted above. These locations included some where there was little or no obstruction to vision between the two vehicles.

One of the suggestions of past research on roadside hazards (see, for example, Kloeden et al, 1999) was that a clear zone of 9 metres be provided on the sides of rural roads having a speed limit of 80km/h or higher. Given that, in this study, over 90 per cent of trees, poles and fences struck by vehicles that had run off the road were within 9 metres of the edge of the roadway, such a clear zone would be expected to be very effective in reducing road trauma in rural areas. Even given that some vehicles striking hazards within this zone would have struck hazards beyond 9 metres from the roadway if such a clear zone had been in place, the finding that fatal tree impacts tended to occur closer to the roadway more than less injurious ones suggests that, in addition to the clear zone reducing the number of crashes, it would also reduce the average severity of these crashes.

Where roadside hazards cannot be removed or relocated from a 9 metre clear zone, consideration should be given to the installation of some form of barrier to protect road users from striking them in the event of loss of vehicular control. If the installation of some physical barrier is considered not to be practicable, then a lower speed limit may be a suitable alternative way to reduce the risks posed by roadside hazards, by reducing the likelihood of a vehicle leaving the roadway. The role of speed in these crashes is discussed in anther paper at this conference (CN Kloeden: Rural Speed and Crash Risk).

Clear zones should not only include the roadside but also any central reservations on divided roads. Trees planted on the medians caused the deaths of three people in two crashes investigated as part of this study. Although trees can block the headlights of oncoming vehicles, thus preventing glare, and can also prevent out of control vehicles from reaching oncoming traffic, these desirable features of the central reservation can be achieved in other ways. Headlights producing glare can be blocked with small shrubs that lack a substantial rigid trunk and vehicles can be prevented from crossing the median by guard rails or other forms of barrier.

Also, as a thorough understanding of the nature of road crashes and the contribution of the road infrastructure to their occurrence is essential for determining the facets of the road environment that need attention, a stron case can be made for the in-depth investigation of rural road crashes to become a routine component of the operation of the road transport system.

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