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Executive Summary

Aims and objectives

The aim of this project was to examine and report on the impact of various alcohol control measures on levels of alcohol consumption and related harm in Central Australia for the period 2000–2010. Specific objectives were to:

- describe trends in alcohol consumption in Central Australia;
- describe trends in key indicators of alcohol-related harm;
- describe key interventions aimed at reducing alcohol-related harm;
- identify any changes in consumption and indicators of harm and to test whether, or to what extent, these can be attributed to particular interventions or combinations of them; and,
- report on the implications for alcohol policy and strategies to reduce alcohol-related harm.

Methods

The project was conducted in three overlapping stages using both quantitative and qualitative methods.

Data on wholesale sales of alcoholic beverages were converted to litres of pure alcohol and were used as a proxy measure of consumption. Alcohol-related hospital separations, emergency department presentations and police incident data were used as indicators of harm.

The geographic area of study was the Central Northern Territory Statistical Sub-Division with 'Greater Darwin' as a control region.

Two methods were used to calculate an appropriate population denominator for the calculation of rates: Estimated Residential Population (ERP) aged ≥15 years plus data on tourist numbers from various sources; and Adjusted Enumerated Population (AEP) based on adjustments to, and extrapolations from, the Enumerated Populations of persons aged ≥15 years at the 1996, 2001 and 2006 Censuses. The differences between these were small and for convenience, the latter was used.

Access to quarterly data on the volume of wholesale sales of alcoholic beverages was provided by the NT Licensing Commission. These data were converted to wholesale sales of litres of pure alcohol. Estimates of annual and quarterly per capita consumption of pure alcohol among persons aged 15 years or older were calculated by dividing wholesale sales of pure alcohol by Adjusted Enumerated Population. To enable examination of changes in the relative contribution of particular beverage types to per capita consumption, estimates were also made of quarterly per capita consumption of each beverage type.

In the absence of detailed data on retail prices an attempt was made to estimate this based on a large sample of newspaper advertisements. This provided incomplete and unsatisfactory estimates. As an proxy measure, we relied on CPI adjusted data on wholesale prices provided by the Licensing Commission and used these to calculate average wholesale price per litre of pure alcohol.

Hospital separations were used as indicators of health-related harms. In particular, we examined:

- all alcohol-attributable conditions (those with any alcohol-attributable ætiologic fraction);
- a small number of key conditions which are wholly alcohol-attributable, and larger groups that have an alcohol-attributable ætiologic fraction of greater than 0.8 (High), have an alcohol-attributable ætiologic of between 0.3 and 0.8 (Medium), or which have a lower ætiologic fraction but have a high frequency including pedestrian and non-pedestrian road traffic injuries (Low); and,
- groups of acute and chronic conditions – as the time courses for responses to restrictions may vary.

Hospital Emergency Department (ED) presentation data were also used as indicators of harm. Unfortunately, it was not possible to accurately identify the contribution of alcohol to various acute conditions such as injuries. For this reason we had to rely on presentations for medical conditions that are known to be significantly related to alcohol consumption and presentations identified as 'assault' at triage.

As a proxy measure of alcohol-related harm and public disorder we used: offences that are, by definition, alcohol-related (e.g. drunk and disorderly behaviour, drink driving offences); or offences which have been shown to be commonly alcohol-related (assaults, protective custody, anti-social incidents and domestic violence).

Three major statistical approaches were used to explore associations:

- cross-correlations to measure the strength of associations between variables;
- time series modelling (ARIMA and exponential smoothing with forecasting) to model indicator time-series and to test if either consumption and/or price made a significant contribution to improving the fit of the model, to test whether individual restrictions contributed significantly to constructing a model of best-fit, and to test whether trends observed in indicators during specific periods in time were different to trends expected to have occurred had an intervention not taken place; and,
- Poisson Regression to compare the Incidence Rate Ratio (IRR) between alcohol- and non-alcohol-attributable events in particular time periods after introduction of restrictions with the ratio immediately prior to the restrictions.

Alcohol control measures

The impacts of the following alcohol control measures in Alice Springs and/or Central Australia were considered.

- 2002 Licensing Commission Decision – Alice Springs Trial Restrictions.
- 2003 Licensing Commission Decision – Alice Springs Amended Restrictions.
- 2006 *Alcohol Court Act NT*.
- 2006 Alice Springs Alcohol Management Plan.
- 2006 Licensing Commission Decision – Alice Springs Liquor Supply Plan (LSP).
- 2007 *Northern Territory Emergency Response Act* – various alcohol-specific provisions
- 2007 Licensing Commission Decision – Alice Springs Restricted Area.
- 2008 Licensing Commission – Introduction of a photographic ID system.
- 2008 Introduction of what was later formalised as the *Excise Tariff Amendment (2009 Measures No. 1) Act 2009* and the *Customs Tariff Amendment (2009 Measures No. 1) Act* 2009 – commonly known as the 'alcopops tax'.

There was no location within the NT that had not been subject to some alcohol harm reduction measures. However, Greater Darwin was selected as a control region as it had minimal additional restrictions. It was subject to the provisions of the NT *Alcohol Court Act* and the Australian Government's *Northern Territory Emergency Response Act* (which had little direct impact on wholesale sales of alcohol in the city) and to the 'alcopops tax'. In addition, at about the time the 'alcopops tax' was introduced, a number of liquor outlets in Darwin voluntarily agreed to withdraw from sale wine in four and five litre casks, and it was a condition of changes to one license that the holder withdraw sale of such casks.

Alcohol consumption

Wholesale sales data were used as the basis for estimating per capita consumption of pure alcohol. Consideration was given to the potential impact of internet and mail order sales on wholesale sales data but the available national evidence suggests that this is negligible and the evidence from this study indicates that those who were unable to purchase cheap cask table and fortified wine when it was withdrawn from sale shifted to full strength beer which was purchased locally.

Over the whole of the study period, estimated annual per capita consumption of pure alcohol among persons aged ≥15 years ranged between 1.25 and 1.76 times the national average in Central Australia and between 1.40 and 1.59 times the national average in Greater Darwin.

Despite fluctuations, over the whole of the study period, in Central Australia there was a decline in estimated per capita consumption of pure alcohol from about 4.0 to about 3.5 litres per quarter.

In Central Australia, in the year prior to the introduction of Trial Restrictions, in April 2002, estimated per capita consumption dropped from 4.53 litres in Q1 2001 to 3.24 litres in Q1 2002. The most likely reason for this was reduction by retailers in wholesale purchases of wine in casks of >2 litres in anticipation of the restrictions coming into effect. Following the introduction of Trial Restrictions in Q2 2002, estimated per capita consumption rose. This rise was due largely to circumvention of the restriction on the sale of wine in casks of >2 litres by the sale of fortified wine.

Following introduction of the Amended Restrictions in Q3 2003, there was a further slight increase in estimated consumption. This increase continued until Q1 2006 when – as was the case prior to the introduction of the Trial Restrictions – there was an anticipatory drop from 3.99 litres per person to 3.53 litres per person at the time the LSP was introduced in Q4 2006.

Subsequent to the introduction of the LSP, estimated per capita consumption continued to decline to a low of 3.1 litres in Q3 2008, thereafter it increased once again to plateau at an average of 3.45 litres per person.

Modelling demonstrates that the Liquor Supply Plan (LSP) had a significant impact on consumption with the observed trend in estimated per capita consumption being significantly lower than that forecast on the basis of trend prior to introduction of the LSP.

In Greater Darwin, estimated quarterly per capita consumption steadily increased from 3.21 litres in Q3 2000 to 4.37 litres in Q2 2008 when sales of wine in four and five litre casks were restricted and the 'alcopops tax' was introduced. Thereafter it declined to 3.71 litres in Q4 2010. This decline was statistically significant with the observed trend being significantly lower than that forecast on the basis of trend prior to the restrictions.

In Central Australia, within the overall decline in estimated per capita consumption, there were marked changes in the types of beverages that contributed to total consumption. Most of this change occurred in relation to cask wine, fortified wine, and full strength beer, and some substitution between beverage types took place. The most obvious of the substitutions was that of fortified wine for cask wine following introduction of the Trial Restrictions. However, the substitution of one for the other was not complete. From Q3 2000 to Q2 2001 combined per capita consumption of cask and fortified wine averaged 1.3 litres per quarter. However, from the introduction of the Trial Restrictions in Q2 2002 until Q2 2005, this dropped to an average of about 1.0 litre per quarter.

Prior to the introduction of the 2002 Trial Restrictions, per capita consumption of full-strength beer averaged about 1.5 litres. After the introduction of the Trial it began to fall reaching a low point of about 1.0 litre just prior to the introduction of the LSP when full-strength beer began to be substituted for cask table and fortified wines that were banned under the LSP. Even so, it did not exceed pre-Trial consumption – that is, 1.5 litres per capita per quarter. Thus most of the reduction in consumption in Central Australia was the result of the reduction in cask wine and fortified wine sales.

At the commencement of the study period, quarterly cask wine consumption in the Greater Darwin region was about 0.35 litres per person and increased to about 0.65 litres in Q2 2008. It dropped significantly to about 0.5 litres in Q3 2008 and continued to decline to about 0.4 litres at the end of the study period. This decline was the result of restrictions on the availability of table wine in four and five litre casks. Bottled wine consumption was steady from Q3 2000 to Q2 2004 at a little under 0.4 litres per person, after which it began to increase, reaching a peak of about 0.6 litres by the end Q4 2010. However, this increase in bottled wine consumption did not offset the decrease in consumption of cask wine. Unlike Central Australia, consumption of fortified wine in Greater Darwin contributed little to overall consumption.

In Greater Darwin, beer of all types was the most commonly consumed alcoholic beverage. Over the study period, estimated per capita consumption rose marginally from about 1.8 to 1.9 litres per quarter. Full-strength beer accounted for most of this – just over 1.4 litres. The balance (approximately 0.6 litres) was made up of low and mid strength beer combined and, as in Central Australia, over the study period their relative contribution was reversed with mid-strength beer rising to about 0.5 litres and low strength beer declining to about 0.1 litres per person.

In Greater Darwin, consumption of standard and mixed spirits combined increased steadily over the study period from about 0.8 to about 1.1 litres per person and they accounted for a little over 24 per cent of all alcoholic beverages consumed. Over the same period, consumption of standard spirits rose from about 0.6 to about 0.75 litres. From Q3 2000 to Q1 2008 consumption of mixed spirits doubled from about 0.2 to 0.4 litres. However, after the introduction of the 'alcopops tax' in Q2 2008, it dropped to about 0.3 litres, but was nevertheless 50 per cent greater than at the start of the study period.

Alcoholic beverage prices

An attempt was made to ascertain the average quarterly retail price per litre for alcoholic beverages by sampling newspaper advertisements. This proved impractical and there were significant gaps in the data. However, as prices estimated by this method were well correlated with wholesale prices, and as the latter data were more complete, the average wholesale price per litre of pure alcohol was used as a proxy measure for retail price.

In Central Australia, there was a significant negative cross-correlation between the quarterly average wholesale price per litre of pure alcohol and estimated per capita consumption. That is, as price increased, consumption decreased. This relationship was also tested using time series analysis which confirmed the results of the cross-correlation analysis.

Cross-correlation and time series analysis were also used to test the data for Greater Darwin. Both methods resulted in a similar negative correlation – that is, increases quarterly average wholesale price were accompanied by reductions in per capita consumption and vice versa.

At least one of the restrictions making up the Alice Springs Liquor Supply Plan (which included changes to takeaway times, and limiting the volume of, and times at which, cask table and fortified wines could be purchased) was found to be statistically significant in reducing estimated per capita consumption. However, the principal change effected by the LSP was a switch from cask wine to more expensive and lower alcohol content full strength beer. This switch was unlikely to have been caused by the other restrictions implemented at the same time, which were focused on limiting hours of sale at licensed premises.

At least one of either enforcement of the 'one per person per day' restriction, the introduction of ID cards, and/or the 'alcopops tax', also had significant effects on reducing consumption. While the ID card restriction might have had some impact, given the role that price has been shown to play it likely that the other restrictions had the greatest impact.

As these findings suggested that restrictions underpinned by changes based on price had a significant effect on consumption, the direct impact of restrictions on price was explored. There were too few observation periods prior to introduction of the Trial Restrictions to reliably test the direct impact of those restrictions on price. However, the impact of the price-related restrictions associated with the Liquor Supply Plan were found to have a statistically significant impact in reducing estimated per capita consumption.

In Greater Darwin the average wholesale price per litre of pure alcohol was decreasing prior to Q3 2008. At that time the availability of wine in four litre casks was reduced and the 'alcopops tax' was introduced and a statistically significant increase in price followed, accompanied by a decrease in estimated per capita consumption.

Health indicators

Hospital separations

The relationships between wholesale price per litre of pure alcohol and alcohol-attributable hospital separations were generally stronger than those between per capita consumption and separations.

Only conditions with high and medium level alcohol-attributable ætiologic fractions (excluding assaults) were found to be significantly positively correlated with consumption: indicating that as consumption rose so did hospitalisations for these conditions although many quarters later.

The significant results related to wholesale price were generally negative, indicating that as price increased there were decreases in the rates of: acute alcohol-attributable separations (excluding assaults); conditions with high alcohol-attributable ætiologic fractions; conditions with medium level alcohol-attributable ætiologic fractions excluding assault; and separations for wholly alcohol-attributable conditions. Predictive time-series models also demonstrated that following introduction of the LSP observed values were significantly lower than the forecast values in Q2 and Q3 of 2007 and from Q1 2008 onwards.

Poisson regression generally produced congruent results but also identified significant decreases in: the proportion of alcohol-attributable separations for most of 2009; and the ratio of alcohol-attributable separations to non-alcohol-attributable separations during the Trial Restrictions period when compared with the preceding quarter.

Further analyses were conducted using categorisations of alcohol-attributable hospital separations by commonly associated drinking pattern (i.e. acute conditions largely associated with short term drinking to intoxication and chronic, conditions which are typically associated with long term exposure) as well as level of alcohol-attributable aetiologic fraction (high/medium/low/wholly). After introduction of the LSP, there was no evidence of significant change in wholly alcohol-attributable conditions (e.g. alcohol abuse, alcoholic gastritis, alcoholic psychosis, alcoholic liver cirrhosis). However, observed trends were significantly lower than forecast trends in: acute cases, particularly assaults; and conditions had 'medium' and 'low' level alcohol-attributable aetiologic fractions.

A disparate proportion of the burden of separations for alcohol-attributable conditions recorded by the Alice Springs Hospital occurred among the Indigenous population and much of this was underpinned by hospitalisation for assault.

Emergency Department presentations

Data for alcohol-attributable Emergency Department presentations were restricted to the period from Q3 2003 onwards and did not contain sufficient information to accurately assess many acute conditions (including assault, road crashes, falls etc.). Analyses were therefore restricted primarily to presentations for chronic diseases. This was a significant limitation, as it is acute rather than chronic conditions that are most likely to be responsive to alcohol restrictions in the time-frames under consideration.

Over the study period, Emergency Department presentations for alcohol-attributable chronic conditions doubled from 3.5 to 7.0 per 1000 persons. Although there was some negative impact upon this due to restrictions on the availability of takeaways >2 litres, the data indicate that this indicator continued to rise regardless of the restrictions and that after the introduction of the LSP the rate of increase exceed that compared to that expected had the pre-LSP trend continued. However, this rise is unlikely to be a function of the restrictions.

A better indicator of the impact of restrictions than ED presentations for chronic conditions was Alice Springs Hospital ED presentations coded at triage as assault. In contrast to chronic conditions, and similar to alcohol-attributable hospital separations, after the introduction of the LSP, the observed rate of presentations per 1000 persons identified at triage as assault was significantly lower than that predicted on the basis of prior trends – especially from Q1 2008 onwards.

Crime and Public Order

Use of homicide data to measure the impact of restrictions in Alice Springs was precluded because the number was too low and variability between intervals over time was too high to subject them to statistical analyses. Analyses of other Police incident data showed that, over the study period, there were extreme fluctuations in protective custody and drink driving incidents, and there had been statistically significant increases in domestic violence and protective custody incidents. However, we were advised by officers from the NT Police that the frequency of these incidents was particularly susceptible to changes in policing policy and the allocation of resources and, in the case of domestic violence, to changes in the law. For these reasons, they advised that changes in the data were more likely to be indicative of Police activity than they were of the likely impact of restrictions.

As we did not have data on drink driver crashes, we examined hospital separation data on the ratio of road crash injuries (not all of which would have been alcohol-related) to non-road crash injuries. The numbers of the former were small and subject to considerable fluctuation. Following introduction of the Trial Restrictions there were significant reductions in 13 of the 16 following quarters but there were no significant changes associated with any of the other restrictions and no firm conclusions can be drawn about the relationship of these to the restrictions.

There was a statistically significant negative relationship between the wholesale price of alcohol and alcohol-related assaults – i.e. with increases in price there appeared to be a decline in assaults. However, a lag between the apparent effect and the poor fit of the time series model indicates that this was probably an artefact of unidentified confounding factors.

Despite the findings summarised above, it was found that:

- after the introduction of the ID & 'alcopops tax' restrictions, the ratio of alcohol-related to non-alcohol-related serious assaults was significantly lower in seven of eleven quarters (through a combination both of increases in non-alcohol-related incidents and decreases in alcohol-related incidents); and,
- following both the Trial Restrictions and introduction of the LSP there were significant reductions in the percentage of anti-social behaviour incidents that were alcohol-related and which appear to be related to those restrictions.

Conclusion

The imposition of additional alcohol control measures has made a significant contribution to the reduction of estimated per capita consumption in Central Australia. The evidence demonstrates that the most effective of these measures have been those which indirectly increased the average price per litre of alcoholic beverages (i.e. the removal of lower priced cask table and fortified wines from the market) and which directly increased the average price (i.e. the so-called 'alcopops tax'). This finding with regard to the impact of price is consistent with the international evidence, and with evidence from the Greater Darwin region over the same time period.

The greatest statistically discernible impact of this reduction in consumption was a reduction in the rates of assaults – as evident in hospital separation and Emergency Department triage presentation data – and reductions in hospital separations for alcohol-attributable conditions.

While the evidence presented in this study shows that price-related alcohol restrictions have had a significant effect in reducing alcohol consumption, it also shows that price is not the only variable impacting upon levels of consumption and related-harm. That levels of consumption in Central Australia remain over 30 per cent higher than the national average, that some indicators of harm continued to rise (albeit at reduced rates), and that rates of some indicators are considerably greater among Indigenous than non-Indigenous residents of Central Australia indicates that significant demand factors are also driving the level of consumption. This evidence indicates that while alcohol control measures are an effective means of reducing consumption and related harm – as endorsed by Australian Governments under the *National Drug Strategy* – they need to be part of a comprehensive strategy that also aims to reduce harm and demand. In the latter regard, it is important that demand reduction strategies not be conceived too narrowly. As well as focusing on interventions specifically targeting alcohol use, such as prevention and health promotion, demand reduction strategies need also to focus on broad-based interventions which address the underlying social determinants of health and alcohol and other drug use, including early childhood development, education and employment programs.

1. Introduction

Concerns about high levels of alcohol-related harm in Central Australia (and elsewhere in the Northern Territory) are not new. Several reports have highlighted levels of consumption that are considerably greater than the national average, the harm related to this, and proposed or described various interventions.[1,2,3,4,5,6] Among the interventions have been various attempts to impose additional restrictions on the availability of alcohol.

As in all state and territory jurisdictions, the Northern Territory Government's *Liquor Act* (1978) places general restrictions on who may purchase alcoholic beverages, who may sell them, the places from and hours at which they may be sold, as well a specific conditions that can be imposed upon individual licences. In 1979, the *Liquor Act* was amended to include the 'general restricted areas' provisions of Part VIII (with further amendments to this section in 2006) which provided for application to be made (usually by community groups) to the Licensing Commission to declare an area a 'general restricted area' in which the possession or consumption of alcohol was prohibited or restricted. Between then and 2005, over 100 Aboriginal communities used these provisions to support alcohol management.[7] Although not part of the *Liquor Act,* in 1983 the *Summary Offences Act* was amended to include Section 45D which made it an offence to consume alcohol within two kilometres of licensed premises – the so-called 'Two Kilometre Law'.

More broadly, the Living With Alcohol (LWA) program introduced in 1991 included a variety of demand reduction programs (prevention and treatment) and supply reduction initiatives. LWA also included price-based restrictions in the form of various levies on the wholesale sale of alcoholic beverages that were intended to fund the demand reduction strategies, but which were demonstrated to have led to reduction of consumption and harm in their own right.[6]

In the late 1990s, in the light of good international and national evidence for the effectiveness of restrictions in reducing both consumption and related harm, and the success of such measures elsewhere in the Northern Territory,[8,9,10] various community groups and health and welfare advocates increased calls for additional restrictions to be placed on the availability of alcohol in Alice Springs. In 2002 – in response to these calls and the high levels of alcohol-related harm – the NT Licensing Commission imposed, on a trial basis, a number of additional restrictions on the availability of alcohol in the town, as well as some complementary measures aimed at reducing demand.[11] Subsequently, other restrictions followed. These included: modification of the Trial Restrictions in 2003;[12] the Alice Springs Alcohol Management Plan and the Alice Springs Liquor Supply Plan – both introduced in 2006; various provisions of the Australian Government's *Northern Territory Emergency Response Act* and the NT Licensing Commission's declaration of the Alice Springs Restricted Area introduced in 2007; and the introduction of a photographic ID system for the purchase of alcohol in 2008.

We were not able to identify any written rationale by the Licensing Commission for restrictions on the availability of table and fortified wines in casks; and it appears that it has been viewed as simply restricting or taking a product out of the market. If this were the case, given the demand for alcohol, one would expect to observe a simple substitution of other beverages. However, as we demonstrate, while this does occur to some extent, the impact of the measure in reducing consumption works through the price mechanism. That is, beverages with the lowest price per volume of alcohol are removed from the market and – given a degree in the elasticity of demand – consumers substitute them with a reduced volume of more expensive beverages. It is thus an *indirect* price control measure. In contrast, the imposition by the Australian Government of the so-called 'alcopops tax' (see Chapter 3) – which applied across the country as well as to Central Australia – was a *direct* price control measure which left relatively cheap, spirit-based, pre-mixed drinks in the market but increased their price.

Formal evaluations were conducted of the 2002 Trial Restrictions and the Alice Springs Alcohol Management Plan – each of which demonstrated reductions in harm.[13,14] Both these evaluations covered limited time periods. The former reported on the period January 1999 to 2003 and the latter the period March 2005 to December 2008. However, no longitudinal study of the impact of the interventions had been undertaken. Furthermore – although Hogan and others have discussed the implications of the 2002 trial for alcohol pricing policy[15] – there have been no studies which have looked specifically at the impact of price-related restrictions in Central Australia. The project on which this report is based sought to remedy this deficit and to address some of the short-comings identified with the previous evaluations.[16,17]

The aim of this project was to examine and report on the impact of various alcohol control measures on levels of alcohol consumption and related harm in Central Australia for the period 2000–2010. Specific objectives were to:

- describe trends in alcohol consumption in Central Australia;
- describe trends in key indicators of alcohol-related harm;
- describe key interventions aimed at reducing alcohol-related harm;
- identify any changes in consumption and indicators of harm and to test whether, or to what extent, these can be attributed to particular interventions or combinations of them; and,
- report on the implications for alcohol policy and strategies to reduce alcohol-related harm.

2. Research Methods

Both quantitative and qualitative approaches were used in the project which was conducted in three over-lapping stages. In the first stage, Northern Territory Government agencies provided us with access to quantitative data from various administrative collections. These data – including alcohol wholesale sales data (as a proxy measure of alcohol consumption), hospital separations, emergency department presentations, and police incident data – were consistent with those recommended for such evaluations by the World Health Organization and a review conducted by the National Drug Research Institute.[18,45] The data were subjected to correlational, time series and Poisson regression analyses to identify changes in individual variables through time and interrelationships between the variables. In the second stage we tested our first stage results and interpretations, and identified any additional confounding factors, by referring them to key informants from the NT liquor licensing, health and justice sectors. In Stage 3, the quantitative data were re-analysed in the light of the qualitative data obtained in Stage 2.

We had initially hoped to obtain alcohol wholesales data for the three year period prior to the introduction of Trial Restrictions in the second quarter of 2002 until the end of 2009 – that is for the period commencing January 1999 to December 2009. However, we were advised by officers from the NT Department of Justice that anomalies had been identified in the data, and that these had been corrected back to 2000, but data prior to that date were not consistent and access to them could not be provided. Furthermore, as considerable delays were encountered in accessing and cleaning the data, additional data became available and we extended the period of the study to the end of 2010. Thus, the period covered by the report is from July 2000 for wholesale alcohol volume and cost data and from January 2000 to December 2010 for health and police data.

Alcohol Control Measures

Information on all significant interventions during the study period was obtained from the NT Licensing Commission and other NT Government websites. These interventions are described in the following chapter. They include:

- 2002 Licensing Commission Decision – Alice Springs Trial Restrictions
- 2003 Licensing Commission Decision – Alice Springs Amended Restrictions
- 2006 *Alcohol Court Act NT*
- 2006 Alice Springs Alcohol Management Plan
- 2006 Licensing Commission Decision – Alice Springs Liquor Supply Plan
- 2007 *Northern Territory Emergency Response Act* – various alcohol-specific provisions
- 2007 Licensing Commission Decision – Alice Springs Restricted Area

- 2008 Licensing Commission – Introduction of a photographic ID system in Alice Springs
- 2008 Introduction of what was later formalised as the *Excise Tariff Amendment (2009 Measures No. 1) Act 2009* and the *Customs Tariff Amendment (2009 Measures No. 1) Act* 2009 commonly known as the 'alcopops tax'.

Although they are often referred to individually, these interventions are 'packages' of discrete control measures. The fact that they were introduced over a relatively short period of time, and often simultaneously, means that it is difficult to identify their individual impact. Despite this difficulty, each set of restrictions was tested for its potential effect on consumption, price and harms, by being entered as 'event variables' in time-series analyses (see below). Many of the restrictions were found to be not statistically significant over all of these measures and were therefore not considered for further statistical modelling.

Geographic Area of Study

A proportion of the alcohol purchased in Alice Springs is consumed in areas adjacent to the town or is consumed in the town by people who are usually resident in those adjacent areas. For these reasons, simply estimating per capita consumption by dividing the volume of alcohol sold in the town by the residential population results in over-estimation. Thus, the geographic area we selected for study was the Central Australian region – that is, the Australian Bureau of Statistics Central NT Statistical Sub-Division (SD) – rather than the town of Alice Springs itself. This SD includes the Central Desert, MacDonnell, Yulara (previously known as Petermann), and Alice Springs and its constituent Statistical Local Areas (SLAs).

To enable us to better ascertain whether any changes in levels of consumption and indicators of harm in Central Australia were attributable to the additional restrictions or to other events or factors operating in the wider Northern Territory environment, it was important to select a control area in which no, or few, additional alcohol control measures had been implemented. This in itself was difficult as additional restrictions had also been put in place in the larger NT towns such as Tennant Creek, Katherine and Nhulunbuy.

Greater Darwin was subject to the provisions of the NT *Alcohol Court Act* and the Australian Government's *Northern Territory Emergency Response Act* (which had little direct impact on wholesale sales of alcohol in the city) and to the 'alcopops tax'. In addition, at about the time the 'alcopops tax' was introduced, a number of liquor outlets in Darwin voluntarily agreed not to sell wine in four and five litre casks and it was a condition of changes to one license that the holder withdraw sale of such casks. Despite this, Darwin was the area in which the least number of additional control measures had been implemented and was thus used as a control region.

To ensure that it was as comparable as possible to Central Australia – accounting for the fact that alcohol sold in the city of Darwin may be consumed in surrounding areas – we used the Darwin City Statistical Division and included the Palmerston-East Arm and Litchfield Shire Statistical Sub-Divisions – an area which we refer to as 'Greater Darwin'. While comparisons of the Central Australian and 'Greater Darwin' regions provide us with the best estimates of patterns and trends in consumption and the likely effect of additional restrictions, it was not always possible to make exact comparisons on other indicators.

Population Denominators

Selecting the best estimate of population is important as it has the potential to either over- or under-estimate per capita rates of alcohol consumption, and rates of key indicators of harm. In measuring levels of consumption and harm it is usual to include all persons aged fifteen years or older in the population denominator and we have followed this convention.[18] As tourism accounts for a significant component of the Northern Territory economy, it is also important to account for the contribution of tourists to levels of consumption.

In the past, two approaches have been taken towards this issue. The first is to use census counts of 'usual place of residence' and add to them estimates of tourist numbers obtained from Tourism NT. The latter estimates are more reliable at the Territory level and less so at the regional level. This approach has been used by the NT Department of Justice at the Territory level and, for example, at the local level in the evaluation of the Alice Springs Alcohol Management Plan.[14] The second approach has been to take the total population enumerated in a location at the times of the five-yearly Censuses of Population and Housing and to extrapolate from those counts to inter-census periods. Proponents of this approach have argued that 'total count' includes tourists, visitors and seasonal workers and as, in the NT, the Census is undertaken in the peak tourist season it maximises the count and thus provides a conservative measure when used to estimate per capita consumption.[19] A similar approach which relies on enumerated population estimates to derive service population estimates has been developed by the National Alcohol Sales Data Project.[20] For the purposes of this study, both methods were applied and the results were compared.

Estimated residential population plus tourists

For the various statistical areas defined by it, the Australian Bureau of Statistics publishes annual Estimated Residential Population (ERP) figures based on people's 'usual place of residence'. The ABS defines this as:

> that place where each person has lived or intends to live for six months or more from the reference date for data collection. Estimates of the resident population are based on counts from the five-yearly Census of Population and Housing ('Census') by place of usual residence (excluding overseas visitors in Australia), with an allowance for net undercount in the Census, to which are added the number of Australian residents estimated to have been temporarily overseas at the time of the Census.[21]

Table 1 includes the ERP from the 1996, 2001 and 2006 Census counts and the ABS' annually adjusted ERPs. The ERPs are based on financial years and therefore the figures calculated were applied to the entire financial year when being used for quarters, with increases in population in the third quarter of each year.

For the period from 1st January 2000 to 31st December 2010, Tourism Research Australia provided both International Visitor Survey (IVS) and National Visitor Survey

(NVS) data for: Alice Springs, MacDonnell and Petermann; Darwin; and the whole of the Northern Territory. The data from Alice Springs, MacDonnell and Petermann were combined to make a Central NT equivalent count. Data for both years and quarters were made available, although the 95% confidence interval for the individual quarters was much wider than for the years.

The IVS included data on the 'Sum of Visitors' and the 'Sum of Visitor Nights' for each area. The NVS included the 'Sum of Overnight Trips' and the 'Sum of Visitor Nights'. Thus, the only variable under which all tourists could be summed was the 'Sum of Visitor Nights'. The sum of visitor nights was then divided by the number of days in a year (365.25) to find the number of 'full-time resident equivalents' that were present for a given year. These data are summarised in Table 2. The calculated Tourism Board totals for each year were added to the ERPs to give us annual estimates of 'ERP plus tourists' these latter totals are summarised and compared to Adjusted Enumerated Population estimates in Table 5.

Estimates based on enumerated population

As indicated above, it has been argued that – for the purposes of calculating per capita consumption of alcohol – extrapolations from the total counts of persons enumerated in a particular location provides a good estimate of the population of consumers as it includes international tourists and any other persons who might be visiting that location on the night of the Census. Furthermore, as the Census is undertaken at the height of the tourist season in the NT, it is not likely to under-estimate the population of consumers. If this method is valid, it is a more convenient measure as it is more easily calculated.

The Enumerated Population (EP) is the number of persons counted in a given area on the night of the Census. It has the same base population as the ERP but includes international tourists and other visitors to the area but does not include usual residents who are travelling away on the Census night. As its definition makes explicit, this figure is only available for the nights of the Census. Thus, for use in estimating the population of consumers, extrapolations must be made for inter-census years. These extrapolations were made using the following method.

1. For the 1996, 2001 and 2006 Census years the ratios between the EP and the ERP were calculated.
2. Using a simple linear interpolation, the ratios were calculated for inter-census years.
3. The yearly ERPs calculated by the ABS were multiplied by the ratios calculated in step 2 to find the adjusted EPs for each year.

The Enumerated Populations at each Census and the Adjusted EPs (AEP) for each year are presented in Table 3.

Table 1: Census Counts and Estimates Residential Population by Year, Central Australia and Greater Darwin

Region and source	1996	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Central Australia Census ERP	24,997		26,577					26,539				
Central Australia ABS Calculated ERP		28,465	28,781	29,178	29,346	29,231	29,578	29,863	30,302	31,161	31,631	31,935
Greater Darwin Census ERP	68,802		75,679					82,073				
Greater Darwin ABS Calculated ERP		80,547	81,949	82,677	82,792	83,735	86,175	89,091	91,665	94,803	98,066	100,619

Source: Australian Bureau of Statistics – http://www.abs.gov.au/

Table 2: Estimated tourist counts, by year, Central Australia and Greater Darwin

Region and source	1996	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Central Australia												
Census International Tourist Count	2,483		2,677					2,346				
International Visitor Survey		2,381	2,117	2,035	1,736	1,575	1,749	2,275	2,088	1,680	2,311	2,474
National Visitor Survey		4,046	4,326	3,815	3,115	3,445	3,314	4,408	3,628	3,583	3,776	2,905
Tourism Board Total		6,427	6,443	5,849	4,852	5,020	5,062	6,683	5,717	5,264	6,087	5,379
Greater Darwin												
Census International Tourist Count	1,865		2,943					2,647				
International Visitor Survey		5,131	3,468	3,204	2,672	3,460	2,973	3,601	3,347	3,897	4,584	5,580
National Visitor Survey		10,070	7,605	8,262	7,392	9,034	8,446	8,975	10,758	7,897	9,012	8,514
Tourism Board Total		15,200	11,073	11,466	10,064	12,494	11,419	12,576	14,105	11,794	13,596	14,093

Table 3: Enumerated and Adjusted Enumerated Populations by Year, Central Australia and Greater Darwin

Region and count	1996	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Central Australia												
Enumerated population (census)	28,861		30,387					29,583				
Adjusted EP		35,469	35,806	36,061	36,028	35,647	35,828	35,928	36,208	36,979	37,277	37,374
Greater Darwin												
Enumerated population (census)	76,917		85,335					92,978				
Adjusted EP		90,669	92,405	93,313	93,530	94,684	97,534	100,928	103,941	107,600	111,407	114,413

Table 4: Indigenous and non-Indigenous Adjusted Enumerated Populations by Year, Central Australia and Greater Darwin

Region and Indigenous status	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Central Australia											
Non-Indigenous	26,301	26,451	26,461	26,258	25,804	25,756	25,649	25,667	26,028	26,051	25,930
Indigenous	9,167	9,355	9,600	9,770	9,843	10,072	10,279	10,540	10,950	11,227	11,444
Greater Darwin											
Non-Indigenous	84,432	86,031	86,766	86,856	87,813	90,338	93,359	96,019	99,266	102,640	105,267
Indigenous	6,236	6,374	6,547	6,675	6,871	7,196	7,569	7,923	8,334	8,767	9,146

Table 5: Comparison of Population Calculation Methods, 'ABS ERP + Tourists' vs. 'Adjusted Enumerated Population'

Region and count	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Central Australia											
ERP + Tourists	34,892	35,224	35,027	34,198	34,251	34,640	36,546	36,019	36,425	37,718	37,314
Adjusted Enumerated Population	35,469	35,806	36,061	36,028	35,647	35,828	35,928	36,208	36,979	37,277	37,374
Difference (%)	1.7	1.7	3.0	5.4	4.1	3.4	-1.7	0.5	1.5	-1.2	0.2
Greater Darwin											
ERP + Tourists	95,747	93,022	94,143	92,856	96,229	97,594	101,667	105,770	106,597	111,662	114,712
Adjusted Enumerated Population	90,669	92,405	93,313	93,530	94,684	97,534	100,928	103,941	107,600	111,407	114,413
Difference (%)	-5.3	-0.7	-0.9	0.7	-1.6	-0.1	-0.7	-1.7	0.9	-0.2	-0.3

For some purposes, we were also interested in estimating the Indigenous population. However, this was more complicated as there are no yearly estimates of Indigenous ERP and we had to base our estimates on ERPs and EPs from the 1996, 2001 and 2006 Censuses. This was done using the following modified procedure.

1. Ratios of Indigenous to non-Indigenous people were calculated from the ERPs in the census years.
2. These ratios were interpolated for non-census years using a simple linear interpolation.
3. An Indigenous ERP was calculated for each year by multiplying the yearly ABS ERPs by the ratios calculated in step 2.
4. Ratios between the ERP and the EP for Indigenous people in the census years were calculated.
5. ERP to EP ratios were interpolated for inter-census years.
6. The yearly ERP estimates calculated in step 3 were multiplied by the ratios calculated in step 4 to find the Adjusted Indigenous EP for each year.
7. The Indigenous Adjusted EPs were subtracted from the total Adjusted EPs to find the Adjusted non-Indigenous EPs (Table 4).

Which population?

In Table 5, we present a comparison of the two approaches to developing an appropriate population denominator. Although there is some variation from year-to-year, the overall differences between the 'ERP plus tourists' and the Adjusted Enumerated Population figures are quite small. In the case of Central Australia the maximum difference for AEP was 5.5 per cent and the mean 1.7 per cent greater than the 'ERP plus tourists'. In the case of Greater Darwin the maximum was -5.3 per cent and the mean -0.9 per cent. These small differences have a negligible effect on the calculation of per capita consumption. However, as calculations based on the Adjusted Enumerated Population result in a more conservative estimate for consumption in Central Australia and (for future studies) it is an easier measure to calculate, and we have opted to use this as our population denominator.

Alcohol Consumption

Wholesale alcohol sales data provide the best estimate of alcohol consumption and we have used these as a proxy measure. The Northern Territory Department of Justice provided us with Licensing Commission data on wholesale alcohol sales by quarter for the period July 2000 to December 2010. This includes data for approximately two years prior to the introduction, in April 2002, of the Trial of additional restrictions in Alice Springs.

Wholesale sales are reported to the Department of Justice as total volumes of particular beverage types: full (>3.99% alcohol), mid (3.01–3.99% alcohol) and low strength (≤3% alcohol) beer; cask, bottled and fortified wine; cider; and standard and mixed spirits. With the exceptions of cask and bottled table wine, the total volumes of these beverage types were converted to litres of pure alcohol using average alcohol proportions provided by the NT Department of Justice. In the case of cask and bottled table wine, the Australian Bureau of Statistics has shown that average alcohol content increased from approximately 12.1 to 12.8 per cent over the period 1999–2000 to 2009–2010.[22] As use of the Department of Justice conversion factors thus result in an under-estimate, we have used the ABS factors. However, as the increases did not occur at a single point in time, we have used the incremental increases calculated by Chikritzhs and colleagues (see Table 6).[23]

Table 6: Pure alcohol proportions by beverage type by year, 1999–2010

Beverage	Year										
	99/00	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10
Beer Full	.0476	.0476	.0476	.0476	.0476	.0476	.0476	.0476	.0476	.0476	.0476
Beer Mid	.0348	.0348	.0348	.0348	.0348	.0348	.0348	.0348	.0348	.0348	.0348
Beer Light	.0269	.0269	.0269	.0269	.0269	.0269	.0269	.0269	.0269	.0269	.0269
Wine Cask	.121	.122	.123	.124	.125	.126	.126	.126	.127	.128	.128
Wine Bottled	.121	.122	.123	.124	.125	.126	.126	.126	.127	.128	.128
Wine Fortified	.179	.179	.179	.179	.179	.179	.179	.179	.179	.179	.179
Cider	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05	.05
Spirits Mixed	.0501	.0501	.0501	.0501	.0501	.0501	.0501	.0501	.0501	.0501	.0501
Spirits Standard	.417	.417	.417	.417	.417	.417	.417	.417	.417	.417	.417

Sources: NT Department of Justice, Australian Bureau of Statistics,[22] & Chikritzhs *et al.*[23]

Estimates of quarterly per capita consumption were calculated by dividing total quarterly wholesale sales of litres of pure alcohol by the adjusted enumerated population for each region (Central Australia or Greater Darwin) aged ≥15 years.

As we have shown elsewhere, there are seasonal fluctuations in alcohol consumption in both the Northern Territory as a whole and in Alice Springs in particular and, if not controlled for, these can mask real trends in the data.[16,24] For this reason, the consumption data were 'de-seasonalised' (see below) before subjecting them to time-series analysis where appropriate.

Alcoholic Beverage Prices

Retail prices

There is no publicly available direct source of data on the retail prices of particular alcoholic beverages purchased by consumers in Central Australia for the 2000–2010 study period. Furthermore, the major retailers declined to provide such data to us or to provide more general information about the ratio of wholesale to retail prices. However, some baseline data on retail sales prices for the period just prior to the study period were available from a survey conducted for Territory Health Services for the month of October 1998,[25] and the Alice Springs' Peoples Alcohol Action Coalition (PAAC) undertook monitoring of beverage retail prices: in 2001; in 2002 following the introduction of the Trial Restrictions; and in 2007 following the introduction of the Liquor Supply Plan. PAAC provided us with copies of the results of those surveys and we commissioned them to conduct a new survey on our behalf. Unfortunately, however, data from these surveys proved to be insufficiently detailed and they were conducted too infrequently to be of use in estimating prices and trends over the study period.

Given this, a decision was made to conduct a survey of the prices of alcoholic beverages advertised in *The Centralian Advocate* – the major newspaper in Alice Springs which appears on Tuesdays and Fridays each week. For the study period, we recovered microfiche copies of both editions of the paper in the middle week of each quarter and entered all advertised beverages and their prices into an electronic database. If a representative sample was not available in the middle week, advertisements were collected from an edition from the previous week. A total of 2,062 beverage items was sampled (Table 7).

Table 7: Number of individual retail beverage items sampled by day of the week and year

Day	Year											Totals
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Tuesday	114	142	55	34	32	13	6	-	17	-	20	433
Friday	43	35	28	123	83	143	204	198	233	280	259	1,629
Totals	157	177	83	157	115	156	210	198	250	280	279	2,062

The following variables were recorded in the database; 'retail outlet', 'beverage category and type' (employing the same categories used the Department of Justice in its wholesale sales data collection), 'container size', 'container type', 'price', any 'related promotions' (e.g. two for the price of one), 'date of the advertisement', and 'brand'. After all data were entered, the retail price per litre of pure alcohol was calculated using the following procedure.

1. The total volume for each particular item was calculated by multiplying the container size by the number of containers. For example, in the second quarter of 2001, an advertisement by Liquorland for a 30-can carton of Tooheys beer totalled 11.25 litres of beer (i.e. 30 cans multiplied by 375ml).

2. Alcohol content values were entered for each item. These values were retrieved from the Euromonitor International 'Alcoholic Drinks in Australia' website[26] (where available) or from retailer or vendor websites. In some cases accurate values could not be established from these sources and, instead, the average for that particular type of beverage for the quarter was used.

3. For each item, the total volume of beverage was multiplied by the alcohol content to determine the absolute amount of alcohol. For example the 11.25 litres of

Tooheys beer was multiplied by an alcohol content of 4.6% giving a total of 0.518 litres of pure alcohol.

4. The overall price of each item was then divided by its pure alcohol content to ascertain the price per litre. For example the $28.99 cost of the 30-can carton of Tooheys beer was divided by 0.516 litre of pure alcohol giving a price of $56.02 per litre.
5. The overall price per litre of pure alcohol was adjusted for changes in the CPI – obtained from the Reserve Bank of Australia 'Measures of Consumer Price Inflation' website (http://www.rba.gov.au/inflation/measures-cpi.html#quarterly updated 27/04/2011) – to give a final total in Q4 2010 dollars.
6. For each beverage type an overall average (mean) retail price per litre was calculated per quarter by averaging all retail prices collected for that beverage type in that quarter. As there were quarters for which no prices were collected for some beverage types, the averages for these quarters were imputed from values in surrounding quarters. Furthermore, at times advertisements captured retail prices for higher quality/priced items (especially for bottled wines) which unduly increased average price, and such outliers were removed from the dataset for the purpose of calculating the average beverage price per litre per quarter.

The estimates of average advertised retail price per litre were multiplied by the volume of alcohol sold by beverage type per quarter (from the wholesale sales data). This gave a calculated spending figure for total sales that assumes that all beverages were purchased at the average price. The final calculation is as follows.

$$\text{Average retail price per litre} = \frac{\text{total calculated spending given average prices}}{\text{total litres of pure alcohol sold}}$$

It should be noted that the average price per litre was calculated from advertisements which typically represent items that are on sale at the time. It is therefore likely to underestimate the actual average beverage price.

As well as calculating an estimate of average retail price, we also estimated minimum retail price per litre of pure alcohol to compare what an 'average' consumer might pay and the price that might be paid by a person seeking the largest volume of alcohol at the cheapest price. To estimate this minimum price per litre, the same procedure was followed except that, instead of averaging over all beverages (brands) in a category, only the minimum price observed for each beverage category was used. Missing data were again interpolated and outliers were replaced via interpolation from surrounding quarters.

$$\text{Minimum retail price per litre} = \frac{\text{total calculated spending given minimum prices}}{\text{total litres of pure alcohol sold}}$$

While the average retail price per litre is based upon a range of products in any one quarter, the minimum price is based on a single product and might therefore be more responsive to marketing and advertising practices.

Wholesale prices

As well as the volume of wholesale sales of alcohol by beverage type, the NT Department of Justice provided access to data on the wholesale value of beverage purchases made by retailers by pre-aggregated categories – 'full', 'mid' and 'low' alcohol content. The dollar amounts in each of these three categories were summed for each quarter and these were adjusted for changes in the Consumer Price Index (CPI) to provide estimates of quarterly wholesale price totals in Q4 2010 dollars. These totals were then divided by total quantities of pure alcohol sold in each quarter to provide the average (mean) wholesale price per litre of pure alcohol in Q4 2010 dollars for both the Central Australian and Greater Darwin regions. While it would also have been useful to examine the modal price, it was not possible to calculate this from the available wholesale (or retail) data available.

Health Indicators

The key indicators of alcohol-related harms to health that we employed were hospital in-patient separations, and emergency department presentations. Hospital separations are recorded using International Classification of Disease [ICD-10] codes.[27] A robust set of alcohol-attributable ætiologic fractions has been developed for hospitalisations in the wider population which enable estimation of the proportion of cases in a particular diagnostic category that are likely to be caused by alcohol (Appendices 1 and 3).[28,29,30,31] These fractions have also been adjusted to reflect different levels of alcohol consumption in the Australian Aboriginal population and the Northern Territory (Appendices 2 and 4).[32,33] For the purpose of broadly measuring the impact of alcohol consumption and evaluating the impact of alcohol interventions, data on all alcohol-attributable conditions were combined using these ætiologic fractions. However, inclusion of conditions with low ætiologic fractions can potentially mask the impact of restrictions as they may be more strongly influenced by other factors (e.g. smoking rates). For this reason, we also examined data for a small number of key conditions that are wholly alcohol-attributable, have an alcohol-attributable ætiologic fraction of greater than 0.8 (high), have an alcohol-attributable ætiologic fraction of between 0.3 and 0.8 (medium), or which have a lower ætiologic fraction but have a high frequency including pedestrian and non-pedestrian road traffic injuries (low) separately. Furthermore, two groups representing acute (i.e. associated with episodic drinking to intoxication) and chronic conditions (i.e. associated with regular and consistent exposure) were also examined separately as the time courses (i.e. lag) for responses to restrictions may vary. This approach reflects that recommended in the World Health Organization's guidelines for monitoring alcohol consumption and related harms.[18]

Presentations to the Alice Springs Hospital Emergency Department are recorded by principal diagnosis, date and time of presentation, and demographic characteristics. These presentations were available with ICD-10 coded primary diagnoses from Q3 2002 onwards and overall alcohol-attributable harms were calculated using those data. However, as the data were mostly limited to chronic conditions, patient triage data collected by nursing staff over the entire study period were used to investigate assaults and other key wholly alcohol-attributable conditions.

It should be noted that unlike hospital admissions, NT emergency department records do not require mandatory recording of external causes for injuries (as is the case for most EDs throughout Australia).[34] For the vast majority of injuries it is therefore not possible to identify cause of the injury from diagnostic codes. For example, a broken femur may be indicated but it is not possible to determine whether it was caused as the result of a fall, road crash or assault. Thus, we also analysed data from triage nurse fields. All patients have an initial triage assessment by a nurse who selects a category from a limited range of choices. One such category is 'assault' and we used this to observe trends in assault presentations.

Several reports demonstrate that the Northern Territory and Central Australia have the highest rates per capita of alcohol-attributable deaths (including suicides) in the country.[35,36,37] However, the number of such deaths (even annual frequencies) is too small to ascertain any impact that alcohol interventions might have upon them with statistical confidence and we have not reported on them.

Crime and Public Order

Police recording of the presence of alcohol involvement in an incident has not been mandatory in the Northern Territory for the whole of the study period. In the last three years of the study period in which it was mandatory; police officers reported that, on at least some occasions, front-line officers may not always have completed the alcohol field in incident reports and thus some may not be completely accurate. For these reasons, incident and offence reports that are specifically identified as alcohol-related are likely to under-estimate the actual frequency with which they occur. Nevertheless, there are a number of types of incidents and offences that are by definition alcohol-related (e.g. drunk and disorderly behaviour, and drink driving offences); or offences which have been shown to be commonly alcohol-related (assaults, protective custody apprehensions, anti-social incidents and domestic violence). Given this, similar incidents have been used as a valid and reliable proxy measure of alcohol-related crime and public disorder in other studies.[47,18] Access to these data were provided to us by the NT Police by quarter for the period 1 January 2000 to 31 December 2010.

Statistical Analyses

Access to liquor licensing, hospital admissions, emergency department presentations, and police incident data were provided to us in Microsoft Excel™ format. After cleaning, the data were imported into both IBM SPSS Statistics 19 and Stata 11 for statistical analysis. Microsoft SQL Server 2005 was used to assign ætiologic fraction categories to both the hospital and emergency department data. Three major statistical approaches were used in the study; cross-correlation, time-series modelling (ARIMA and exponential smoothing), and Poisson Regression. As part of these approaches, seasonal decomposition of the data was used extensively (this procedure produces time series which are adjusted for seasonal variation).

Cross-correlations

Cross-correlations are similar to standard correlation procedures (which show the strength of association between two variables) but measure the relationship between points in time at different lags (a lag of 0 representing the same quarter, a lag of 1 representing the subsequent quarter etc.). When cross-correlations are calculated, a necessary requirement is that the two series are stationary (i.e. the mean and variance do not change over time) and this is usually achieved by 'differencing' where the difference between each point in time and the following point in time is used rather than the actual values for each of those points.

Time series modelling

All time-series modelling was conducted using IBM SPSS 11. ARIMA is a technique used for modelling time-series data which takes into account three main components of a time series:

- (AR) which represents any auto-regressive component where the time-series values have a high correlation with one another; that is, where consecutive points in time are related to each other;
- (I) which represents whether there is an overall trend in the data which needs to be removed to satisfy the requirement that the model be stationary (level) having the same average over time; and,
- (MA) 'Moving average orders specify how deviations from the series mean for previous values are used to predict current values' (SPSS). The moving average represents the trend of the average value of the variable over time and smooths out short-term fluctuations in the data.

An exponential smoothing model can also be applied to time-series data; although a limitation of this is that it cannot accept independent variables. SPSS has an expert time-series modeller feature ('Forecasting->Create Models') which tests various models and automatically selects the model that best fits (i.e. describes) the data. All time-series models throughout the report had non-significant Ljung-Box test results – indicating that there were no patterns remaining in the residuals that were unaccounted for by the model (unless noted).

Time-series modelling was used in three ways in this study.

1. To model an indicator time-series, such as alcohol-related hospitalisations, and then to test if either consumption and/or price made a significant contribution to improving the fit of the model.
2. To test whether individual restrictions contributed significantly to constructing a model of best-fit. Dummy variables representing each restriction were coded with a 0 value when the restriction was not present and a 1 when the restriction was present. These were entered into the expert modelling procedure as 'event' variables to determine if they were significant for making predictions (similar to interrupted time series modelling).
3. To test whether trends observed in indicators (e.g. hospitalisations) during specific periods in time (i.e. in the eight quarters immediately following an intervention)

were different to expected trends, had the intervention not taken place and past trends had continued. Time series procedures were used to model specified 'before' period trends and to forecast these trends into the post intervention period. The forecast 'expected' trends were then compared to the actual 'observed' trends to determine whether values in the period subsequent to the intervention were significantly different. This procedure supplemented the time series modelling (2 above), the application of which was often restricted due to the close proximity in time of many restrictions.

There were some major difficulties in applying time-series techniques to the available data. It is generally suggested that time-series data should be modelled with at least 50 data periods. However, the data were provided on a quarterly basis, from July 2000 to December 2010, giving a total of 42 time periods; and the numbers of time periods between the introduction of new sets of restrictions were much smaller. For example, there were only seven quarters of data available before the introduction of the Trial Restrictions in Q2 2002. We demonstrate in Chapter 4 that these restrictions appeared to have initiated a reduction in wholesale sales from Q2 2001, leaving only three quarters of data for modelling beforehand. Compounding this, many interventions occurred within a short time of one another. For instance, there were only three quarters between the LSP and the Dry Town legislation, and again three quarters between that and the ID & 'alcopops tax' restrictions. It was difficult therefore to determine whether any changes after this period were due to the individual restrictions, or to a combination of them. The longest un-interrupted period was from the end of the Trial Restrictions in Q3 2003 until the start of the LSP in Q4 2006 and, as such, this period underwent the most intense statistical investigation.

Poisson regression

Poisson Regression offers an alternative approach to ARIMA–type time series analyses by comparing counts of measurement at points in time with a reference period and testing whether changes occurring subsequent to an intervention are significant. Poisson regression measures the Incidence Rate Ratio (IRR); which is suitable for count data and can therefore be used to good effect for frequencies of events, such as the number of hospitalisations for alcoholic pancreatitis each year. Poisson regression requires a reference point and this is usually set as the time interval (e.g. quarter) immediately before the intervention of interest so that subsequent intervals can be compared and tested for significantly different changes. In order to control for overall fluctuations in the total number of cases of a particular indicator (e.g. total hospitalisations tend to increase from year to year), the ratio between alcohol-related events and non-alcohol-related events in the same time interval was used as the indicator, i.e. rate ratios were calculated as follows:

$$RR = \frac{(\text{risk for alcohol in quarter } x \text{ / risk for non-alcohol in quarter } x)}{(\text{risk for alcohol in reference quarter / risk for non-alcohol in reference quarter})}$$

All Poisson regression analyses were conducted using Stata 11 on de-seasonalised data where consistent seasonal patterns existed.

Seasonal decomposition

Seasonal decomposition, also known as de-seasonalising, is a technique whereby any regular seasonal component of a time series is identified and removed from the data. With many of the time series available, there was a strong seasonal component – that is, there were regular patterns between quarters from year to year. For example, consumption in both Alice Springs and Darwin is at its lowest in the first and highest in the third quarter of every year. These seasonal patterns can hide or obscure overall trends and are best adjusted for prior to analysis (ARIMA can also model seasonal components in time series data). In each case, this was done with the SPSS 'Analyze -> Forecasting -> Seasonal Decomposition' technique, using an additive model type with all points considered equal. In the case of count variables applied in Poisson Regression analyses, the de-seasonalised variables were rounded to the nearest integer to maintain compatibility for processing.

Interviews with Key Informants

The meaning of statistical data is not inherent in the data themselves – they require interpretation. Such interpretation needs to be internally consistent with the data and consistent with evidence from other sources. In addition, sources of confounding in associations or correlations need to be taken into account. Some of the latter may be identified in the design of the research but others need to be sought when considering the preliminary results of analysis.

To ensure that our final interpretation of the quantitative data was as robust as possible, after the preliminary analyses we conducted a series of semi-structured interviews with key informants. These informants included relevant senior staff and officers from the Alice Springs Hospital, Royal Darwin Hospital and the NT Police as well as staff from Aboriginal community-controlled organisations such as Central Australian Aboriginal Congress. Our initial findings were described to them and they were asked to comment on these and to provide their interpretations. Records were made of these interviews and subjected to thematic analysis specifically aimed at identifying factors that might have confounded the findings of the Stage 1 statistical analyses or which might have confirmed or contradicted the interpretations of the results of those analyses. These qualitative data were then used to guide concurrent re-analysis of the quantitative data as part of Stage 3 of the project.

Ethical Issues

The project was undertaken within the framework of the National Health and Medical Research Council (NHMRC) and Australian Vice Chancellors Committee's *National Statement on Ethical Conduct in Human Research* and the NHMRC's *Guidelines for Ethical Conduct in Aboriginal and Torres Strait Islander Health Research.*[38,39] Approval to conduct the project was given by Curtin University's Human Research Ethics Committee (HR 99/2010) and the Central Australian Human Research Ethics Committee (2010.08.05).

3. Alcohol Control Measures

There have long been concerns about the high level of alcohol-related harm in Alice Springs. Much of this focussed on issues such as violence, disorderly conduct and petty crime – particularly among Aboriginal people. The concern was reflected in: public discussion, newspaper articles, and various reports going back at least as far as the 1950s,[40,41] the Royal Commission into Aboriginal Deaths in Custody;[1,2,3,42] and the formation of community action groups such as the Alice Springs People's Action Coalition. It was manifested in calls for measures to control the demand for alcohol and calls for various additional restrictions on the sale and supply of alcohol – although community views on the latter were far from unanimous.

As discussed in the introduction, the Northern Territory *Liquor Act (1978)* placed general restrictions on who may purchase alcoholic beverages, who may sell them, the places from and hours at which they may be sold, as well as specific conditions that can be imposed upon individual licences. In 1979, the Liquor Act was amended to include the 'general restricted areas' provisions of Part VIII (with further amendments to this section in 2006) which provided for application to be made (usually by community groups) to the Licensing Commission to declare an area a 'general restricted area' in which the possession or consumption of alcohol was prohibited or restricted. Between then and 2005, over 100 Aboriginal communities used these provisions to support alcohol management. Although not part of the Liquor Act, in 1983 the *Summary Offences Act* was amended to include Section 45D which made it an offence to consume alcohol within two kilometres of licensed premises – the so-called 'Two Kilometre Law'. In addition to these general provisions, a range of mandatory controls were imposed by the Northern Territory Licensing Commission on particular licenses in various locations across the Territory.

In 1991 the Northern Territory Government introduced the 'Living With Alcohol Program' (LWA). The LWA program included a wide range of initiatives aimed at reducing alcohol-related harm. These included:

- a reduction of liquor licensing fees on beverages containing less than three per cent pure alcohol by volume and imposition of additional levies of $0.20 per litre on beer, $0.48 per litre on wine and cider, and $1.60 per litre on spirits (introduced in1992); and,
- an additional levy of $0.35 per litre on cask wine (introduced in 1995).[6]

The levies were intended to fund various demand reduction strategies (prevention and treatment programs) but, in their own right, they led to reductions in consumption and related harms.[6,43] Despite the success of this intervention, the program was wound down after the High Court decision which found that such levies were illegal as they were essentially excise duties which, under the Australian Constitution, only the Commonwealth Government can impose.[44]

The Northern Territory Licensing Commission imposed additional liquor restrictions – commonly referred to as the 'Thirsty Thursday' experiment – on Tennant Creek in 1995. Evidence from evaluations of these restrictions showed they had a positive effect in reducing consumption and a range of alcohol-related problems within the town.[45,46,47] Over the next five years, in a number of towns, there were calls from community members and groups for further restrictions including the buy-back of some existing liquor licences, reduction of trading hours, and banning of sales of four and five litre wine casks and, in some instances, fortified wine.

In Alice Springs issues came to a head in March 2001 when a former Minister for Central Australia, Dr Richard Lim, facilitated a public meeting which passed a number of resolutions recommending to the Licensing Commission the introduction of various restrictions in the town.[48] In response, the Commission called for submissions from the broader Alice Springs community and received over 2500 responses. These were polarised with slightly more being in favour of the restrictions than against. In May 2001 the Commission made a decision not to act at that time but to work with groups from the community to develop 'suitable initiatives' including new 'complementary measures' to provide prevention and treatment initiatives.[48] Following an NT election in August 2001, work by various community groups, and the holding of public hearings, the Commission decided to introduce Trial Restrictions for a period of 12 months commencing on the 1st April 2002.[11]

Subsequently other restrictions followed, including: amendment of the Trial Restrictions in 2003; the Alice Springs Alcohol Management Plan and the Alice Springs Liquor Supply Plan, both introduced in 2006; the NT Licensing Commission's declaration of the Alice Springs Restricted Area in 2007; and the introduction of a photographic ID system for the purchase of take-away alcohol in 2008. In addition provisions of the Australian Government's *Northern Territory Emergency Response Act* and amendments to the Australian Governments *Excise Tariff* and *Customs Tariff Acts* in 2008 have also impacted on the supply of alcohol in both Central Australia and the Northern Territory more generally. The nature of these various restrictions are summarised below (and in Table 8).

2002 Licensing Commission Decision – Alice Springs Trial Restrictions

In March 2002, the Commission determined to introduce a trial of additional restrictions on the sale of liquor in Alice Springs. The Decision arose from a Hearing conducted in accordance with Section 33 (3) of the *Liquor Act 1978* and the trial was proposed for a twelve month period, commencing 1st April 2002, concluding 31st March 2003.[11] After minor exemptions, such as the Alice Springs Airport and 'mini-bars' in licensed accommodation, sixty-six of the town's ninety-one licensed premises were subject to the Trial Restrictions. The trial licence conditions were as follows:

- for the sale of liquor for consumption away from the premises, (commonly referred to as "take-aways"), trading shall not commence before 2:00 PM on any weekday and shall cease no later than 9:00 PM;
- "take-away" trading hours will remain unaltered on Saturdays and Public Holidays (10.00 AM –9.00 PM) and Sundays (Noon–9.00 PM);

- no liquor of any type or description shall be sold or supplied for consumption away from the premises in containers larger than two (2) litres; and
- no liquor other than light beer shall be sold or supplied prior to 11.30 AM on premises during weekdays.[11]

Not long after the trial commenced, it became apparent that retailers introduced relatively cheap two-litre casks of fortified wine, thus in part circumventing one of the restrictions. However, despite protests from some sections of the community, the restrictions were continued in their original form without any attempt to address this issue.

An 'Evaluation Reference Group' (ERG) consisting of key stakeholders was established to oversee evaluation of the restrictions. On behalf of this group an evaluation was conducted by Crundall and Moon and both the evaluation report and a report of the ERG were submitted to the Licensing Commission.[4,49] In addition, Tangentyere Council – an umbrella organisation for the Alice Springs Town Camps – commissioned a survey of Town Camp residents' attitudes to the restrictions, and Gray undertook a critique of the report by Crundall and Moon.[16,50]

2003 Licensing Commission Decision – Alice Springs Amended Restrictions

Following completion of the trial, the Licensing Commission determined that the restrictions should remain in-force until it had time to consider the outcomes. As part of the latter process, the Commission reviewed the reports cited above and various other documents and met with key stakeholders including representatives of community groups, the liquor industry, and territory and local government representatives. On the basis of its deliberations, on 10th July, 2003, the Commission handed down a decision amending the restrictions. In its decision, the Commission wrote:

> These (new) license conditions are congruent with the conditions that applied throughout the period of the Trial Restrictions except that the restriction on container size has been removed with the effect of permitting the sale of four and five litre "wine casks".[12]

2006 Alcohol Court Act (NT)

The *Alcohol Court Act* was passed in 2006 as a key element in the Northern Territory Government's anti-social behaviour strategy.[51] Intended to build on the experience and success of the Court Referral and Evaluation for Drug Intervention Treatment (CREDIT) program, the stated aims of the Alcohol Court regime were to:

- address alcohol dependence that leads to crime;
- facilitate reduction in the commission of offences associated with alcohol dependence;
- facilitate the rehabilitation of offenders;
- contribute to improvements in offenders' health and social functioning; and

- provide for a treatment process which will contribute to the safety and wellbeing of the broader community.[51]

This Act granted the Alcohol Court power to 'make particular orders in respect of certain offenders with alcohol dependency and to make sentencing orders and ancillary orders in respect of those offenders and for related matters'.[52] Rather than being a broad-based population measure, this intervention targeted alcohol dependent persons. It aimed to direct such people into treatment and restricted availability through intervention or prohibition orders addressing the alcohol-related offender handed down at sentencing.

In 2011, subsequent to the study period, this Act was repealed and replaced by the *Alcohol Reform (Substance Misuse Assessment and Referral for Treatment Court) Act 2011.*

2006 Alice Springs Alcohol Management Plan and Liquor Supply Plan

In 2004, in response to community concerns about alcohol-related crime and other harms, the Northern Territory Government developed an 'Alcohol Framework'. This Framework aimed to provide '... an overarching, whole-of-Government approach to minimising alcohol abuse and the problems it causes our community'.[53,54] Within this Framework, in September 2006 the NT Chief Minister announced the introduction of an Alice Springs Management Plan (AMP),[55] and its implementation coincided with the recent introduction of the Alice Springs Liquor Supply Plan (LSP).[56] The AMP was intended to be managed by members and organisations from the community affected by alcohol whereas the LSP was a set of externally driven measures implemented to change the drinking context.

The LSP was initially announced in June 2006 but – subject to concerns by licensees about some aspects of compliance – a Revised LSP was announced in September 2006, to take effect on the 1st October 2006. The measures introduced under the LSP were as follows.

- No liquor other than light beer shall be sold or supplied on premises prior to 11.30am during weekdays. The trading hours for takeaway liquor sales are as follows:
  - Monday – Friday 14:00 – 2100 hours, Saturday and Public Holidays 10:00 – 21:00 hours, Sunday 12:00 – 21:00 hours.
  - There is no takeaway trading in all licensed premises on Christmas Day and Good Friday and no takeaway trading in stores on Sundays, only hotels.
- The takeaway sale of all wine products is be restricted to container sizes of no larger than one (1) litre for fortified wine and no larger than two (2) litres for other wine products.
- Sales of fortified wine or cask wine can only be made during the last three (3) scheduled hours of trading each day. On any given day, sale to a person of more than one (1) bottle of fortified wine or one (1) cask of wine is prohibited and Licensees who knowingly or recklessly make such sales will be in breach of this condition. (Interviews with key stakeholders in Alice Springs suggest that this 'one

per person per day' restriction had no formal infrastructure in place to enforce it and probably was largely circumvented, at least until the introduction of the ID system in 2008.

- All Licensees are required to provide liquor product sales figures as directed by the Commission.
- Licensees who are licensed to sell liquor for consumption both on and off premises are required to provide liquor figures clearly identifying "on and off premises" sales.
- All staff involved in the service of alcohol must hold a Responsible Service of Alcohol Certificate within one (1) month from commencement of employment. (With a reasonable period permitted for current staff to obtain certification.)
- A holder of a Responsible Service of Alcohol Certificate must be on premises at all times during trading hours. Hotel type premises that have separate drive through bottle shops are required to have a person who holds a Responsible Service of Alcohol Certificate in the bottle shop area in addition to the main area of the licensed premises.
- All stores and venues with drive through bottle shops are required to have camera surveillance to the satisfaction of the Deputy Director of Licensing.[56]

The Alcohol Management Plan was evaluated by Senior *et al.* and was the subject of a critique by MacKeith *et al.*[5,17] Senior *et al* reported an 18 per cent reduction in consumption following the introduction of the AMP. There was also indication that there had been a reduction in the severity of assaults and homicides, although both of these outcomes might have been a consequence of the Liquor Supply Plan which came into effect around the same time. Nevertheless these results indicate the restrictions did have a positive outcome.

2007 Licensing Commission Decision: Alice Springs Restricted Area

In May, 2007, the Alice Springs Town Council applied for Public Restricted Area ('Dry Town') status. This was approved by the Commission and commenced on 1st August 2007. It prohibited consumption of alcohol within a public restricted area unless a specific permit had been obtained or the alcohol consumption took place within private premises.[57] Individuals found in breach of this provision faced various penalties including:

- Forfeiture of liquor.
- Liquor tipped out or confiscated.
- A $100 infringement notice issued.
- A maximum fine of $500 if the matter goes to court.
- In the case of repeat offenders (multiple infringement notices) or complaints made by Police, a person may go before the court of summary jurisdiction and be referred to the Alcohol Court.[57]

Given that the 'Two Kilometre Law' had already been in effect for more than 20 years and the fact that most areas in which public drinking occurred were within two kilometres of a licensed outlet in Alice Springs, this restriction was not entirely new. It did, however, provide police with some increased powers to act and provided sanctions against public drinking. Furthermore, interviews with police and residents suggest that when enforced on a regular basis there was a reduction in public drinking within the town.

2007 Northern Territory Emergency Response Act

The *Northern Territory Emergency Response Act* – commonly referred to as 'the intervention' – was introduced by the Australian Government in 2007 as a set of initiatives relating to welfare provision, law enforcement, land tenure and other measures. [58,59] Part two of the Act is specific to alcohol and 'enables special measures to be taken to reduce alcohol-related harm in Indigenous communities in the Northern Territory'.

Specifically the Act:

- enables the government to introduce a general ban on people having, selling, transporting and drinking alcohol in prescribed areas; and
- applies tougher penalties to people who are benefiting from supplying or selling grog to these communities.[58]

Licensed premises on Aboriginal land were still able to operate if strict alcohol management rules were put in place and enforced.

In the 2011 *Northern Territory Emergency Response Evaluation Report*, it was reported that the alcohol restrictions were more consistently enforced than any previous restrictions and that levels of alcohol-related crime had decreased following implementation of the NTER.[58] Records showed that less full-strength alcohol and cask wine were being procured and community members indicated they felt safer in their communities. However, those outcomes might also have been attributable to an increase in policing, night patrol activity, and income management in remote communities, as well as new alcohol management arrangements and the seldom enforced prohibition of alcohol being taken onto or consumed within town camps in Alice Springs, Katherine, Tennant Creek and Nhulunbuy which was separate to the NTRP.[58] It was at this time (September 2007) that the town camps in Alice Springs became theoretically legally 'dry' under the NTER legislation.

2008 Licensing Commission Decision: Introduction of Photographic ID.

In mid-2008, the NT Licensing Commission approved the introduction of a photographic ID system in Alice Springs which required individuals to produce proof of identity, such as a driver's licence for the purchase of take-away alcohol. It formed part of the Alice Springs Alcohol Management Plan which aimed to reduce the supply of alcohol in Alice Springs and the level of anti-social behaviour caused through excessive drinking.[60] Introduction of the requirement to produce photographic ID when purchasing takeaway beverages facilitated enforcement of the limit on takeaways imposed under the Alice Springs Liquor Supply Plan which until that time had been largely unenforceable.

2008/2009 Excise Tariff Amendment Act and Customs Tariff Amendment Act (the 'Alcopops Tax')

In April 2008, the Australian Government increased excise and customs tariffs on pre-mixed spirit drinks ('alcopops') to the same rates as that on 'standard' spirits beverages. The aim of this was to increase the overall price of these beverages in an attempt to reduce drinking to intoxication – particularly among young people. Although collection of the revenues commenced at that time, there were some legislative delays and it was not until August 2009 that the measures were formalised with the passage in , the *Excise Tariff Amendment (2009 Measures No.1) Act 2009* and the *Customs Tariff Amendment (2009 Measures No.1) Act 2009*. These Acts increased the excise duty payable on pre-mixed spirit-based beverages to the same rate as that on standard spirits – that is, from $39.36 to $66.67 per litre of alcohol by volume.[61,62] The Acts effectively closed a loophole, created by the introduction of the Goods and Services Tax (GST), which had enabled the alcohol industry to market ready-to-drink (RTD) beverages at a lower tax rate than standard spirits beverages. Skov *et al.* reported that, 'Excise data from the first full year after the tax came into effect showed a more than 30% reduction in RTD sales and a 1.5% reduction in total pure alcohol sold in Australia'.[63]

Alcohol Control Measures in Darwin

It was important to ascertain whether any changes in patterns of alcohol consumption and related harm in Central Australia were due to the impact of alcohol control measures, or were part of broader changes taking place across the Northern Territory. For this reason, the Darwin region was selected as a 'control' area (see Chapter 2). Of the measures summarised above, only the Australian Government's 'alcopops tax' was implemented there. However, at the time that tax was introduced, a number of liquor outlets in Darwin voluntarily agreed not to sell wine in four and five litre casks and it was a condition of changes to one licence that it withdraw sale of four litre casks.

Summary

Over the past decade, various additional restrictions on the availability of alcohol have been introduced in Central Australia. As can been seen from the description above, these have been introduced as packages which themselves include a number of discrete restrictions. These packages have been introduced over a short period of time and sometimes simultaneously. Furthermore, some restrictions may not have been implemented as initially envisioned. This makes it difficult to identify any impact that some individual restrictions might have had. Despite this, as discussed in the previous chapter and in accord with the objectives of the study, all of these restrictions were tested for their potential effect on consumption, price and harms.

Table 8: Application of additional licensing restrictions and related interventions in Alice Springs, 2002–2010

Restriction	Type			Year and quarter																																		
	Vol.	Bev.	Time	2002			2003				2004				2005				2006				2007				2008				2009				2010			
				2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Time: Takeaways only from 2pm-9pm weekdays	Y		Y																																			
Volume: Takeaways only ≤ 2L	Y																																					
Type: Light beer only before 11:30am on premises	Y	Y	Y																																			
Take-aways 10am-9pm Sat & Public Holidays	Y		Y																																			
Take-aways noon-9pm on Sundays	Y		Y																																			
Volume: 1L Fortified Wine, 2L other wine	Y	Y	Y																																			
Cask and Fortified only in last 3 hours of takeaway	Y	Y																																				
Only 1 per person per day	Y	Y																																				
Moratorium on new takeaway licenses (12 months)	Y																																					
Income quarantining	Y																																					
Town Camps Dry	Y																																					
Dry town decision	Y																																					
Alcohol Takeaway Identification Cards	Y																																					
Beer in long-necks banned	Y	Y																																				
Alcopops tax	Y	Y																																				

Note: Type refers to the likely impact of restrictions on: volume consumed (Vol.); beverage type consumed (Bev.); or the time at which different beverages could be purchased (Time) . The block highlighted in orange indicates that this restriction might have been less than effectively enforced during that period of time.

4. Alcohol Consumption

As indicated previously, wholesale alcohol sales data provide the best available estimate of alcohol consumption and they have been used widely as a reliable proxy measure of consumption. The Northern Territory Department of Justice provided access to these data from collections made by the NT Licensing Commission. The data included wholesale purchases by all licensed premises in the Central Australian and Greater Darwin regions by quarter for the period July 2000 to December 2010. We had initially hoped for a longer baseline period but, as indicated in Chapter 2, data prior to that time are not regarded as reliable by the Department of Justice.

Recently, it has been argued that the wholesale sales data significantly under-estimate the actual volume of sales, as they do not include sales made over the internet or mail order sales, which are used to circumvent licensing restrictions.[64] Detailed data on on-line sales of alcoholic beverages are not available. However Access Economics reported that these are estimated to account for 1.9 per cent of total sales of alcoholic beverages in Australia.[65] Within the Northern Territory, on-line sales by some large retailers are shipped internally and thus are included in sales data reported to the Licensing Commission. Where they are shipped from outside the NT they are not included. There is some observational evidence to suggest that on-line sales have been increasing. However, even if on-line sales in Central Australia were double the national average (unlikely), and none were captured in the Licensing Commission data, they would make little appreciable difference to estimates of consumption based on wholesale sales data. Furthermore, as shown in Chapter 4 (page 34 ff.) the evidence from this study indicates that those who were unable to purchase cheap cask table and fortified wine shifted to full strength beer which was purchased locally.

The Department of Justice data included: the total volume of the following beverage types: full, mid, and low strength beer; cask, bottled and fortified wine; cider; and standard and mixed spirits. Using the methods described in Chapter 2, each beverage type was converted to litres of pure alcohol and these were summed to provide total wholesale sales of pure alcohol for both Central Australia and Greater Darwin. To facilitate comparison between regions (and other studies) the total volumes of pure alcohol were converted to estimates of per capita consumption by dividing them by the annually Adjusted Enumerated Population aged ≥15 years. Total wholesale sales and estimates of per capita consumption are summarised on an annual basis in Table 9 and compared to national estimates of per capita consumption for Australia as a whole. In Central Australia, estimated annual per capita consumption ranged from a high of 1.76 times that national average in 2000 to a low of 1.25 times the national average in 2008. In greater Darwin, it ranged from a low of 1.4 times the national average in 2001 to a high of 1.59 times in 2008. In Figure 1, estimates of per capita consumption are plotted on a quarterly basis.

Table 9: Annual wholesale sales of pure alcohol (litres) and estimates of per capita consumption (15+yrs), Central Australia, Greater Darwin and Australia, 2000–2010

	2000*	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Central Australia											
Total	625,967	553,332	520,574	540,961	538,788	571,655	544,721	489,397	477,659	515,747	513,260
Per capita	17.65	15.53	14.48	15.01	15.04	15.99	15.18	13.57	13.05	13.89	13.75
Ratio CA:Aust	1.76	1.55	1.43	1.46	1.46	1.55	1.45	1.28	1.25	1.34	1.36
Greater Darwin											
Total	1,329,415	1,287,106	1,341,951	1,357,681	1,518,909	1,560,788	1,589,800	1,698,383	1,765,681	1,761,068	1,749,599
Per capita	14.66	14.05	14.44	14.53	16.13	16.23	16.00	16.56	16.68	16.07	15.48
Ratio GD:Aust	1.46	1.40	1.42	1.41	1.57	1.57	1.53	1.57	1.59	1.55	1.53
Australia#											
Total	148,326,000	149,017,500	152,412,000	154,832,500	158,849,500	163,444,000	165,487,500	168,795,500	173,913,000	179,373,000	181,912,000
Per capita	10.04	10.05	10.15	10.29	10.27	10.31	10.44	10.57	10.48	10.34	10.13

* 2000 figures for Central Australia and Greater Darwin are an estimate based on consumption for the third and fourth quarters of that year.

\# Source: ABS.[66] Given that ABS publishes figures for financial years, the mean of adjacent years was used to estimate calendar year values. The ABS increased its wine conversion values from 2005–05 onwards. Figures prior to that time are thus likely to be under-estimations.[23]

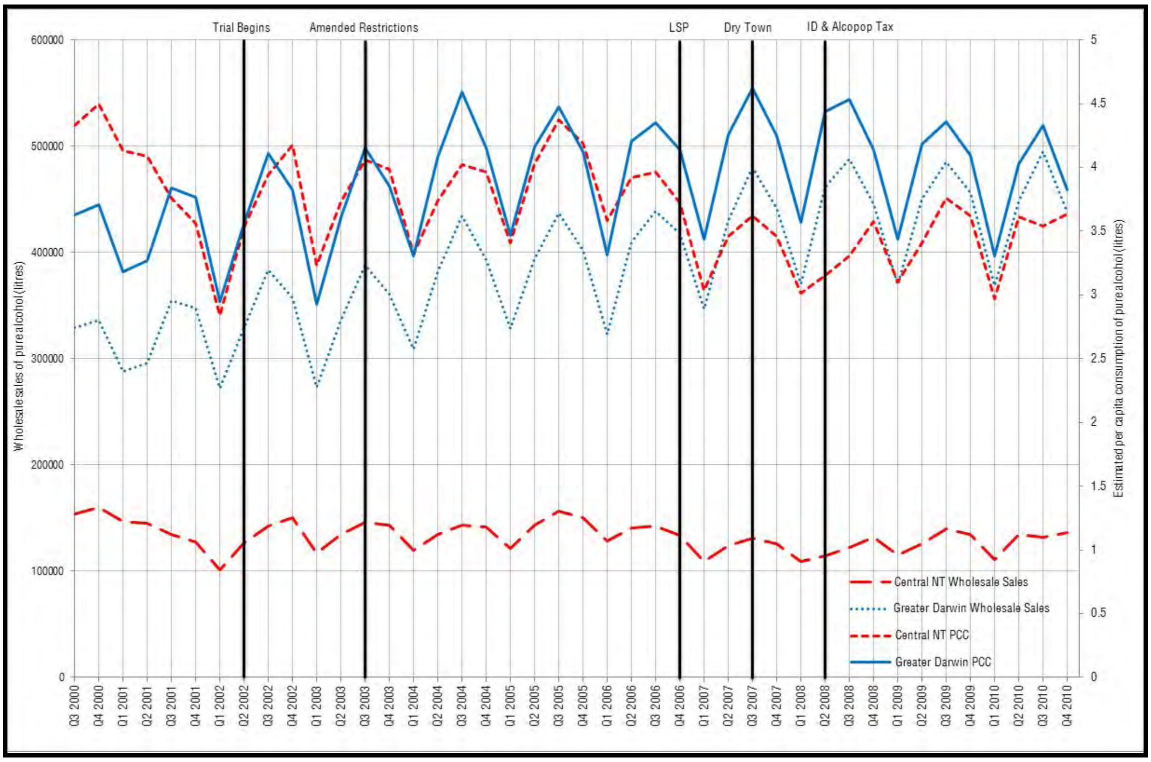


Figure 1: Total wholesale sales of pure alcohol (litres) and estimated per capita consumption of pure alcohol (litres) by persons aged ≥15 years by quarter, Central Australia and Greater Darwin, July 2000–December 2010

As can be seen in Figure 1, there were significant seasonal fluctuations in alcohol sales in both regions. The highest volume of sales generally occurred in the third quarter and the lowest in the first quarter of each year – with the high level in the third quarter being purchases by retailers in anticipation of high levels of consumption in the lead up to the Christmas new-year holiday season in the fourth quarter. As discussed in Chapter 2 these fluctuations were controlled for using the SPSS 'Analyze -> Forecasting -> Seasonal Decomposition' procedure prior to time series analysis.

When the quarterly estimates of per capita consumption were de-seasonalised, the underlying pattern became evident (Figure 2). In Central Australia, in the year prior to the introduction of Trial Restrictions, in April 2002 estimated per capita consumption dropped from 4.53 litres in Q1 2001 to 3.24 litres in Q1 2002. The most likely reason for this was reduction by retailers in wholesale purchases of wine in casks of >2 litres in anticipation of the restrictions coming into effect. Following the introduction of Trial Restrictions in Q2 2002, estimated per capita consumption rose. This rise was due largely to circumvention of the restriction on the sale of wine in casks of >2 litres by the sale of fortified wine (which contains a greater percentage of alcohol than table wine) in two litre casks (see below). Following introduction of the Amended Restrictions in Q3 2003, there was a further slight increase in estimated consumption. This increase continued until Q1 2006 when – as was the case prior to the introduction of the Trial Restrictions – there was an anticipatory drop from 3.99 litres per person to 3.53 litres per person at the time the LSP was introduced in Q4

2006. Subsequent to the introduction of the LSP, estimated per capita consumption continued to decline until after the introduction of the ID and 'alcopops tax' to a low of 3.1 litres in Q3 2008, thereafter it increased once again to plateau at an average of 3.45 litres per person. However, despite these fluctuations, over the whole of the study period, there was a marked decline in estimated per capita consumption in Central Australia. Mean de-seasonalised estimated per capita consumption before the LSP was 3.84 litres of pure alcohol per quarter which decreased to 3.40 litres after the introduction of the LSP. It should be remembered that the mean prior to the LSP also included any reductions arising from the initial trial restrictions.

In Greater Darwin, estimated per capita consumption steadily increased from 3.21 litres in Q3 2000 to 4.37 litres in Q2 2008 when sales of wine in four and five litre casks were restricted and the 'alcopops tax' came into effect (Figure 2). Thereafter it declined to 3.71 litres in Q4 2010. That the overall decline up to Q2 2008 in Central Australia was not matched in Greater Darwin, suggests that the former is attributable to the restrictions there.

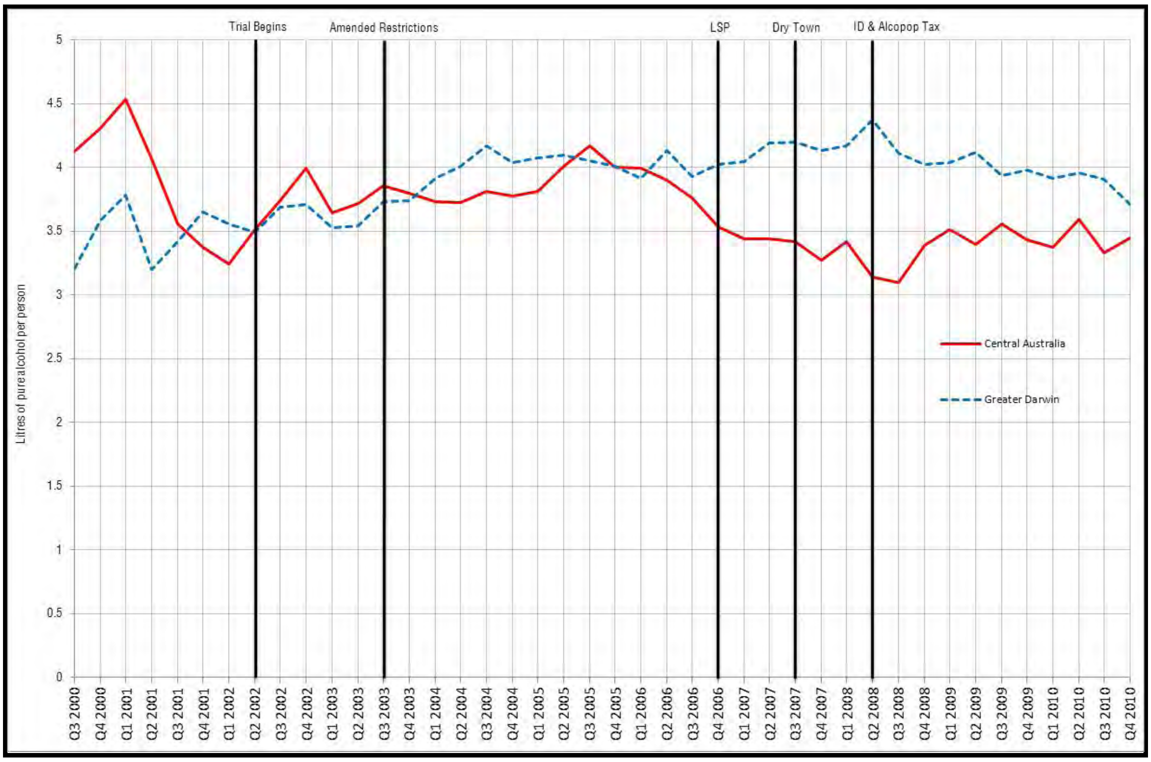


Figure 2: De-seasonalised estimates of per capita consumption (litres) of pure alcohol (by persons ≥15 years) by quarter, Central Australia and Greater Darwin, July 2000–December 2010

It was not possible to use time-series forecasting to examine the effects of the Trial as there were not enough data points available for analysis in the preceding period. This difficulty was accentuated by the fact that wholesale purchasing started decreasing in advance of the beginning of the trial itself (Figure 2).

Having established a reasonable baseline model over the entire period, the next step was to test models built on a restricted time period prior to introduction of the LSP and to make predictions – based on past known trends – about what would have occurred (the expected forecast) had the restrictions not been introduced. The forecast was then compared to what actually occurred (the observed trend) to examine whether the restrictions had an effect. Using the period from Q3 2000 to Q3 2006, a simple seasonal model was discovered that was slightly more accurate than the baseline model (Stationary R^2 = .773, MAPE 4.19%, MaxAPE 14.74%). There was little divergence apparent between the observed and predicted values after the beginning of the LSP (Figure 3) – suggesting that the introduction of the LSP had no measurable effect on estimated per capita consumption.

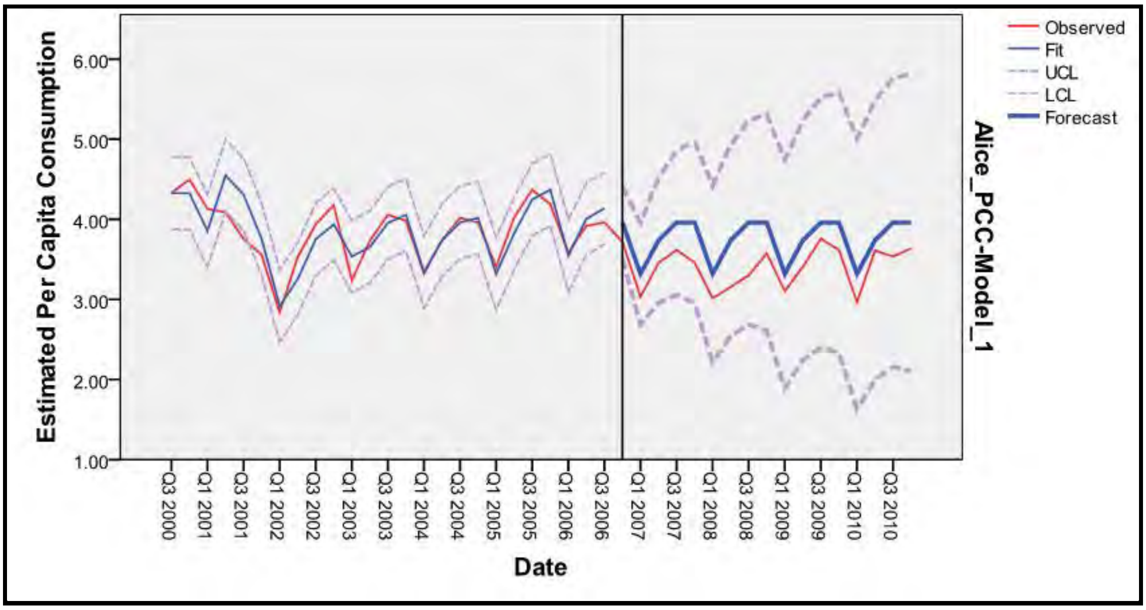


Figure 3: Observed estimated per capita alcohol consumption and forecast values based on the ARIMA model of best fit constructed from Q3 2000 – Q3 2006, Central Australia

Given that the model based on all quarters prior to its introduction showed the LSP had no impact on estimated per capita consumption, a model was built on data from the end of the Trial (Q3 2003) until the beginning of the LSP (Q4 2006) with a simple seasonal model (Stationary R^2 = .507, MAPE = 2.28%, MaxAPE = 4.15%) and little divergence (Figure 4). The results were similar to that described above.

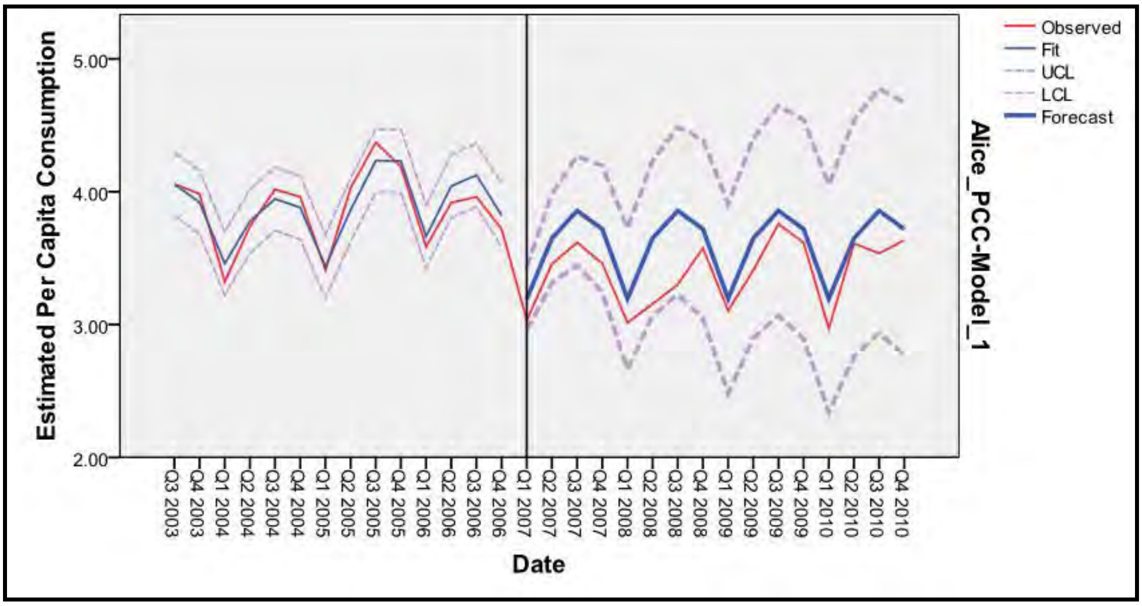


Figure 4: Observed estimated per capita consumption of pure alcohol and forecast values based on the ARIMA model of best fit constructed from Q3 2003 – Q4 2006, Central Australia

Despite the results based on models constructed around the official start date of the LSP, it can reasonably be argued that a model based on the dates of actual changes in wholesale sales would be more appropriate. To test this, data were selected to include quarters from Q1 2002 when wholesale sales fell to their lowest point (immediately prior to introduction of the Trial Restrictions), after which they increased steadily) through until Q1 of 2006 when wholesale sales dropped as retailers changed their purchasing in anticipation of the introduction of the LSP. When these dates are selected to construct a time-series model, the model selected by the expert modeller was a Winters' Additive model (Stationary R^2 = .614, MAPE = 2.76%, MaxAPE = 6.63%) which was a better fit than the two previous models (Figure 5).

As illustrated in Figure 5, the model forecasts an increase in estimated consumption in Central Australia from Q2 2006. However, the observed estimate decreased from this period. This difference is statistically significant ($p<.05$), as the observed values fall outside the 95% lower confidence limit (LCL in Figure 5) demonstrating that the LSP did have a significant impact in reducing consumption in Central Australia.

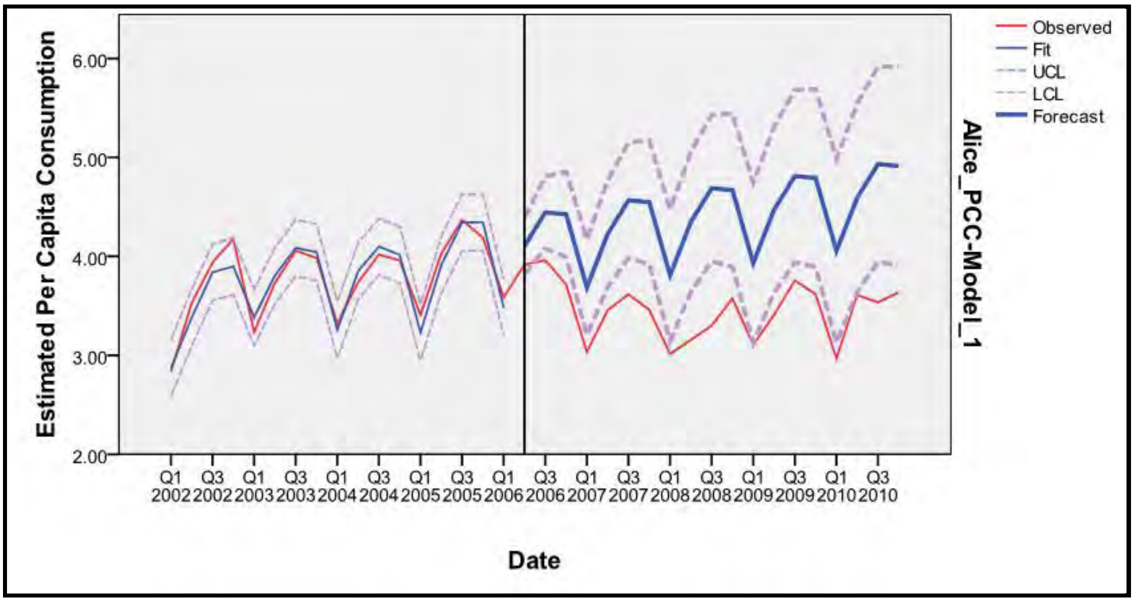


Figure 5: Observed and forecast values of estimated per capita consumption of pure alcohol, based on the ARIMA model of best fit constructed from Q1 2002 – Q1 2006, Central Australia

When the data selected to build the model ranged from the official end of the Trial period in Q3 2003 until the fall in consumption from Q1 2006 (Figure 6), a very accurate Winters' Additive model was found – (Stationary R^2 = .674) with very low average (MAPE = 1.26%) and maximum (MaxAPE = 2.62%) errors. Again the forecast was for an increase in consumption while the observed values consistently fell below the lower confidence bound suggesting a significant effect of the LSP in reducing consumption.

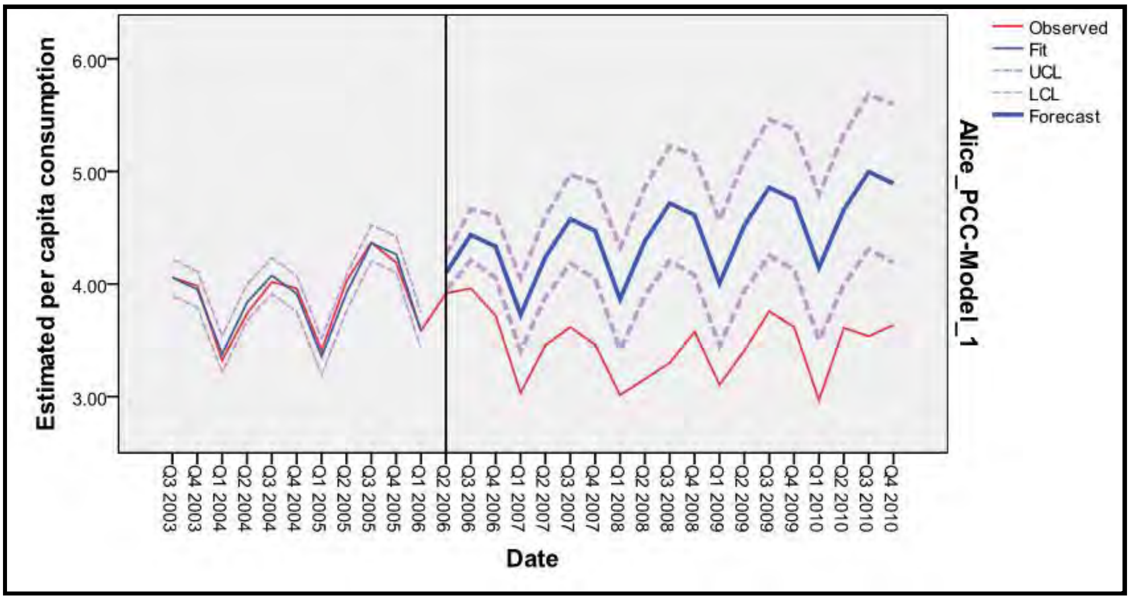


Figure 6: Observed and forecast values of estimated consumption of pure alcohol, based on the ARIMA model of best fit constructed from Q3 2003 – Q1 2006, Central Australia

Both models based on time periods prior to the actual introduction of the LSP have less optimal levels of fit (Stationary R^2 <0.5) and the upper and lower confidence bounds diverge too rapidly to be of use. This indicates that the models are not well specified – probably because the models were forced to incorporate part of the changing trends (i.e. reductions in consumption prior to the introduction of the LSP). Overall, these analyses suggest that the actual changes in consumption (as measured by wholesale sales) brought about by the LSP did in fact begin earlier than the official commencement of the restrictions.

Total per capita consumption in Darwin also dropped significantly in Q2 2008 when compared to that predicted from the pre-tax period – due to both reduction in the availability of cask wine and the introduction of the 'alcopops tax'. A Winters' multiplicative model was specified with reasonable fit and overall error levels (Stationary R^2 = .362, MAPE 2.97%, MaxAPE 9.83%).

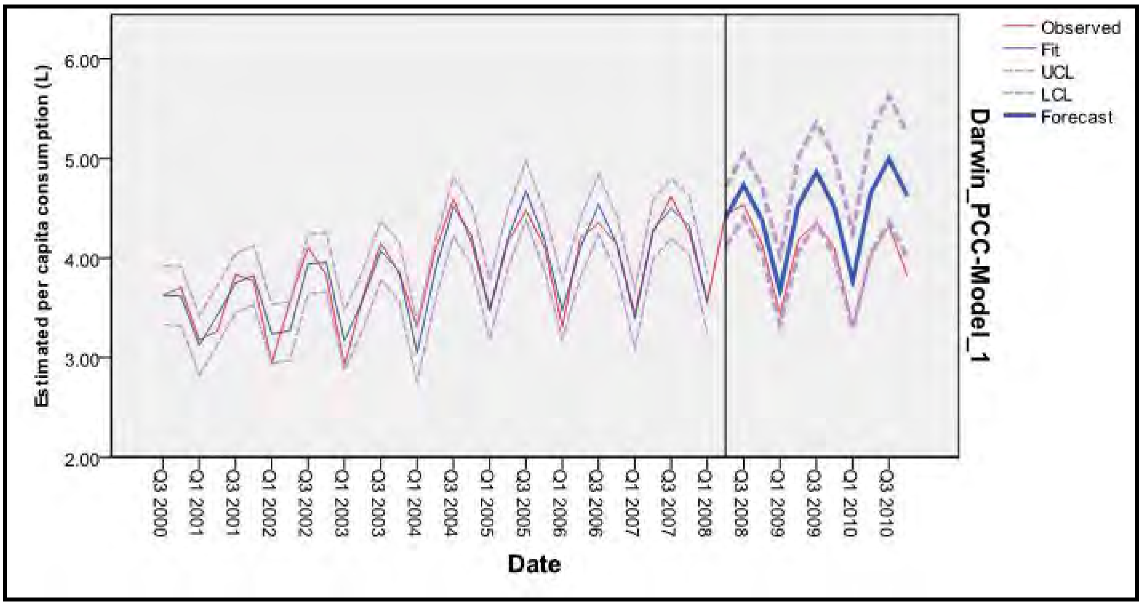


Figure 7: Observed and forecast values of estimated consumption of pure alcohol, based on the ARIMA model of best fit constructed from Q3 2003 – Q4 2010, Greater Darwin

Wholesale Sales by Beverage Type

Within the overall trends in wholesale sales of pure alcohol and estimated per capita consumption, discussed above, it is important to recognise that there were changes in the amount that various beverage types contributed to the totals. These have been summarised for Central Australia in Table 10 and Figure 8. When examining these figures it should be remembered that the data are not de-seasonalised and may conceal underlying trends.

Table 10: Quarterly estimated per capita consumption of pure alcohol (litres) by persons aged ≥15 years, by beverage type, Central Australia, July 2002–December 2010

Quarter	Beer Full	Beer Mid	Beer Low	Wine Cask	Wine Bottled	Wine Fortified	Cider	Spirits Mixed	Spirits Standard	Total
Q3 2000	1.51	0.16	0.18	1.27	0.48	0.07	0.04	0.08	0.54	4.33
Q4 2000	1.64	0.14	0.20	1.23	0.48	0.05	0.04	0.10	0.62	4.50
Q1 2001	1.51	0.10	0.15	1.23	0.40	0.07	0.04	0.09	0.53	4.13
Q2 2001	1.55	0.09	0.16	1.19	0.43	0.09	0.04	0.08	0.46	4.09
Q3 2001	1.45	0.12	0.15	0.82	0.45	0.08	0.04	0.12	0.54	3.76
Q4 2001	1.58	0.13	0.17	0.71	0.25	0.06	0.04	0.13	0.50	3.56
Q1 2002	1.28	0.12	0.14	0.58	0.18	0.07	0.03	0.11	0.34	2.84
Q2 2002	1.42	0.17	0.16	0.23	0.25	0.64	0.04	0.18	0.44	3.53
Q3 2002	1.51	0.14	0.15	0.20	0.32	0.76	0.03	0.19	0.64	3.94
Q4 2002	1.54	0.24	0.17	0.14	0.30	0.81	0.05	0.23	0.71	4.18
Q1 2003	1.19	0.19	0.13	0.12	0.21	0.74	0.03	0.14	0.48	3.24
Q2 2003	1.22	0.21	0.13	0.17	0.27	0.91	0.04	0.17	0.63	3.73
Q3 2003	1.33	0.24	0.13	0.27	0.34	0.85	0.04	0.20	0.65	4.06
Q4 2003	1.44	0.21	0.18	0.19	0.25	0.76	0.05	0.21	0.70	3.98
Q1 2004	1.12	0.22	0.12	0.20	0.22	0.63	0.04	0.20	0.56	3.32
Q2 2004	1.16	0.24	0.11	0.30	0.30	0.74	0.04	0.25	0.60	3.74
Q3 2004	1.24	0.24	0.12	0.33	0.36	0.71	0.04	0.28	0.71	4.02
Q4 2004	1.37	0.22	0.18	0.21	0.32	0.65	0.04	0.29	0.69	3.96
Q1 2005	1.12	0.22	0.14	0.32	0.23	0.69	0.04	0.24	0.41	3.41
Q2 2005	1.19	0.26	0.13	1.05	0.31	0.37	0.04	0.30	0.38	4.03
Q3 2005	1.20	0.26	0.13	1.37	0.40	0.10	0.04	0.37	0.50	4.37
Q4 2005	1.23	0.28	0.13	1.30	0.36	0.05	0.04	0.35	0.46	4.19
Q1 2006	0.99	0.25	0.11	1.31	0.26	0.04	0.04	0.26	0.33	3.59
Q2 2006	1.05	0.27	0.11	1.32	0.34	0.05	0.04	0.29	0.45	3.92
Q3 2006	1.12	0.28	0.11	1.26	0.37	0.04	0.04	0.30	0.45	3.96
Q4 2006	1.66	0.31	0.13	0.14	0.47	0.01	0.05	0.40	0.53	3.72
Q1 2007	1.49	0.26	0.10	0.11	0.41	0.02	0.04	0.25	0.36	3.03
Q2 2007	1.54	0.27	0.10	0.15	0.51	0.02	0.04	0.32	0.50	3.46
Q3 2007	1.60	0.25	0.17	0.15	0.54	0.02	0.04	0.38	0.48	3.62
Q4 2007	1.63	0.25	0.13	0.11	0.44	0.01	0.04	0.36	0.49	3.46
Q1 2008	1.37	0.25	0.10	0.16	0.41	0.01	0.04	0.29	0.38	3.01
Q2 2008	1.41	0.24	0.09	0.18	0.50	0.02	0.03	0.21	0.49	3.16
Q3 2008	1.50	0.20	0.11	0.14	0.57	0.01	0.04	0.19	0.54	3.30
Q4 2008	1.63	0.28	0.10	0.15	0.51	0.01	0.05	0.25	0.60	3.57
Q1 2009	1.40	0.27	0.08	0.16	0.39	0.01	0.05	0.16	0.58	3.10
Q2 2009	1.44	0.27	0.10	0.19	0.54	0.01	0.05	0.23	0.59	3.41
Q3 2009	1.61	0.23	0.15	0.20	0.61	0.01	0.06	0.26	0.63	3.76
Q4 2009	1.54	0.26	0.13	0.19	0.55	0.01	0.07	0.25	0.63	3.62
Q1 2010	1.31	0.23	0.11	0.18	0.42	0.01	0.06	0.18	0.48	2.97
Q2 2010	1.43	0.26	0.10	0.21	0.56	0.01	0.06	0.22	0.75	3.61
Q3 2010	1.42	0.23	0.10	0.20	0.63	0.01	0.06	0.25	0.65	3.54
Q4 2010	1.45	0.28	0.11	0.20	0.56	0.01	0.06	0.27	0.70	3.64

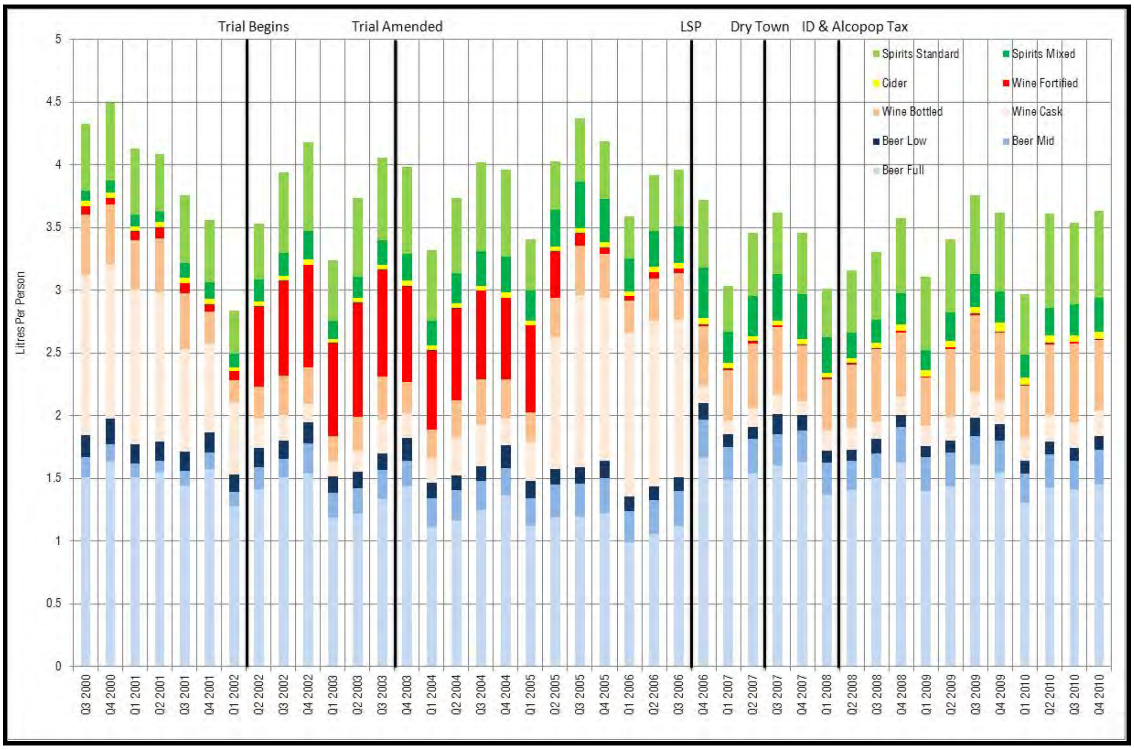


Figure 8: Quarterly estimated per capita consumption of pure alcohol by persons aged ≥15 years, by beverage type by quarter, Central Australia, July 2000 – December 2010

From Q2 2002 until the introduction of the LSP, combined sales of bottled, cask and fortified wine averaged 1.4 litres per person (although there were fluctuations within this period). After the introduction of the LSP in Q4 2006, this fell to about 0.7 litres. Throughout the study period, consumption of bottled wine increased steadily from 0.4 to 0.6 litres per person. Thus most of the change was due to reduction in consumption of cask and fortified wine.

From Q3 2000 to Q3 2001 per capita consumption of cask wine was about 1.2 litres. It then began to decline until Q2 2002 when the Trial Restrictions were introduced – including a ban on the sale of wine in containers of >2 litres – and it dropped to about 0.2 litres where it remained until Q2 2005 (seven quarters after the lifting of the ban) when it rose again to about 1.2 litres. Cask wine remained at about 1.2 litres until the introduction of the LSP in Q4 2006 when it dropped dramatically to about 0.2 litres, thereafter remaining at a similarly low level for the rest of the study period.

Prior to introduction of the LSP, consumption of fortified wine was inversely related to consumption of cask wine. Until the introduction of the Trial Restrictions in Q2 2002, per capita consumption of fortified wine was about 0.07 litres. When the Trial Restrictions were introduced, this rose to about 0.7 litres (following the introduction of fortified wine in two litre casks) where it stayed until Q2 2005 (when cask wine consumption again began to rise). It then dropped to 0.5 litres until Q4 2006 when the sale of fortified wine in containers of >1 litre was banned and consumption fell, and remained at 0.01 litres per person.

All types of beer comprised the largest percentage of estimated consumption of pure alcohol – about 48 per cent overall. From Q3 2000, consumption of all beer declined from about 1.8 litres per person aged ≥15 years to about 1.35 litres in Q1 2006. From the time of the introduction of the LSP in Q2 2006 it rose back to about 1.8 litres and stayed at that level until the end of the study period. Combined, consumption of low and mid-strength beer remained steady rising only slightly from about 0.35 to 0.37 litres over the whole of the study period, although mid-strength beer increased as low strength declined. Thus, most of the change in combined beer consumption was driven by changes in consumption of full-strength beer, which declined from about 1.5 litres per person at the start of the study period to just over 1.0 litre per person prior to the introduction of the LSP and then rose to, and levelled off at, about 1.5 litres per person.

With some fluctuation, combined sales of standard and mixed spirits, averaged about 20 per cent of per capita consumption over the study period. Prior to the introduction of the Trial Restrictions they were steady at about 0.6 litres. Following introduction of those restrictions they rose to about 0.8 litres where they remained until introduction of the 'alcopops tax' when they increased slightly to about 0.85 litres. At the same time, consumption of mixed spirits gradually increased from Q3 2000 to Q3 2005 when at 0.4 litres it almost matched standard spirits consumption of 0.5 litres. Thereafter consumption of both beverages ran in parallel until Q2 2008 when the 'alcopops tax' was introduced and consumption of standard spirits rose to about 0.6 litres and mixed spirits dropped to 0.2 litres. Up until that time consumption of cider, which had averaged about 0.4 litres per person, increased to 0.6 indicating that there was some substitution of cider for mixed spirits when the tax was introduced.

As indicated above, most of the change in consumption in Central Australia occurred in relation to full strength beer, cask wine and fortified wine and some substitution of them took place. The most obvious of the substitutions was that of fortified wine for cask wine. However, the substitution of one for the other was not complete. From Q3 2000 to Q2 2001 combined per capita consumption of cask and fortified wine averaged 1.3 litres. From the introduction of the Trial Restrictions in Q2 2002 up until Q2 2005 this dropped to an average of about 1.0 litre.

Prior to the introduction of the Trial Restrictions, estimated per capita consumption of full-strength beer averaged about 1.5 litres. After the introduction of the trial it began to fall reaching a low point of about 1.0 litre just prior to the introduction of the LSP when full-strength beer began to be substituted for cask table and fortified wines that were banned at that time. Even so, it only climbed back to the level of consumption prior to the introduction of the Trial, that is 1.5 litres per capita. Thus most of the reduction in total consumption in Central Australia was the result of the reduction in cask wine and fortified wine consumption.

In Greater Darwin, bottled and cask wine combined accounted for a little over 24 per cent of total consumption. From Q3 2000 it rose from about 0.8 litres per person, peaked at about 1.2 litres in Q3 2007 and then dropped back to a little under 0.95 litres by Q4 2010 – an overall increase of a little less than 0.2 litres. The rise and fall in total table wine sales was driven by the change in consumption of cask wine. At the commencement of the study period, estimated per capita consumption of cask wine in the Greater Darwin region was about 0.35 litres per person and increased to about 0.65 litres in Q2 2008. It dropped significantly to about 0.5 litres in Q3 2008 and continued to decline to about 0.4 litres as the end of the study period. This decline was the result of the restrictions on the availability of table wine in four and five litre casks. Bottled wine consumption was steady from Q3 2000 to Q2 2004 at a little under 0.4 litres per person, after which it began to increase, reaching a peak of about 0.6 litres by the end Q4 2010. However, this increase in bottled wine consumption did not offset the decrease in consumption of cask wine. Unlike Central Australia, consumption of fortified wine in Greater Darwin contributed little to overall consumption and remained relatively stable being about 0.05 litres until Q4 2007 but afterwards increasing marginally to about 0.06 litres.

As in Central Australia, in Greater Darwin, beer of all types was the most commonly consumed beverage (about 48 per cent). However, unlike Central Australia there was little fluctuation in the amount consumed. Over the study period, total consumption rose marginally from about 1.8 to 1.9 litres per person per quarter. Full-strength beer accounted for most of this – just over 1.4 litres. The balance was made up of low and mid strength beer combined and, as in Central Australia, over the study period their relative contribution was reversed with mid-strength beer rising to about 0.4 litres and low strength beer declining to a little over 0.1 litres per person.

Table 11: Quarterly estimated per capita consumption of pure alcohol (litres) by persons aged ≥15 years, by beverage type, Greater Darwin, July 2000–December 2010

Quarter	Beer Full	Beer Mid	Beer Low	Wine Cask	Wine Bottled	Wine Fortified	Cider	Spirits Mixed	Spirits Standard	Total
Q3 2000	1.47	0.19	0.34	0.31	0.45	0.05	0.07	0.15	0.59	3.63
Q4 2000	1.42	0.15	0.35	0.32	0.48	0.05	0.08	0.17	0.70	3.70
Q1 2001	1.26	0.08	0.27	0.35	0.39	0.04	0.07	0.20	0.52	3.18
Q2 2001	1.36	0.07	0.30	0.37	0.41	0.05	0.07	0.15	0.49	3.27
Q3 2001	1.54	0.10	0.30	0.39	0.51	0.05	0.08	0.25	0.62	3.84
Q4 2001	1.53	0.09	0.32	0.44	0.34	0.05	0.08	0.27	0.65	3.77
Q1 2002	1.21	0.08	0.23	0.41	0.25	0.04	0.06	0.22	0.45	2.95
Q2 2002	1.30	0.17	0.27	0.55	0.36	0.04	0.07	0.28	0.52	3.56
Q3 2002	1.57	0.13	0.28	0.58	0.43	0.05	0.07	0.34	0.66	4.11
Q4 2002	1.39	0.24	0.28	0.48	0.36	0.05	0.07	0.28	0.68	3.82
Q1 2003	0.97	0.19	0.20	0.53	0.25	0.04	0.05	0.19	0.50	2.92
Q2 2003	1.25	0.27	0.26	0.50	0.34	0.05	0.07	0.26	0.61	3.61
Q3 2003	1.42	0.31	0.25	0.57	0.45	0.06	0.07	0.30	0.72	4.15
Q4 2003	1.32	0.31	0.25	0.48	0.36	0.04	0.07	0.28	0.74	3.85
Q1 2004	1.04	0.25	0.18	0.54	0.31	0.04	0.05	0.27	0.61	3.31
Q2 2004	1.28	0.34	0.23	0.61	0.44	0.05	0.06	0.33	0.73	4.08
Q3 2004	1.41	0.36	0.22	0.65	0.53	0.05	0.06	0.38	0.91	4.59
Q4 2004	1.31	0.29	0.29	0.53	0.46	0.04	0.06	0.39	0.79	4.16
Q1 2005	1.07	0.28	0.21	0.56	0.34	0.04	0.06	0.31	0.60	3.46
Q2 2005	1.36	0.39	0.21	0.61	0.47	0.04	0.06	0.40	0.60	4.16
Q3 2005	1.46	0.41	0.21	0.65	0.54	0.05	0.07	0.42	0.67	4.48
Q4 2005	1.34	0.37	0.19	0.51	0.48	0.05	0.07	0.41	0.70	4.12
Q1 2006	1.03	0.32	0.15	0.52	0.36	0.04	0.05	0.32	0.52	3.31
Q2 2006	1.34	0.41	0.18	0.61	0.47	0.06	0.06	0.43	0.64	4.20
Q3 2006	1.39	0.41	0.18	0.64	0.56	0.05	0.07	0.40	0.65	4.35
Q4 2006	1.36	0.40	0.17	0.53	0.46	0.04	0.06	0.42	0.69	4.14
Q1 2007	1.05	0.33	0.13	0.63	0.39	0.04	0.05	0.30	0.51	3.44
Q2 2007	1.30	0.43	0.17	0.67	0.52	0.05	0.06	0.43	0.64	4.26
Q3 2007	1.38	0.41	0.29	0.67	0.59	0.05	0.06	0.47	0.70	4.62
Q4 2007	1.35	0.37	0.18	0.56	0.49	0.04	0.06	0.48	0.72	4.25
Q1 2008	1.11	0.33	0.13	0.57	0.41	0.06	0.05	0.38	0.54	3.57
Q2 2008	1.41	0.47	0.16	0.65	0.56	0.06	0.06	0.36	0.71	4.44
Q3 2008	1.54	0.39	0.23	0.48	0.64	0.06	0.08	0.32	0.80	4.54
Q4 2008	1.40	0.39	0.19	0.39	0.52	0.05	0.08	0.30	0.82	4.14
Q1 2009	1.15	0.46	0.11	0.34	0.41	0.06	0.07	0.24	0.58	3.43
Q2 2009	1.39	0.46	0.16	0.39	0.57	0.07	0.08	0.34	0.72	4.18
Q3 2009	1.47	0.36	0.26	0.42	0.63	0.06	0.09	0.33	0.74	4.36
Q4 2009	1.36	0.38	0.18	0.37	0.57	0.06	0.09	0.31	0.78	4.10
Q1 2010	1.09	0.35	0.14	0.37	0.42	0.06	0.08	0.25	0.56	3.31
Q2 2010	1.38	0.45	0.16	0.39	0.54	0.04	0.09	0.32	0.65	4.03
Q3 2010	1.46	0.43	0.18	0.40	0.63	0.05	0.10	0.33	0.74	4.32
Q4 2010	1.24	0.39	0.14	0.27	0.55	0.05	0.09	0.30	0.79	3.83

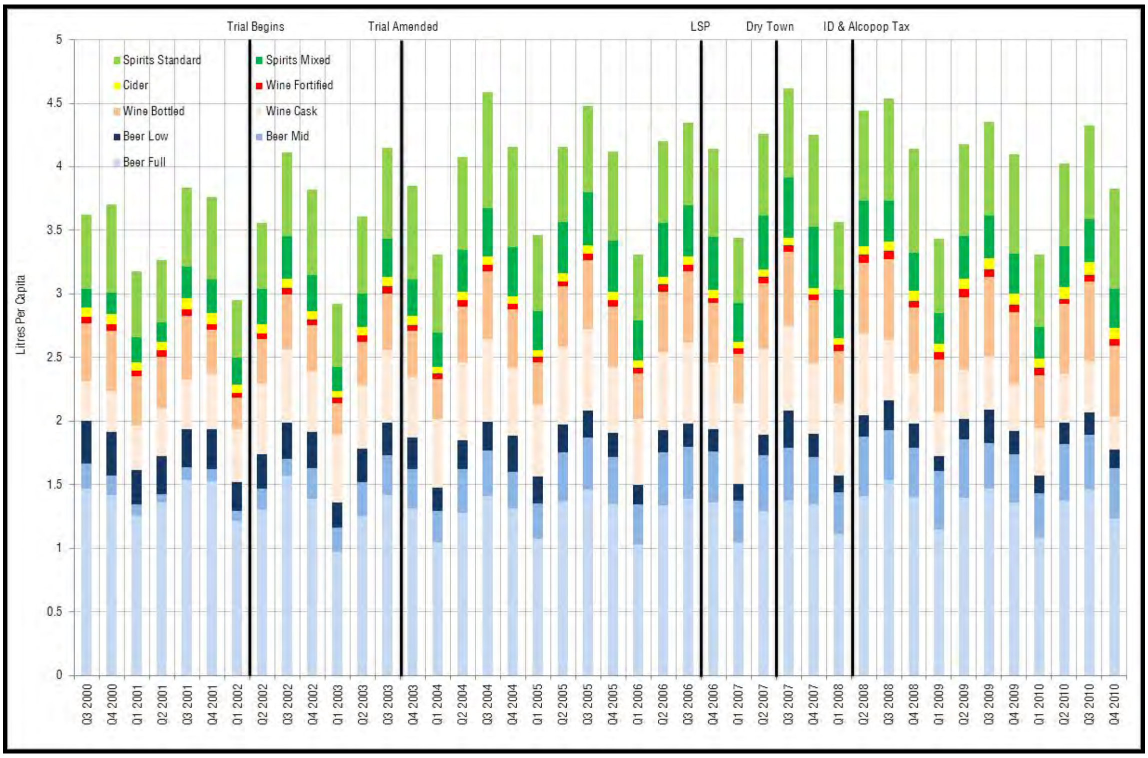


Figure 9: Quarterly estimated per capita consumption of pure alcohol (litres) by persons aged ≥15 years by beverage type by quarter, Greater Darwin, July 2000 – December 2010

In Greater Darwin, consumption of standard and mixed spirits combined increased steadily over the study period from about 0.8 to about 1.1 litres per person and they accounted for a little over 24 per cent of all alcoholic beverages consumed. Over the same period, consumption of standard spirits rose from about 0.6 to about 0.75 litres. From Q3 2000 to Q1 2008 consumption of mixed spirits doubled from about 0.2 to 0.4 litres. However, after the introduction of the 'alcopops tax' in Q2 2008 it dropped to about 0.3 litres, but was nevertheless 50 per cent greater than at the start of the study period. Cider accounted for less than two per cent of consumption over the whole study period. However it increased from about 0.06 litres per person before Q2 2008 to about 0.08 litres after that date, when there was a small shift to it from mixed spirit drinks.

Overall then, in the Greater Darwin region, estimated per capita consumption increased from about 3.4 litres per quarter to about 4.2 litres in Q3 2008 and thereafter dropped and levelled off at about 4.0 litres. That is an overall increase of about 0.6 litres. About half of this (0.3 litres) was the result of increased consumption of both standard and mixed spirits. Both bottled and cask wine contributed about 0.2 litres and beer about 0.1 litre to the overall increase.

Summary of Consumption

While it is difficult to fully assess the first set of Trial Restrictions using statistical methods, they and the LSP appear to have reduced the per capita consumption of alcohol in Alice Springs. The common factor in both of these sets of restrictions was changes in the type of beverage consumed with a partial substitution of fortified cask wine for cask table wine during the Trial Restrictions and partial substitution of full strength beer for cask and fortified wine after the introduction of the LSP. It is important to consider the time course of restrictions which alter drinking patterns in this way, as wholesale sales are being used as a *proxy* for consumption. These sales began to drop before the implementation of both sets of restrictions as retail outlets prepared for drops in sales of the restricted beverages whereas the increase in the alcohol types being substituted occurred at the time the restrictions were implemented. Apart from some changes in the pattern of consumption after the 'alcopops tax' the other restrictions do not appear to have had any significant effects on consumption in Central Australia.

It could be argued that the drop in consumption of pure alcohol was due to change in the alcohol content of the beverages being consumed. However, this is not the case in the first set of Trial Restrictions where the major switch was from cask wine (12.2 – 12.8 per cent) to the higher alcohol content fortified wines (17.9 per cent). This leaves price as the most likely intervening mechanism in the reductions in consumption.

5. Alcoholic Beverage Prices

International research has demonstrated that price is a major determinant of levels of alcohol consumption,[8] and an aim of this study was to examine the relationship between price and consumption in Central Australia. In this chapter, we examine the relationships: between the wholesale and retail prices of alcoholic beverages; between price and consumption; and the impact of restrictions on consumption and price.

Retail and Wholesale Beverage Prices

As indicated in Chapter 2, in the absence of comprehensive data on retail prices of alcoholic beverages in Alice Springs, we attempted to estimate these prices by sampling advertised prices in *The Centralian Advocate*. The lowest, average and highest prices per standard drink observed in retail advertisements (and the quarter/year advertised) are shown in Table 12. Cask wine had the lowest advertised minimum retail price at $0.22 per standard drink and also the lowest advertised average price at $0.53 per standard drink. The estimated average minimum price for cask wine was unfortunately based on only eight advertisements as it rarely appeared among the advertisements we sampled. Based on the sample of advertisements, fortified wine was the next lowest priced beverage, but again this was rarely advertised and this was based on only two observations. Mixed spirits showed the largest gap between lowest advertised price and the average price. Furthermore, the average advertised price per standard drink for full strength beer was lower than for low strength beer.

It is important to note that some beverages – especially fortified wine and four and five litre casks of wine – were advertised less frequently than others and that prices for some quarters were imputed from adjacent values. Thus, to some extent the estimates are incomplete and their closeness to actual retail prices is not known.

On the basis of the advertised prices – as described in Chapter 2 – we then estimated the average and minimum retail prices per litre of pure alcohol. These estimates are plotted in Figure 10. Over the entire study period, the average advertised price ranged between about $80 and $120 per litre and the minimum price between about $60 and $100. For comparison, the average wholesale price per litre (derived from wholesale sales data, see below) is included in the plot. At some points in the data series – especially after 2005 – the minimum advertised retail price per litre appears to be less than the average wholesale price per litre. This is because wholesale price per litre is averaged over all brands and products and the retail price of a specific item might be lower than the average.

Table 12: Minimum, average and highest advertised retail prices per standard drink (2010 dollars), Alice Springs, July 2000 – December 2010

Beverage	Lowest Price	Date	Average Price	Highest Price	Date
Beer Full $\geq$ 4%	0.85	Q4 2004	1.33	2.88	Q1 2003
Beer Mid 3.01% – 3.99%	1.05	Q2 2007	1.28	1.84	Q4 2009
Beer Low $\leq$ 3%	1.27	Q1 2007	1.54	1.81	Q3 2000
Cask wine	0.22	Q3 2007	0.53	0.89	Q4 2001
Bottled wine	0.71	Q3 2000	1.50	12.94	Q2 2004
Fortified	0.84	Q2 2001	0.84	0.84	Q2 2001
Cider	1.11	Q4 2002	1.38	2.90	Q4 2009
Mixed spirits	0.68	Q2 2010	2.07	3.73	Q2 2001
Standard spirits	1.15	Q1 2007	1.52	4.03	Q2 2002

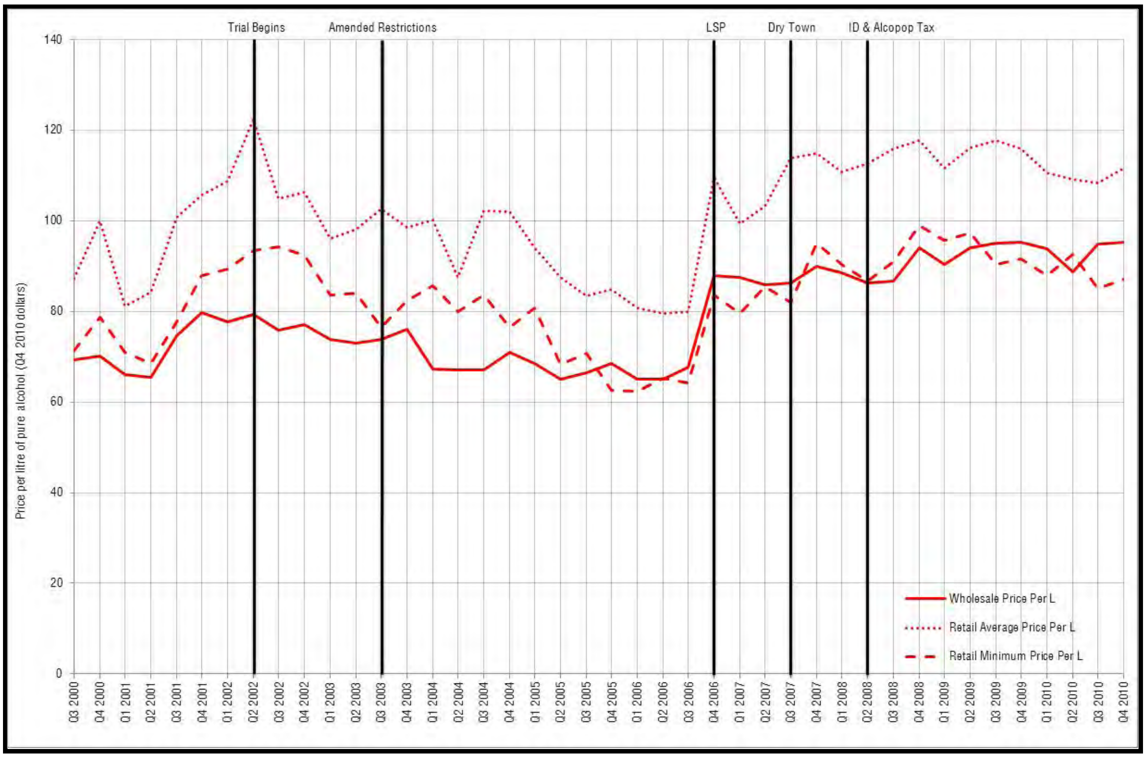


Figure 10: Advertised average and minimum retail prices and average wholesale price per litre of pure alcohol by quarter, Central Australia, July 2000 – December 2010

As noted, the procedure used for estimating the average retail price of alcoholic beverages was resource intensive and it was not possible to obtain a complete data set for all beverages in all quarters. We therefore investigated the relationship between our estimate of the retail price and the known average (mean) wholesale price per litre of pure alcohol with the intention of determining whether the former provides a suitable proxy measure of the latter.

In Figure 11, average wholesale prices (in Q4 2010 dollars) per litre of pure alcohol – calculated by the method described in Chapter 2 – are plotted for both Central Australia and Greater Darwin. Although, generally, over the whole of the study period there was an increase in the CPI adjusted average wholesale price of alcohol per litre in Central Australia, there were some significant fluctuations. From the beginning of the study period, the average wholesale price per litre rose to about $80 per litre in Q4 2001. During the period of the Trial Restrictions, the average price fell and continued to decline until the introduction of the LSP in Q4 2006 when it rose sharply to $87.94 per litre. At that point it levelled off but rose again to over $90 following the introduction of the 'alcopops' tax (Figure 11). In contrast, in Greater Darwin, there was a slight decline in price from $88.71 in Q3 2000 to $73.82 in Q1 2004. At that point it levelled off but began rising in Q2 2008 – following reduction in the availability of cask wine and the introduction of the 'alcopops tax' – and rose to over $90 in Q4 2000 and thereafter.

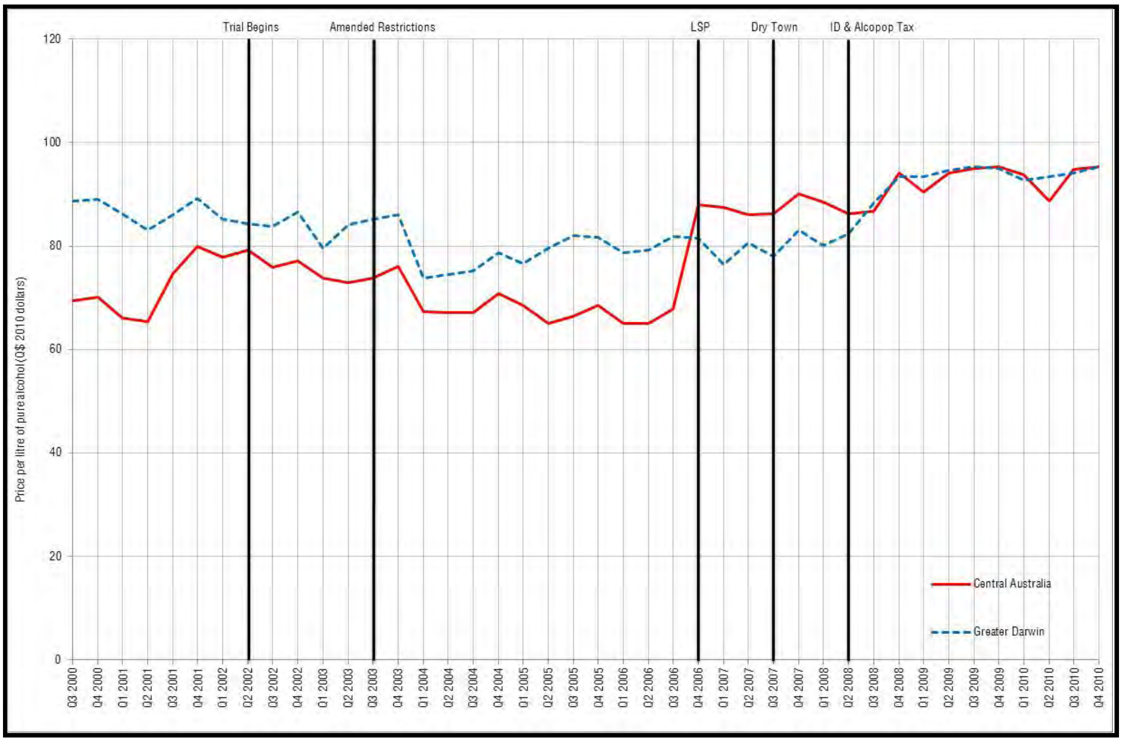


Figure 11: Average wholesale price per litre of alcohol (in Q4 2010 dollars) by quarter, Central Australia and Greater Darwin, July 2000 – December 2010

To test the relationship between the average advertised retail price and the average wholesale price per litre of pure alcohol in Central Australia, a cross-correlation was performed. A statistically significant ($p<0.05$) cross-correlation (.636) was found at lag 0 which implies that when the wholesale price increased, the retail price increased in the same quarter and vice versa. Cross-correlations at other lags were non-significant.

A significant (p.<05) cross-correlation (.507) was also found between average wholesale price and the minimum retail price. These significant correlations between retail and wholesale prices indicate that it is reasonable to use average wholesale price as a proxy for retail price in the analysis of the relationship between price and the volume of wholesale sales and therefore in estimates of per capita consumption. Wholesale price data were preferred as the collection methods were more robust and the data were available territory-wide (unlike the sampled retail data), thereby enabling us to make direct comparisons with Greater Darwin.

Wholesale Price and Alcohol Consumption

The relationship between average wholesale price per litre of pure alcohol (in Q4 2010 dollars) and estimated per capita consumption among persons aged ≥15 years in Central Australia is illustrated in Figure 12. As indicated previously, the series was de-seasonalised as a strong seasonal pattern was apparent. A cross-correlation was then performed in SPSS on the de-seasonalised data (using a differencing of 1, as the series appeared to be non-stationary) and a significant (p<0.05) negative correlation (-.395) was found at lag 0. That is, consumption decreased as price increased and vice-versa. Given that the correlation at lag 0 (within the same quarter) was statistically significant, this result is unlikely to be the result of chance and represents a real-world negative association between consumption and price.

Figure 12: Average wholesale price (Q4 2010 dollars) per litre of pure alcohol and estimated per capita consumption of alcohol (persons aged ≥15 years) by quarter, Central Australia, July 2000 – December 2010

The relationship between price and estimated per capita consumption was also tested using time-series analysis, with average wholesale price per litre entered as the independent variable and estimated per capita consumption entered as the dependent variable. The expert modeller chose ARIMA (0,0,1)(0,1,0) as the model of best fit with Stationary R^2 = .560 and a low average error (MAPE = 5.57%) where average wholesale price per litre was a significant predictor of estimated per capita consumption in this model after being seasonally differenced once (estimate = -.020, p<.01). Thus, after controlling for underlying stochastic processes, ARIMA analysis confirmed that a significant association exists between per capita alcohol consumption and average wholesale price per litre over time in Central Australia.

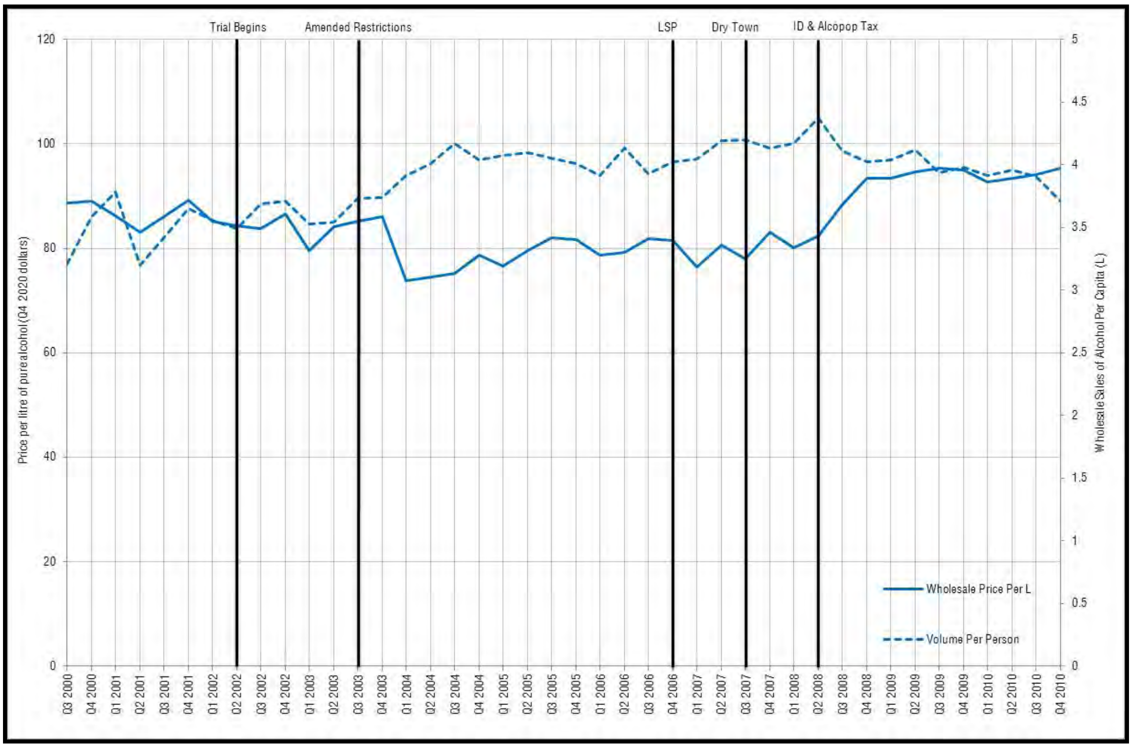


Figure 13: Average wholesale price (Q4 2010 dollars) per litre of pure alcohol and estimated per capita consumption of alcohol (persons aged ≥15 years) by quarter, Greater Darwin, July 2000 – December 2010

The relationship between average wholesale price and estimated per capita consumption in the Greater Darwin region was also examined. Here a slightly different pattern emerged. As in Central Australia, cross-correlations with a differencing of 1 and a seasonal differencing of 1 showed a negative correlation within the same quarter (lag 0 = -.418) suggesting that within the same quarter, a decrease in the price was correlated with an increase in consumption. However, a strong positive correlation was also found at a 12 month lag, (lag 4 [quarters] = .692), suggesting that in the longer term, an increase in the amount consumed per person was followed by an increase in wholesale price. As shown in Figure 5, both of these results were significant as they fall outside the 95% confidence limits and are unlikely to be due to chance (Figure 14). While the 0 lag result is consistent with the relationship observed in Central Australia and with the broader literature, the anomalous lagged correlation has no obvious explanation and requires future investigation with particular attention to industry pricing practices.

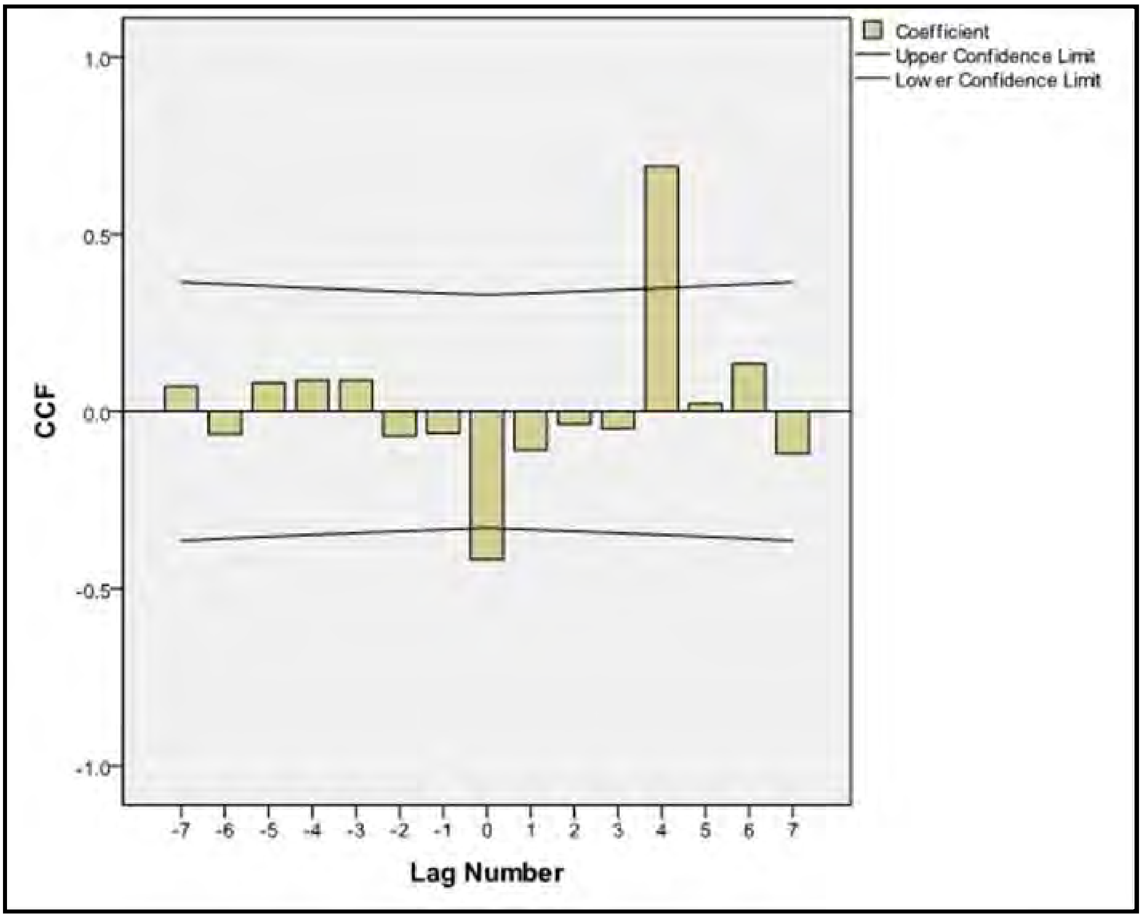


Figure 14: Cross-correlations at different lags between wholesale price per litre of pure alcohol and estimated per capita consumption, Greater Darwin

As with the Central Australian data, the Greater Darwin data were also subjected to time-series analysis to test the relationship between price and consumption. The time-series expert modeller selected an ARIMA(0,1,0)(0,1,0) model. Although the Stationary R^2 (.170) was much smaller than for Central Australia the average error was also smaller (MAPE = 2.96%). Average wholesale price per litre was a significant predictor (estimate = -.019, $p<.01$) of consumption, after being differenced once and seasonally differenced once. Again, this confirms a negative correlation between consumption and price.

Taken together, these results demonstrate that there was a robust significant negative relationship between price and consumption in both Central Australia and Greater Darwin over the entire time period. This is consistent with results found in previous research.

Restrictions and Consumption

As described above there were major changes over time in price and consumption in both regions. In Central Australia, price increased sharply prior to introduction of the Trial Restrictions and again as the LSP was introduced. In Greater Darwin, price increased after a reduction in the availability of cask wine and the introduction of the 'alcopops tax'. Unsurprisingly, given the correlations between price and consumption shown above, observation indicates that consumption in Central Australia fell sharply before the introduction of the Trial Restrictions then slowly increased prior to another large drop before the introduction of the LSP. In Greater Darwin, total consumption dropped after the reduction in the availability of cask wine and introduction of the 'alcopops tax'. While there were gradual increases and decreases over time in some periods, the rapid changes in each region reflected the timing of restrictions. These relationships in time between the direct effects of restrictions on price and consumption were tested, bearing in mind that – due to wide range of restrictions being introduced at particular points in time and in quick succession – in many instances it is difficult to attribute changes to any one particular restriction.

Dummy variables (i.e. event variables) were created to represent the time periods during which each restriction was applied. Based on their start and end points, these event variables grouped restrictions together if they were implemented over the same time period.

As a first step, a baseline time-series model was created for consumption in Central Australia over the whole period and the best fit was provided by a Simple Seasonal model (Stationary R^2 = .672, MAPE = 4.24%, MaxAPE = 14.41%). Event variables representing each of the restrictions were entered into the model individually as independent variables, but none were found that led to an improved model of best fit. However, this model was of the exponential smoothing type which does not allow multiple variables to be included.

As there was a strong seasonal component to the consumption series, the expert modeller procedure was applied to de-seasonalised consumption data for Central Australia. The initial model was a simple model with very poor fit (Stationary R^2 =-.007), although the average error (MAPE = 4.25%) and maximum error (MaxAPE = 14.56%) were reasonable. Nevertheless, when tested independently, two sets of restrictions introduced at different times were found to have a significant effect on the de-seasonalised consumption data and they each considerably improved the model fit.

First, the LSP – including changes to takeaway times, limiting container sizes for cask and fortified wine, and restricting trading hours – was found to be significant at lag 0 (estimate = -.385, $p<.01$) using an ARIMA (1,0,0)(0,0,0) model which had a good fit (Stationary R^2 = .685) and reasonable average (MAPE = 3.89%) and maximum (MaxAPE = 12.21%) errors. Second, the combined effect of the 'one per person per day' (where a person was limited to the purchase of only one cask or bottle of fortified wine per day), the 'ID' (photographic identification required to purchase alcohol) and the 'alcopops tax' restrictions (which all came into effect at the same time and therefore independent effects cannot be determined here) was found to be significant at lag 0 (Estimate = -.331, $p=0.05$) also using an ARIMA(1,0,0)(0,0,0) model with good fit

(Stationary R^2 = .668) and average (MAPE = 4.1%) and maximum (MaxAPE = 12.53%) errors. Furthermore, when the restriction periods for the LSP and the ID/'alcopops tax'/one per day were entered together, their independent effects were not found to be statistically significant. It is important to note, however, that there were only six quarters between their implementation. As the analysis produces estimates of the effect of each intervention when controlled for the 'effect' of the other, any short- to medium-term temporal impact of the interventions would be cancelled out by the presence of the others (this would be particularly true for the LSP). Thus, the individual impacts of the interventions are difficult to discern.

Together, these findings suggest that at least one of the particular restrictions making up the 'LSP', and at least one of either the 'one per person per day' restriction (initially introduced as part of the LSP), the introduction of ID cards and/or the 'alcopops tax', had significant effects on reducing consumption. Given the trends in consumption by beverage type discussed in Chapter 4, it appears that the principal change effected by the LSP was a switch from cask wine to more expensive and lower alcohol content full strength beer. This switch was unlikely to have been caused by the other restrictions implemented at the same time which were focused on limiting hours of sale at licensed premises.

Similarly, initial partial enforcement of the 'one per person per day' restriction effectively limited the amount of low cost alcohol that could be purchased, and the 'alcopops tax' increased the price of mixed spirits. The restriction that did not have price as a likely causal mechanism was the introduction of the requirement to produce ID to purchase takeaway beverages. However, given the evidence of the impact of the other price-related restrictions over the study period, it is likely that the former two restrictions had a greater impact than the latter.

Restrictions and Price

Given that these findings strongly suggest that restrictions based on changes in price had a significant effect on consumption, the impact of restrictions directly on price was explored. When the event variables representing the restrictions were entered individually into the expert modeller, the only restriction found to be significant in improving the model for the wholesale price per litre in Central Australia was the introduction of the LSP at lag 0 (estimate = 14.92, $p<.001$) after being differenced once and seasonally differenced once, where an ARIMA(0,1,0)(1,1,0) model was chosen with good fit (Stationary R^2 = .605) and average (MAPE = 3.37%) and maximum errors (MaxAPE = 16.67%).

The data in Figure 12 above clearly show there was an increase in average wholesale price per litre of pure alcohol in the period immediately prior to introduction of the Trial Restrictions. However, this was not found to significantly improve the basic model. This is probably due to the small number of time periods available for observation before the increase. The absence of additional pre-trial data meant that we were unable to conduct a more reliable test of impact of the Trial Restrictions.

In Greater Darwin there was a decreasing trend in the average wholesale price per litre from Q3 2000 to Q2 2008. However, in Q3 2008 following restrictions on availability of cask wine and introduction of the 'alcopops tax', there was an increase in the average wholesale price. The significance of this increase was confirmed by predictive time-series analyses. A model was constructed from the start of the time series in Q3 2000 to Q2 2008, just before the tax was introduced. Subsequent to reduction in the availability of cask wine and introduction of the 'alcopops tax', the rise in price was higher than that predicted on the basis of the preceding time series via a simple seasonal model of good fit (Stationary R^2 = .529), low average error (MAPE 2.38%), and reasonable maximum error (MaxAPE 10.26%). This indicates that, the 'alcopops tax' and the reduction in availability of cask wine had a significant effect on both average wholesale price and per capita alcohol consumption in Darwin.

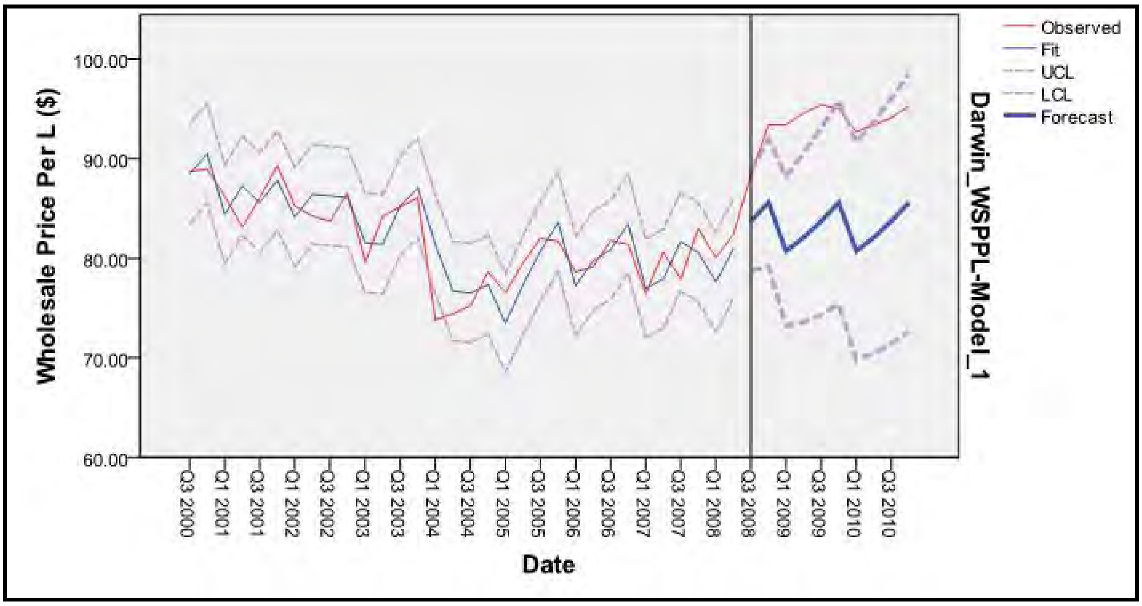


Figure 15: Observed and estimated average wholesale price per litre of pure alcohol based on ARIMA model of best fit, constructed from Q2 2000 to Q2 2008, Greater Darwin

Summary

There was a strong correlation between the average advertised retail price per litre of pure alcohol and the average wholesale price. Given this and the relative difficulties of collecting the former and the greater accuracy of the latter, average wholesale price appears to be a reasonable proxy measure of average retail price. Overall, as demonstrated by use of multiple statistical methods and consistent with research from elsewhere,[8] there were strong negative correlations between average wholesale price per litre of pure alcohol and per capita consumption in both Central Australia and Greater Darwin – with consumption declining at the same time as increases in price.

Using time-series modelling, two sets of restrictions showed significant effects in reducing per capita consumption in Central Australia; the 'LSP' and the raft of controls that became effective in Q2 2008; and the combined 'one per person per day', 'ID cards' and the 'alcopops tax'. Arguably, most of these restrictions altered consumption through a price-based mechanism. Interestingly, when wholesale price per litre was modelled via time-series the only restriction that showed a significant improvement in the model was the LSP. It is nevertheless noteworthy that reduction of the availability of cask wine and introduction of the 'alcopops tax' led to a significant increase in average wholesale price and decreased per capita consumption in Greater Darwin. This suggests that the 'alcopops tax', rather than introduction of the 'ID card' restriction was more likely to have been responsible for the concurrent increase in price and decrease in consumption observed for Central Australia.

These findings indicate that the restrictions that have had the greatest impact in reducing per capita consumption of pure alcohol in Central Australia are those that effected a change in the price of alcohol. That is, those restrictions that either reduced the availability of high alcohol content low-priced cask and fortified wine and led to their substitution with lower alcohol content more expensive full-strength beer, or increased the price of cheaper mixed spirit-based drinks leading to similar substitution.

6. Health Indicators

There is an extensive literature on the health impacts of high levels of alcohol use. A range of health indicators have been used to measure the impact of alcohol use on populations and to evaluate the effects of alcohol control measures and interventions.[8,67,68] The World Health Organization's *International Guide for Monitoring Alcohol Consumption and Related Harm* recommends using mortality and hospital separation data as key indicators of alcohol-related harm.[18] In order to quantify deaths and hospitalisations attributable to alcohol by various individual conditions, an epidemiological approach known as the 'ætiologic fraction method' has been widely developed over several decades and applied across many countries.

Death records are usually an excellent indicator of harms due to alcohol in a population as the underlying cause is usually reliably and consistently recorded over time. However, in Central Australia, due to the relatively small population, quarterly and even annual numbers of deaths due to alcohol are too infrequent (in statistical terms) and too variable from one interval to the next to provide a reasonable indicator series. Therefore, alcohol-attributable deaths have not been utilised in the study.

While hospital separation data are a commonly used indicator of alcohol-related harm, it has long been recognised that a large proportion of presentations at hospital emergency departments (EDs) are also alcohol-related. In addition, ED attendances occur frequently and can be a particularly useful indicator for small populations where deaths and hospitalisations are relatively infrequent events. However, use of these data is less straight forward than hospital separations. A recent report which estimated alcohol-attributable fractions for all injuries presenting to EDs has highlighted the fact that currently, in all states and territories of Australia, the recording of external causes of injuries (e.g. assault, road crash, fall) is not mandatory. For the vast majority of ED injuries therefore, only a primary diagnosis is available (e.g. fracture of femur) and it is not possible to distinguish among the various external causes of injury or to apply individual alcohol-attributable ætiologic fractions to specific types of injuries.[34] Although their application and interpretation may require caution, Northern Territory ED records have been employed as an indicator of alcohol-related harm in this report.

Hospital Separations

Hospital separations data provide a reliable indicator of alcohol-related harms experienced in a population. In the Northern Territory, using the *International Statistical Classification of Diseases and Related Health Problems* Revision 10 (ICD-10),[27] each separation is professionally coded by trained staff after a patient has been discharged. Data from both the Alice Springs and the Royal Darwin Hospitals were accessed. These data were cleaned to make them more appropriate for use in this study. The most important steps taken were to: remove any transfers (both within and between hospitals); remove any re-admissions within a day; remove any non-patient visitor admissions; and to remove regular recurring admissions (e.g. dialysis).

Between July 2000 and December 2010, the rate of hospital separations per 1000 persons at the Alice Springs Hospital increased significantly. Comparatively, the rise in admissions to Royal Darwin Hospital from 2000 to 2010 was small (Figure 16). Although a full investigation of the underlying causes of this apparent regional disparity was beyond the scope of this study, we explored the possibility that funding changes or available bed numbers may have been partly responsible. Enquiries of local health authorities indicated that this was unlikely to be the case. It was suggested, however, that a large increase in funding for primary health care in the Central Australian district relative to the Darwin area may have had some impact and increased the number of people referred for tertiary medical care. In any case, the direct implication for this study was that Darwin could not be employed as suitable control area for Alice Springs in statistical analyses.

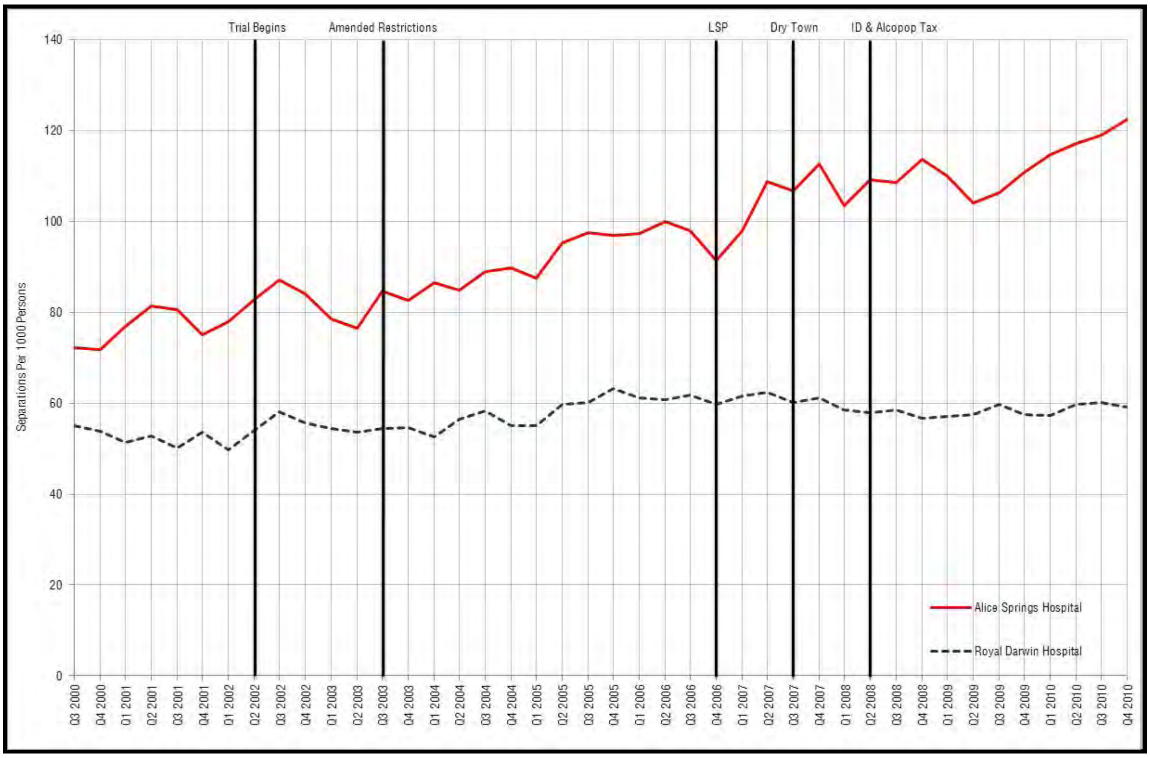


Figure 16: Hospital separation rates per 1000 persons by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 to December 2010

The pattern for hospitalisation separation rates for alcohol-attributable conditions was similar to that for total separations (Figure 17). In the Alice Springs Hospital, across the entire study period, the rate of hospitalisations per thousand persons for alcohol-attributable conditions more than doubled (from four to over ten); whereas in the Royal Darwin Hospital there was only a slight increase. Increasing rates of hospital separations for alcohol-attributable conditions over time is an observation common to most Australian states and territories. This is partly due to on-going technological and medical improvements in screening for, and treatment of, disease but it is also associated with changes in per capita alcohol consumption.[69,70] Typically, as per capita alcohol consumption rises, alcohol-attributable illness and disease rates also increase.[18] However, that the hospital separation rate for alcohol-attributable conditions in Alice Springs should so markedly exceed the rate of increase in Darwin was, nonetheless, unexpected.

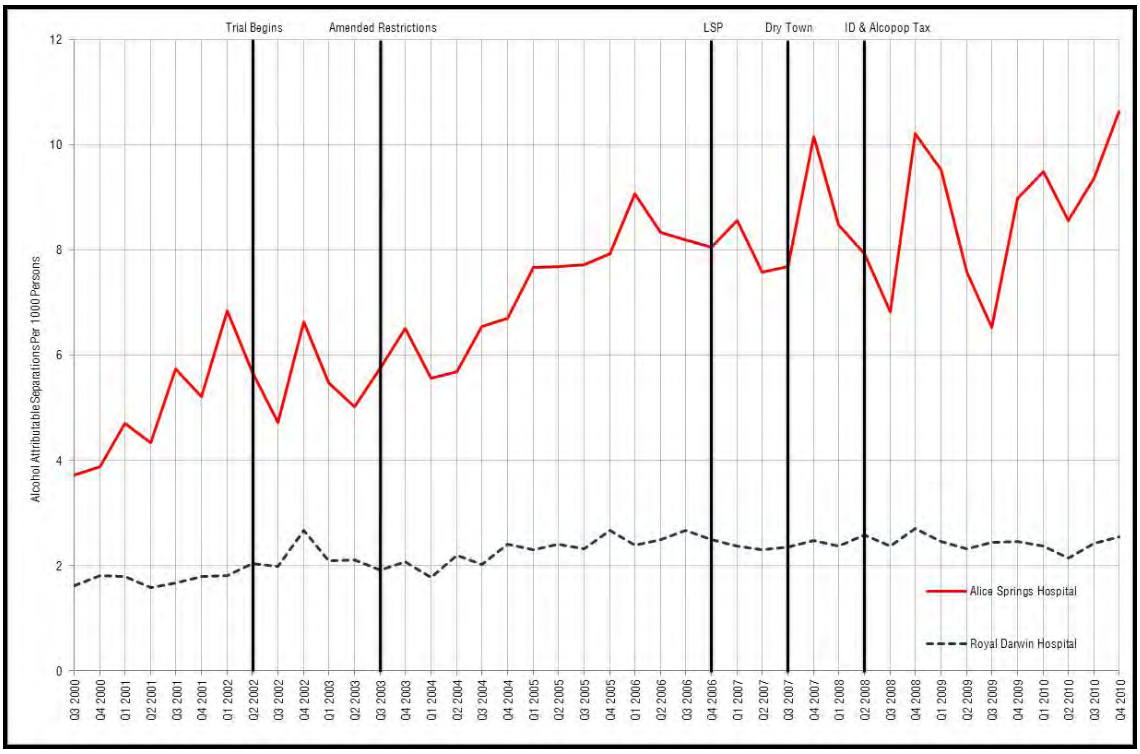


Figure 17: Hospital separation rates per 1000 persons for alcohol-attributable conditions by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

Consumption, Price, Restrictions, and Hospital Separations

Analyses were conducted to explore whether per capita consumption of alcohol and average wholesale price per litre of alcohol were associated with hospital separation rates for alcohol-attributable conditions in Alice Springs. These relationships were explored by examining cross-correlations using de-seasonalised data with a differencing of 1 (see Chapter 2 for more detail). The conditions that fell into each category used in the following analyses are outlined in Table 13.

Table 13: Acute and chronic conditions by level of alcohol involvement in ætiology

Level of alcohol involvement	Acute conditions	Chronic conditions
High (alcohol-attributable ætiologic fraction >0.8)	Alcoholic Psychosis Alcohol Abuse Alcoholic Gastritis Alcoholic Pancreatitis All Alcohol Poisoning	Alcohol Dependence Alcoholic Polyneuropathy Alcoholic Cardiomyopathy Alcoholic Liver Cirrhosis Pancreatitis, Chronic Rectal Cancer IF Fœtal Alcohol Syndrome
Medium (alcohol-attributable ætiologic fraction 0.3–0.8)	Haemorrhagic Stroke IF, M Gastro-Oesophageal Haemorrhage Pancreatitis Acute Intentional Self-Harm/Suicide** Assault Hospitalisations: non-pedestrians from NAIP M	Oropharyngeal Cancer Oesophageal Cancer Liver Cancer Laryngeal Cancer Epilepsy Cardiac Arrhythmias Oesophageal Varices Unspecified Liver Cirrhosis Colon Cancer Psoriasis Rectal Cancer NIF
Low (alcohol-attributable ætiologic fraction <0.3)	Spontaneous Abortion F Intrauterine Growth Retardation/Low Birth Weight Hospitalisations: non-pedestrians from NAIP F Falls Fires: Injury Drowning Aspiration Occupational Machine Injuries: Injury Child Abuse Hospitalisations: pedestrians from NAIP	Female Breast Cancer F Hypertensive Disease Rectal Cancer M Ischaemic Stroke IM**

Source: Chikritzhs et al. [6]

Note: NIM (Non-Indigenous Male), NIF (Non-indigenous Female), IM (Indigenous Male), IF (Indigenous Female), F (all females), M (all males). Where not stated all were included in a single category. Haemorrhagic Stroke for Non-Indigenous Females was not classified as the fractions over different age groups ranged from 0.419 to -.406.

Overall the cross-correlations between wholesale price per litre and hospital separations (Table 15) were generally stronger than those between per capita consumption and separations (Table 14). Only conditions with a high alcohol-attributable ætiologic fraction and medium alcohol-attributable ætiologic fraction (excluding assaults) were found to be significantly positively correlated with consumption, indicating that as consumption rose so did hospitalisations for these conditions. It is important to note that many of these significant correlations were at lags 3 or 4, indicating that a change in consumption was followed by a change in hospitalisations three or four quarters later. Conditions with a low alcohol-attributable ætiologic fraction decreased as consumption increased but, given that the contribution of alcohol to the ætiology of these conditions is marginal, it is highly likely that they were influenced by other factors (e.g. smoking). The significant correlations related to average wholesale price were generally negative, indicating that as price increased there were decreases in: acute alcohol-attributable separations (excluding assaults); conditions with a high alcohol-attributable ætiologic fractions;

conditions with medium alcohol-attributable ætiologic fractions (excluding assault); and separations for wholly alcohol-attributable conditions.

Table 14: Cross-correlations for per capita alcohol consumption (PCC ≥15yrs) and hospital separations for alcohol-attributable conditions, Alice Springs Hospital

Variable	Sig (0.05)	Correlation	Lag
Overall Hospitalisations	No		
Alcohol-attributable	No		
Acute	No		
Acute no assault	No		
Chronic	No		
High	Yes	.362	4
Medium	No		
Medium no assault	Yes	.329	1
Medium no assault	Yes	-.386	3
Low	Yes	-.325	3
Wholly alcohol-attributable	No		

Note: If a row item appears more than once, it indicates that significant values occurred at more than one lag

Table 15: Cross-correlations for wholesale price per litre and alcohol-attributable hospitalisations, Alice Springs Hospital

Variable	Sig (0.05)	Correlation	Lag
Overall Hospitalisations	Yes	-.350	0
Alcohol-attributable	No		
Acute	No		
Acute no assault	Yes	-.405	1
Chronic	No		
High	Yes	-.331	1
Medium	No		
Medium no assault	Yes	-.321	1
Low	No		
Wholly alcohol-attributable	Yes	-.352	1
Wholly alcohol-attributable	Yes	.335	2

Note: If a row item appears more than once, it indicates that significant values occurred at more than one lag

Total hospital separations for alcohol-attributable conditions were subjected to time series analysis using the seasonally adjusted series of the quarterly sum of total separations for alcohol-attributable conditions as the dependent variable, and consumption, wholesale price and the event variables for the interventions as independent variables. None of the independent variables contributed significantly to the optimum model. The basic expert model selected was a Holt model with good fit (Stationary R^2 = .747) and reasonable average (MAPE 9.8%) and maximum (MaxAPE 28.21%) error values. This concurs with the absence of significant cross-correlations between total separations for alcohol-attributable conditions, alcohol consumption and wholesale price shown in Table 14 and Table 15.

Predictive time-series models were created using the time periods before an intervention and comparing the trend predicted after the intervention with the observed values. It was not possible to test the impact of the Trial Restrictions in this way because of the small number of quarters for which pre-trial data were available. In each other case, the preceding time period was modelled from the Amended Restrictions of Q3 2003 (unless noted) so that the longest time period without any changes in restrictions was available. The only restriction for which the predicted and observed series deviated significantly was the LSP.

The LSP appeared to have had a substantial effect on total separations for alcohol-attributable conditions. Using data restricted to the period from the end of the Trial Restrictions (Q3 2003) until the implementation of the LSP (Q3 2006) to forecast the remainder of the period, the forecast values continued to rise after the introduction of the LSP while the observed values were significantly lower than the forecast values in Q2 and Q3 of 2007 and from Q1 2008 onwards (Figure 18). A Winters' Additive model was chosen using data from Q3 2003-Q3 2006 with good fit (Stationary R^2 =.782) and relatively low average and maximum errors (MAPE = 5.62%, MaxAPE = 15.55%).

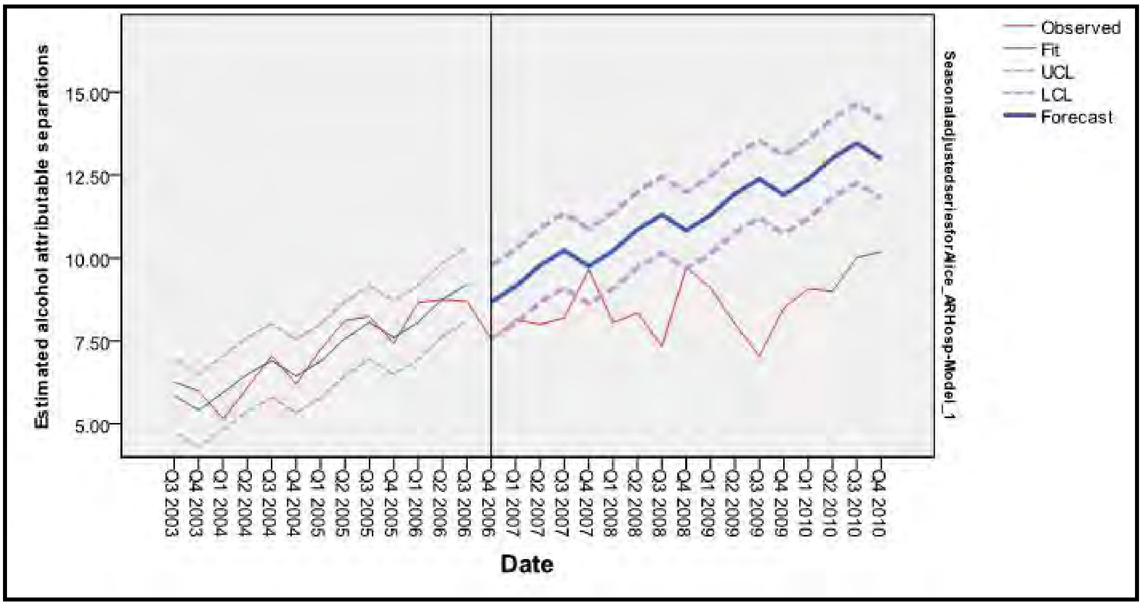


Figure 18: Hospital separation rates for alcohol-attributable conditions, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

The divergence was even more pronounced if data were selected from Q3 2003 until the beginning of the drop in consumption before the LSP in Q1 2006 – with a Winter's additive model with better fit than the previous model (Stationary R^2 = .826) and lower average and maximum error rates (MAPE = 5.38%, and MaxAPE = 13.29%) with non-significant model parameters (Figure 19).

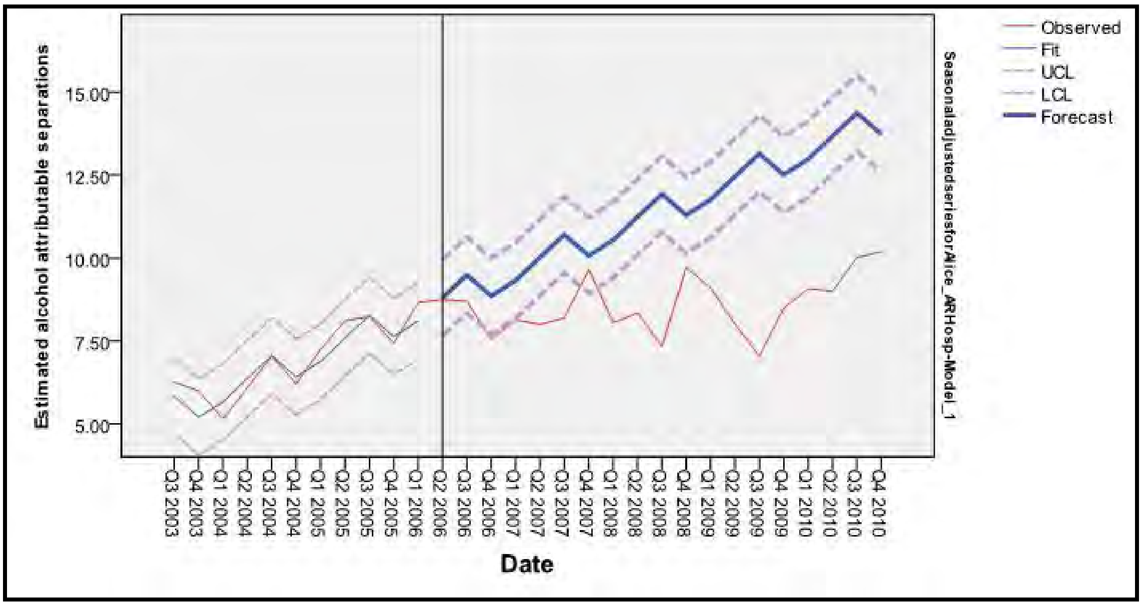


Figure 19: Hospital separation rates for alcohol-attributable conditions, Alice Springs observed and forecast values post-Q1 2006, based on a model constructed from Q3 2003 – Q3 2006

Separations for alcohol-attributable and non-alcohol-attributable conditions

The total numbers of hospital separations for alcohol-attributable conditions (i.e. those with any level of alcohol involvement) and non-alcohol-attributable conditions (i.e. no alcohol-attributable ætiologic fraction applied) for Alice Springs Hospital by quarter between July 2000 and December 2010 are shown in Figure 20. The ratios between these are plotted in Figure 21, and Poisson regression was used to investigate them during key periods related to each of the restrictions.

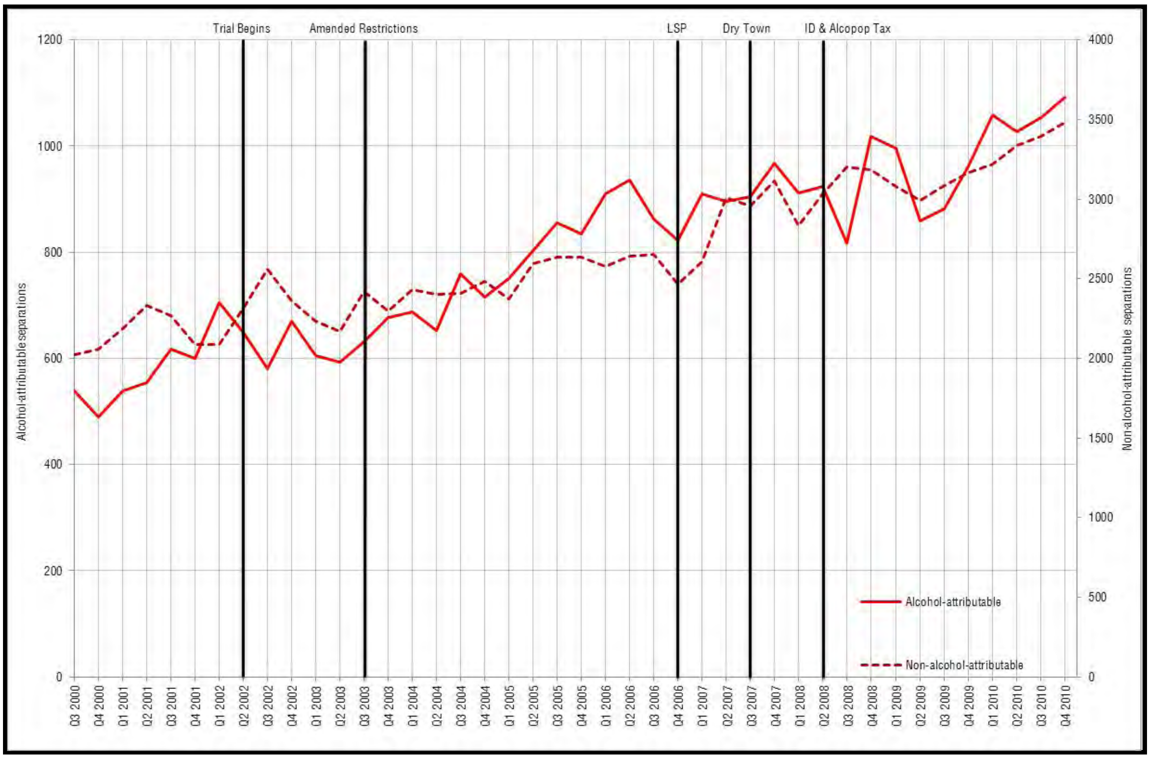


Figure 20: Numbers of hospital separations for alcohol-attributable and non-alcohol-attributable conditions by quarter, Alice Springs Hospital, July 2000 – December 2010

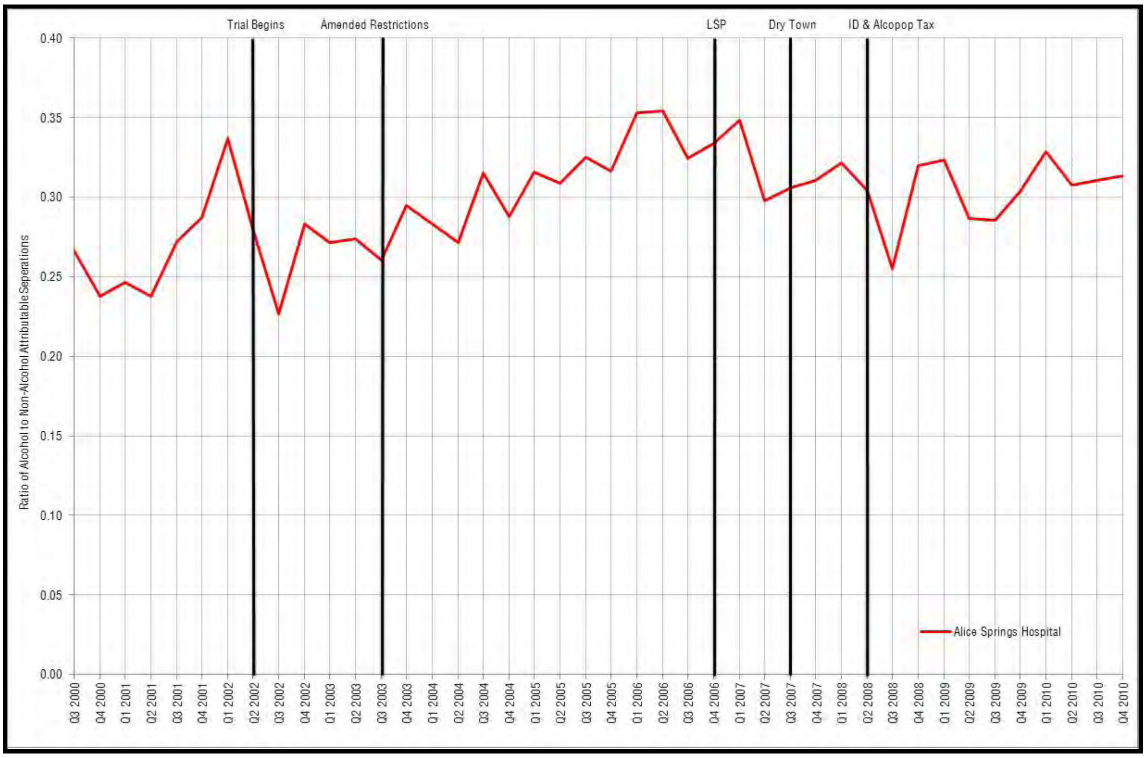


Figure 21: Ratio of hospital separation rates for alcohol to non-alcohol-attributable conditions by quarter, Alice Springs Hospital, July 2000 – December 2010

In order to examine the impact of the LSP, Poisson regression analysis was performed on the Alice Springs hospitalisation ratio series using Q3 of 2006 as the reference quarter (i.e. immediately before the introduction of the LSP). As illustrated in Table 16, the incidence rate ratios (IRR) did not show a consistent linear trend. A significantly lower IRR occurred in Q2 2007 due to an increase in admissions for non-alcohol-attributable conditions. Subsequently, no significant difference was found for five quarters. Almost two years after the introduction of the LSP – and coinciding with the period immediately following the ID and 'alcopops tax' restrictions – Q3 2008 was significantly lower due to a large decrease in separations for alcohol-attributable conditions in that quarter, as were Q2, Q3, and Q4 of 2009 which also corresponded with lower admissions for alcohol-attributable conditions.

Table 16: Results of Poisson regression comparing the ratio of hospital separations for alcohol to non-alcohol-attributable conditions in Alice Springs, pre- and post-LSP

Quarter	IRR	Std. Err.	Z	P>Z	95% Confidence Interval	
Q3 2006	Reference quarter					
Q4 2006	0.984	0.048	-0.34	0.734	0.89	1.08
Q1 2007	0.989	0.047	-0.24	0.81	0.90	1.09
Q2 2007	0.902	0.043	-2.18	0.029	0.82	0.99
Q3 2007	0.940	0.044	-1.31	0.19	0.86	1.03
Q4 2007	0.917	0.043	-1.86	0.063	0.84	1.00
Q1 2008	0.914	0.043	-1.9	0.058	0.83	1.00
Q2 2008	0.922	0.043	-1.73	0.083	0.84	1.01
Q3 2008	0.783	0.038	-5.05	0.0	0.71	0.86
Q4 2008	0.944	0.044	-1.24	0.215	0.86	1.03
Q1 2009	0.923	0.043	-1.73	0.084	0.84	1.01
Q2 2009	0.870	0.042	-2.91	0.004	0.79	0.96
Q3 2009	0.876	0.042	-2.77	0.006	0.80	0.96
Q4 2009	0.896	0.042	-2.34	0.019	0.82	0.98
Q1 2010	0.940	0.043	-1.34	0.179	0.86	1.03
Q2 2010	0.930	0.043	-1.58	0.115	0.85	1.02
Q3 2010	0.949	0.043	-1.15	0.252	0.87	1.04
Q4 2010	0.926	0.042	-1.69	0.092	0.85	1.01

To examine the impact of the Trial Restrictions, Poisson regression analysis was performed on the Alice Springs hospitalisation ratio series using Q1 2002 (i.e. the quarter immediately preceding the introduction of the Trial) as the reference quarter. As indicated in Table 17, with the exception of Q4 2003, in each quarter following the introduction of the Trial Restrictions there was a significantly ($p<.05$) lower ratio of alcohol to non-alcohol-attributable hospitalisations compared to the reference quarter.

Table 17: Results of Poisson regression comparing the ratio of hospital separations for alcohol to non-alcohol-attributable conditions in Alice Springs, post-Trial Restrictions

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2002	Reference quarter					
Q2 2002	0.905	0.049	-1.84	0.066	0.81	1.01
Q3 2002	0.744	0.042	-5.26	0.000	0.67	0.83
Q4 2002	0.884	0.048	-2.26	0.024	0.79	0.98
Q1 2003	0.803	0.045	-3.9	0.000	0.72	0.90
Q2 2003	0.886	0.049	-2.17	0.030	0.79	0.99
Q3 2003	0.857	0.047	-2.82	0.005	0.77	0.95
Q4 2003	0.919	0.050	-1.55	0.122	0.83	1.02
Q1 2004	0.844	0.046	-3.13	0.002	0.76	0.94
Q2 2004	0.877	0.048	-2.41	0.016	0.79	0.98

After the introduction of the Amended Restrictions – when the restrictions on the availability of cask wine was lifted – the proportion of hospital separations that was alcohol-attributable was significantly higher in Q3 2004 and for an extended period from Q2 2005, when cask wine sales increased again, through until the introduction of the LSP (Table 18).

Table 18: Results of Poisson regression comparing the ratio of hospital separations for alcohol to non-alcohol-attributable conditions in Alice Springs, post-Amended Restrictions

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2003	Reference quarter					
Q4 2003	1.073	0.059	1.29	0.199	0.96	1.20
Q1 2004	0.984	0.054	-0.28	0.781	0.88	1.10
Q2 2004	1.024	0.057	0.42	0.672	0.92	1.14
Q3 2004	1.204	0.064	3.48	0.001*	1.08	1.34
Q4 2004	1.050	0.057	0.89	0.372	0.94	1.17
Q1 2005	1.101	0.060	1.78	0.076	0.99	1.22
Q2 2005	1.160	0.061	2.81	0.005*	1.05	1.29
Q3 2005	1.237	0.064	4.09	0.000*	1.12	1.37
Q4 2005	1.155	0.061	2.74	0.006*	1.04	1.28
Q1 2006	1.238	0.064	4.13	0.000*	1.12	1.37
Q2 2006	1.327	0.068	5.54	0.000*	1.20	1.47
Q3 2006	1.237	0.064	4.09	0.000*	1.12	1.37

*Significant, p<.05

As shown in Table 19, when compared to Q2 2007 (i.e. the quarter immediately prior to the introduction of the Dry Town legislation) the ratio for each of the subsequent quarters remained unchanged (i.e. close to 1).

Table 19: Results of Poisson regression comparing the ratio of hospital separations for alcohol to non-alcohol-attributable conditions in Alice Springs, before and after the Dry Town legislation

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q2 2007	Reference quarter					
Q3 2007	1.042	0.049	0.89	0.374	0.95	1.14
Q4 2007	1.017	0.047	0.36	0.721	0.93	1.11
Q1 2008	1.013	0.048	0.28	0.780	0.92	1.11

Using the quarter before the ID & 'alcopops tax' restrictions were introduced as the reference period (Q1 2008), Q3 2008 showed a significantly lower ratio of separations for alcohol to non-alcohol-attributable conditions, but there did not appear to be an overall linear trend and no further quarters showed a significant difference for the remainder of the time period (Table 20).

Table 20: Results of Poisson regression comparing the ratio of hospital separations for alcohol to non-alcohol-attributable conditions in Alice Springs, before and after the ID & 'alcopops tax'

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2008	Reference quarter					
Q2 2008	1.009	0.047	0.19	0.85	0.92	1.11
Q3 2008	0.857	0.041	-3.21	0.001	0.77	0.94
Q4 2008	1.034	0.047	0.72	0.471	0.94	1.13

Indigenous vs. non-Indigenous alcohol-attributable hospitalisations

Interestingly, unlike the alcohol consumption series, the alcohol-attributable hospitalisation series did not respond well to de-seasonalisation and attempts to remove seasonality from the series only marginally improved the clarity of the underlying trend. Seasonal trends appeared to change over the study period and became increasingly acute after the introduction of the dry-town legislation in Q3 2007. Several expert interviewees suggested that the increasingly large fluctuations towards the end of the study period might reflect changes in movements of Indigenous people within the Central Australian region. In keeping with this observation, further investigation revealed that most of the fluctuations were in fact underpinned by changes in the proportions of Indigenous alcohol-attributable admissions to the Alice Springs hospital. The differences in the burden of harms experienced by Indigenous and non-Indigenous people were marked, with rates of alcohol-attributable hospitalisations some ten times higher among the Indigenous population (Figure 22).

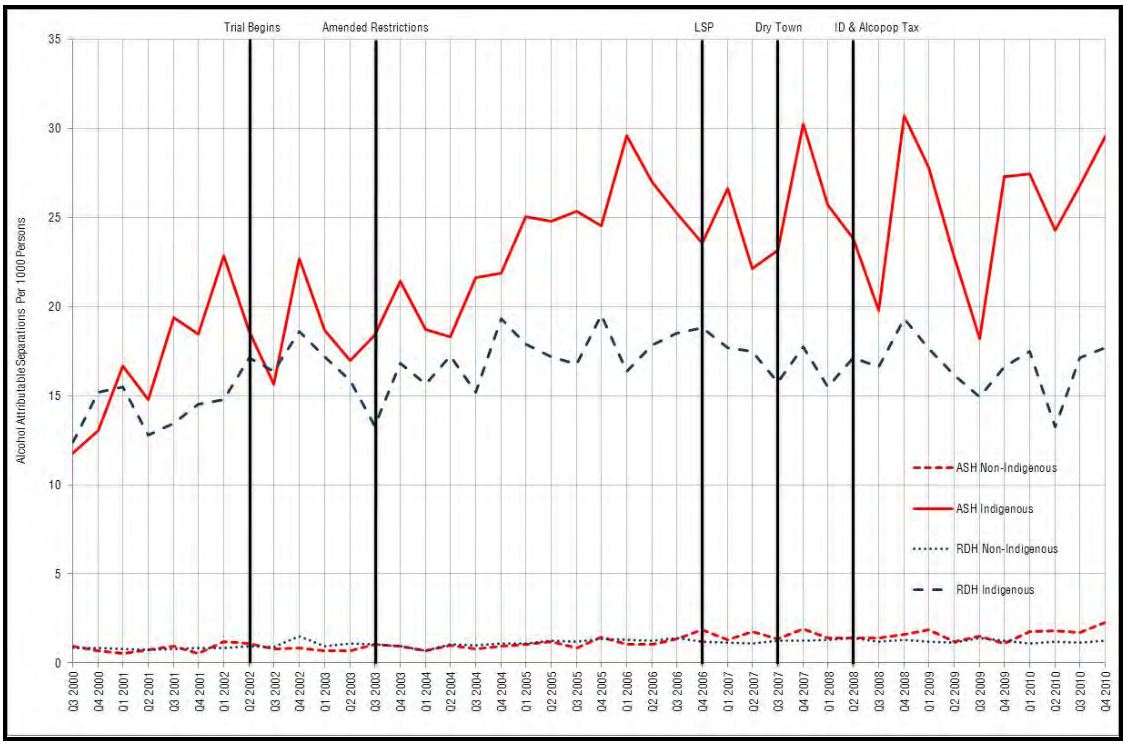


Figure 22: Indigenous and non-Indigenous hospital separations per 1000 persons for alcohol-attributable conditions by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

Acute vs. chronic, high/medium/low alcohol contributions, and wholly alcohol-attributable hospital separations

The previous analyses in this section have been concerned with total alcohol-attributable hospitalisations. However, changes in factors other than alcohol consumption might drive changes in rates of conditions which are only partially attributable to alcohol (e.g. cancers). Furthermore, some conditions, such as injuries associated with intoxication, may respond quickly to various restrictions while others might require a considerable lag to show effect (e.g. chronic health conditions). For these reasons it is also important to independently consider wholly alcohol–attributable conditions.

Alcohol-attributable conditions were grouped based on whether:

- conditions were wholly alcohol-caused (i.e. the condition was, by definition, caused by alcohol and thereby attracted an alcohol-attributable ætiologic fraction of 1);
- whether the condition attracted an alcohol-attributable ætiologic fraction which was either high (>0.8), medium (0.3-0.8) or low (<0.3); or,
- whether the condition was acute (i.e. associated with drinking to intoxication) or chronic (i.e. associated with consistent, ongoing exposure) in nature.

These groupings were in keeping with those used previously in the evaluation of the impact of the Northern Territory Living With Alcohol Program.[6] The various conditions and the groupings into which they fell – based on their ætiologic fractions in the Northern Territory – are summarised in Table 13. When the effects of consumption and wholesale price were tested on each of these groupings using time series analysis none were found to be significant.

The trend for separations for conditions wholly alcohol-attributable at Alice Springs Hospital (Figure 23) was notably different to that for separations for all alcohol-attributable conditions (Figure 17). While both series appeared to plateau at the time the LSP was introduced, there was a large and rapid increase in the rate of separations for wholly alcohol-attributable conditions in late 2009 and 2010. With the exception of a significant drop in the ratio of separations for alcohol to non-alcohol-attributable conditions during one quarter (Q1 2007, IRR = 0.64, $p < 0.05$) following the introduction of the LSP, forecast analyses, time series analysis (with the restrictions entered as event variables) and Poisson regression all showed no significant impact for any of the restrictions (results not shown).

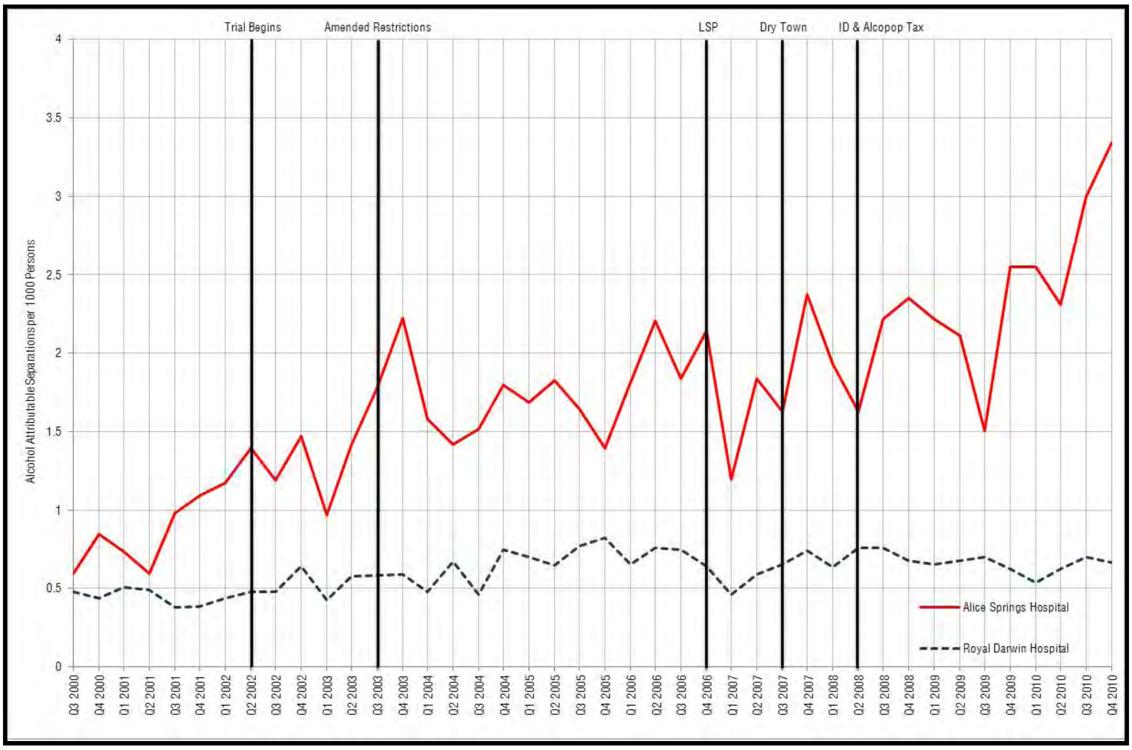


Figure 23: Separations per 1000 persons for conditions wholly attributable to alcohol by quarter, Alice Springs Hospital & Royal Darwin Hospital

Figure 24 shows trends in the rates of hospital separations for alcohol-attributable conditions in Alice Springs grouped according to condition and level of alcohol causation (i.e. size of the alcohol-attributable ætiologic fractions). Separations for conditions categorised according to whether they were wholly alcohol-attributable or had high alcohol-attributable aetiologic fractions included many of the same conditions, and the trends were therefore very similar. Separation rates per 1000 persons for both these categories more than trebled – from slightly less than one in Q3 2003 to over three in Q4 2010.

The category of separations including conditions with medium level alcohol-attributable aetiologic fractions (e.g. assault, acute pancreatitis, cancers – Table 13) increased rapidly and consistently from Q3 2004 to Q1 2006 and thereafter sustained a higher average quarterly rate than the earlier period prior to the end of the Trial Restrictions. The rate of separations in this category more than doubled over the period, rising from 2.69 per 1000 person in Q1 2000 to 6.14 in Q4 2010. Separations for conditions with low alcohol-attributable ætiologic fractions showed the least variability from quarter to quarter but also increased to almost double the initial rate 0.74 per 1000 in Q3 2000 to 1.35 in Q4 2010.

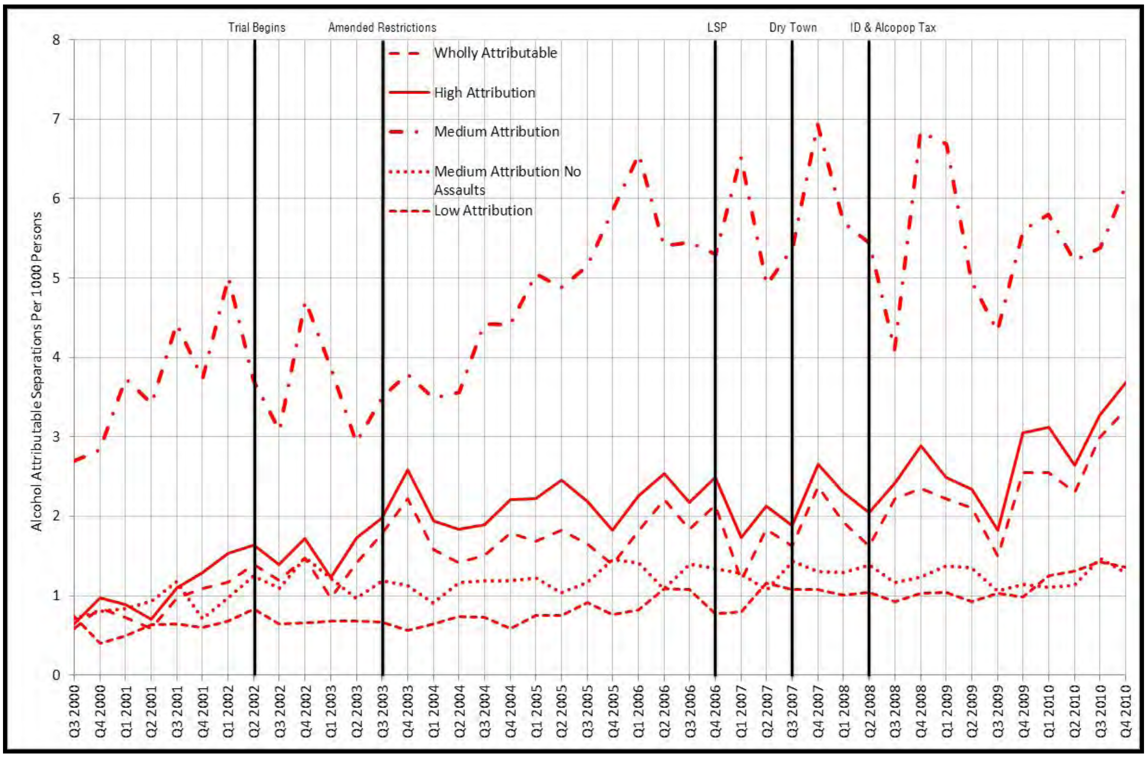


Figure 24: Separations per 1000 persons for conditions wholly attributable to alcohol and conditions with high, medium, medium excluding assaults, and low level alcohol-attributable aetiologic fractions by quarter, Alice Springs Hospital, July 2000 – December 2010

As illustrated in Figure 25, the trends for separations for acute and chronic alcohol-attributable conditions were notably different. Separations for acute conditions appeared to increase rapidly over the study period while those for chronic conditions remained relatively stable. Given that assaults make up such a large proportion (average of 55% over the entire period) of acute alcohol-attributable harms recorded at Alice Springs Hospital, the trend in separations for acute conditions excluding assaults is also shown in Figure 25. The series for separations for acute conditions excluding assault had substantially less variability between intervals and was considerably smoother than the series for separations which included assaults. Exclusion of assaults changed the overall pattern in acute separations from a levelling off after the LSP to a steady increase over the entire period.

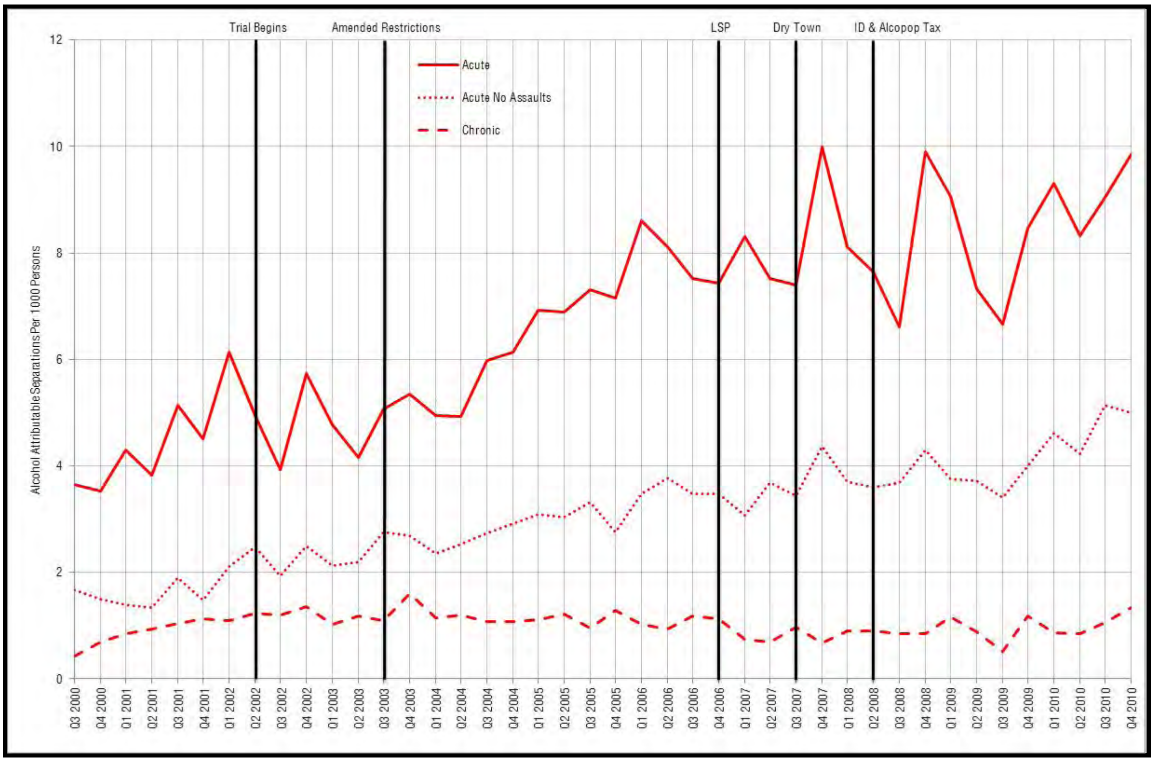


Figure 25: Separations per 1000 persons for alcohol-attributable acute and chronic conditions by quarter, Alice Springs Hospital, July 2000 – December 2010

Predicted series were forecast for separations for all alcohol-attributable acute conditions and acute conditions excluding assaults at Alice Springs Hospital. After the introduction of the LSP, the observed trend in quarterly separation rates for all alcohol-attributable acute conditions was significantly lower than predicted on the basis of previous trend for all but four of the 17 quarters to Q4 2010 (Figure 26 and Table 21). However, when assaults were excluded – apart from a period from Q2 2009 to Q4 2009 – the observed series was not significantly different to the expected series (Figure 27 and Table 22). This suggests that assaults were largely, though not entirely, responsible for the decline in separation rates for acute alcohol-attributable conditions.

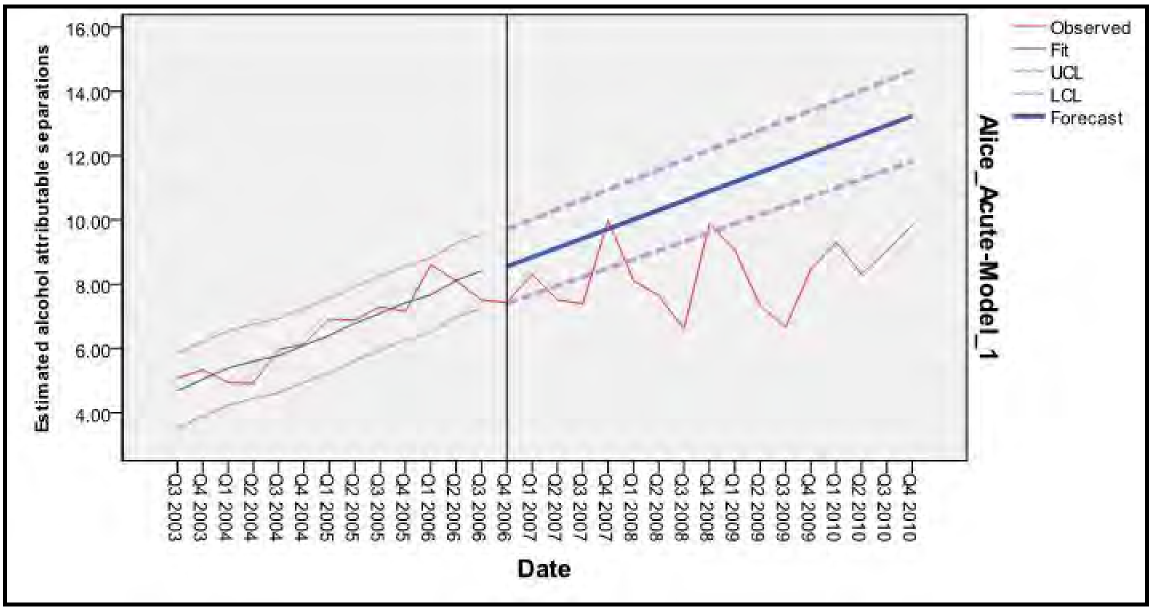


Figure 26: Separation rates per 1000 persons for all alcohol-attributable acute conditions *including assaults*, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 21: Observed values, predicted values and confidence limits for separations for all alcohol-attributable acute conditions *including assaults*, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	7.43	8.55	7.40	9.71
Q1 2007	8.31	8.84	7.67	10.02
Q2 2007	7.52*	9.14	7.95	10.33
Q3 2007	7.39*	9.43	8.22	10.64
Q4 2007	9.99	9.72	8.50	10.94
Q1 2008	8.11*	10.01	8.78	11.25
Q2 2008	7.64*	10.31	9.05	11.56
Q3 2008	6.61*	10.60	9.33	11.87
Q4 2008	9.90	10.89	9.61	12.18
Q1 2009	9.06*	11.19	9.88	12.49
Q2 2009	7.33*	11.48	10.16	12.79
Q3 2009	6.66*	11.77	10.44	13.10
Q4 2009	8.47*	12.06	10.72	13.41
Q1 2010	9.31*	12.36	11.00	13.72
Q2 2010	8.32*	12.65	11.27	14.02
Q3 2010	9.04*	12.94	11.55	14.33
Q4 2010	9.84*	13.23	11.83	14.64

Significant *p<.05

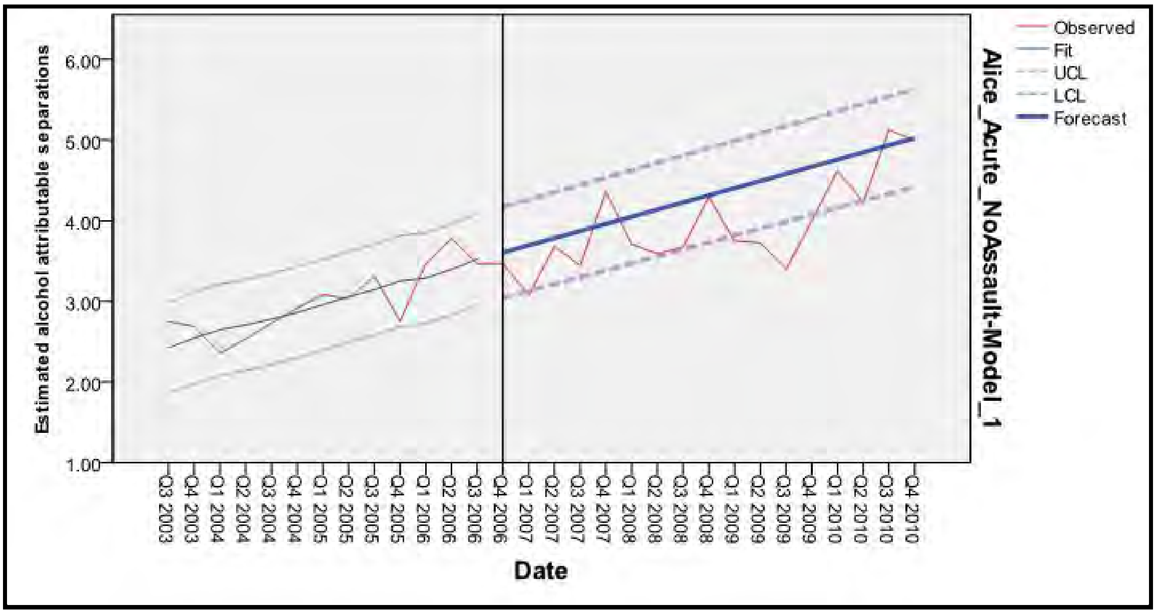


Figure 27: Separation rates per 1000 persons for alcohol-attributable acute conditions *excluding assaults*, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 22: Observed values, predicted values and confidence limits for alcohol-attributable separation rates per 1000 persons for acute conditions *excluding assaults*, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	3.47	3.61	3.04	4.17
Q1 2007	3.08	3.69	3.13	4.26
Q2 2007	3.68	3.78	3.21	4.35
Q3 2007	3.44	3.87	3.30	4.44
Q4 2007	4.37	3.96	3.39	4.54
Q1 2008	3.71	4.05	3.47	4.63
Q2 2008	3.59	4.14	3.56	4.72
Q3 2008	3.68	4.23	3.64	4.81
Q4 2008	4.29	4.32	3.73	4.90
Q1 2009	3.75	4.40	3.82	4.99
Q2 2009	3.72*	4.49	3.90	5.08
Q3 2009	3.39*	4.58	3.99	5.18
Q4 2009	4.00*	4.67	4.07	5.27
Q1 2010	4.62	4.76	4.16	5.36
Q2 2010	4.23*	4.85	4.25	5.45
Q3 2010	5.13	4.94	4.33	5.54
Q4 2010	4.99	5.03	4.42	5.63

Significant *p<.05

For separations for conditions (including assaults) with medium level alcohol-attributable ætiologic fractions (Table 13), observed values were significantly lower than expected for most quarters after the introduction of the LSP (Figure 28 and Table 23). Moreover, the observed values remained significantly lower than forecast from Q3 2009 onwards even when assaults were removed (Figure 29 and Table 24).

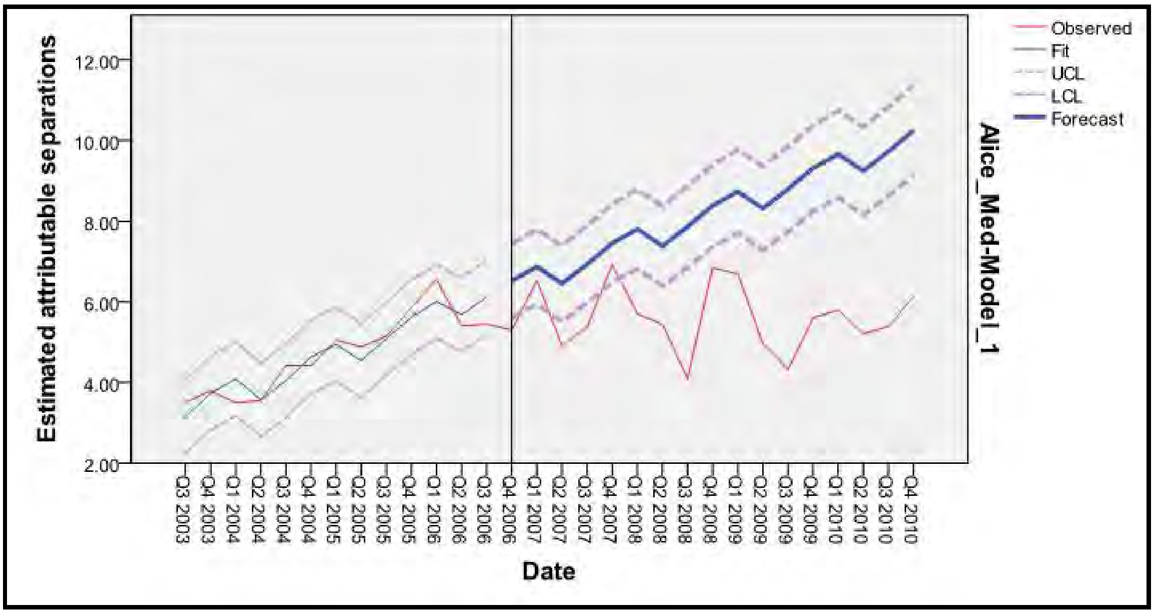


Figure 28: Separations for conditions *including assaults* with medium level alcohol-attributable aetiologic fractions, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 23: Observed values, predicted values and confidence limits for separations for conditions *including assaults* with medium level alcohol-attributable aetiologic fractions, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	5.30*	6.52	5.61	7.44
Q1 2007	6.52	6.87	5.94	7.80
Q2 2007	4.91*	6.45	5.51	7.39
Q3 2007	5.38*	6.93	5.98	7.89
Q4 2007	6.93	7.45	6.49	8.42
Q1 2008	5.70*	7.80	6.82	8.79
Q2 2008	5.44*	7.38	6.39	8.38
Q3 2008	4.10*	7.87	6.86	8.87
Q4 2008	6.84*	8.39	7.37	9.41
Q1 2009	6.69*	8.74	7.70	9.77
Q2 2009	4.96*	8.32	7.27	9.36
Q3 2009	4.33*	8.80	7.74	9.85
Q4 2009	5.61*	9.32	8.25	10.39
Q1 2010	5.79*	9.67	8.59	10.75
Q2 2010	5.22*	9.25	8.16	10.34
Q3 2010	5.38*	9.73	8.63	10.83
Q4 2010	6.14*	10.25	9.14	11.37

Significant *p<.05

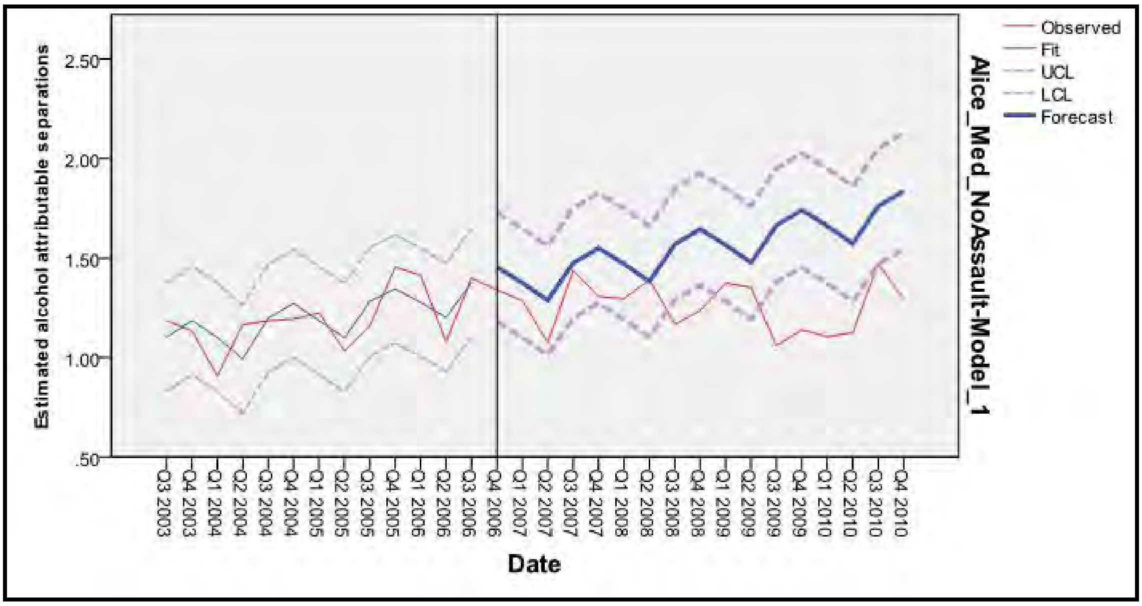


Figure 29: Separations for conditions *excluding assaults* with medium level alcohol-attributable aetiologic fractions, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 24: Observed values, predicted values and confidence limits for separations for conditions *excluding assaults* with medium level alcohol-attributable aetiologic fractions, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	1.34	1.46	1.18	1.73
Q1 2007	1.29	1.38	1.10	1.65
Q2 2007	1.07	1.29	1.01	1.56
Q3 2007	1.44	1.47	1.20	1.75
Q4 2007	1.31	1.55	1.27	1.83
Q1 2008	1.30	1.47	1.19	1.75
Q2 2008	1.39	1.38	1.10	1.66
Q3 2008	1.17*	1.57	1.29	1.85
Q4 2008	1.24*	1.65	1.36	1.93
Q1 2009	1.37	1.57	1.28	1.85
Q2 2009	1.35	1.48	1.19	1.76
Q3 2009	1.06*	1.66	1.38	1.95
Q4 2009	1.14*	1.74	1.45	2.03
Q1 2010	1.11*	1.66	1.37	1.95
Q2 2010	1.13*	1.57	1.28	1.86
Q3 2010	1.47	1.76	1.47	2.05
Q4 2010	1.29	1.84	1.54	2.13

Significant *p<.05

Compared to expected (forecast) quarterly separation rates based on trends prior to introduction of the LSP, the observed values for conditions with low level alcohol-attributable ætiologic fractions were significantly lower for about half the quarters from Q1 2008 onwards (Figure 30 and Table 25).

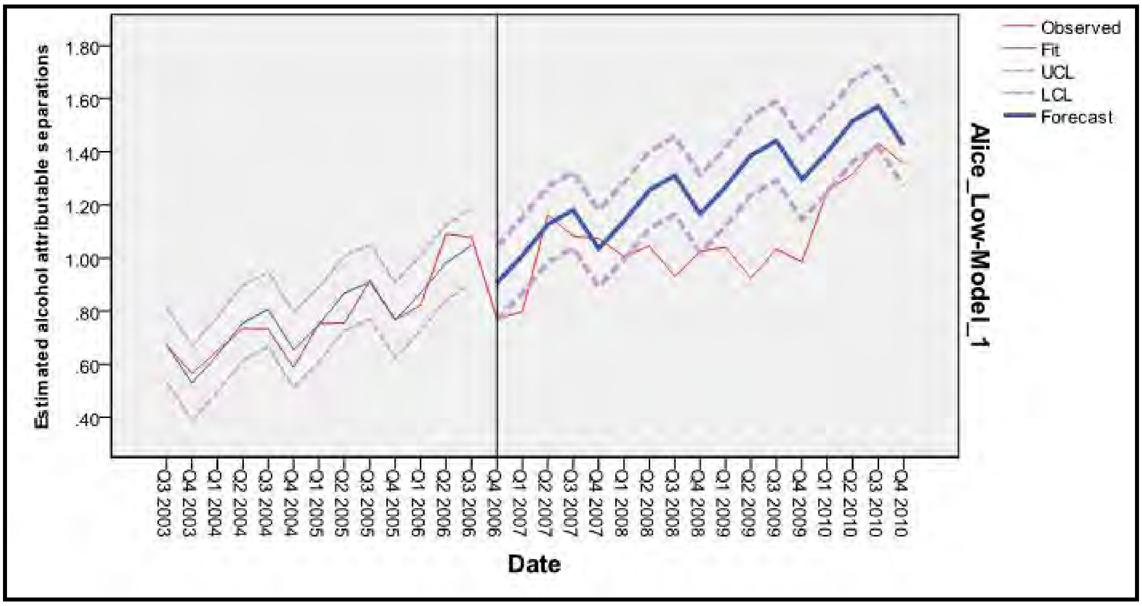


Figure 30: Separations for conditions *excluding assaults* with low level ætiologic fractions, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 25: Observed values, predicted values and confidence limits for separations for conditions *excluding assaults* with low level ætiologic fractions, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	0.77	0.91	0.77	1.05
Q1 2007	0.80*	1.01	0.87	1.15
Q2 2007	1.16	1.13	0.98	1.27
Q3 2007	1.08	1.18	1.04	1.32
Q4 2007	1.07	1.04	0.89	1.18
Q1 2008	1.01	1.14	0.99	1.28
Q2 2008	1.05*	1.26	1.11	1.40
Q3 2008	0.93*	1.31	1.16	1.46
Q4 2008	1.03	1.17	1.02	1.31
Q1 2009	1.04*	1.27	1.12	1.42
Q2 2009	0.92*	1.39	1.24	1.53
Q3 2009	1.03*	1.44	1.29	1.59
Q4 2009	0.99*	1.30	1.15	1.45
Q1 2010	1.25	1.40	1.25	1.55
Q2 2010	1.32*	1.52	1.36	1.67
Q3 2010	1.43	1.57	1.42	1.72
Q4 2010	1.35*	1.43	1.27	1.58

Significant *p<.05

It is important to note that within the aggregated categories of separation rates analysed above, the contributions of individual conditions are not equal and some may contribute substantially more to a series than others. Assault in particular, is the largest contributor to admissions to the Alice Springs Hospital for alcohol-attributable conditions (Figure 31). Furthermore, the substantial variation between Indigenous and non-Indigenous separation rates was largely underpinned by differences in admission for assault-related conditions (Figure 22). Given that assaults are clearly an important issue for the region, they are discussed in a separate section below (page 88).

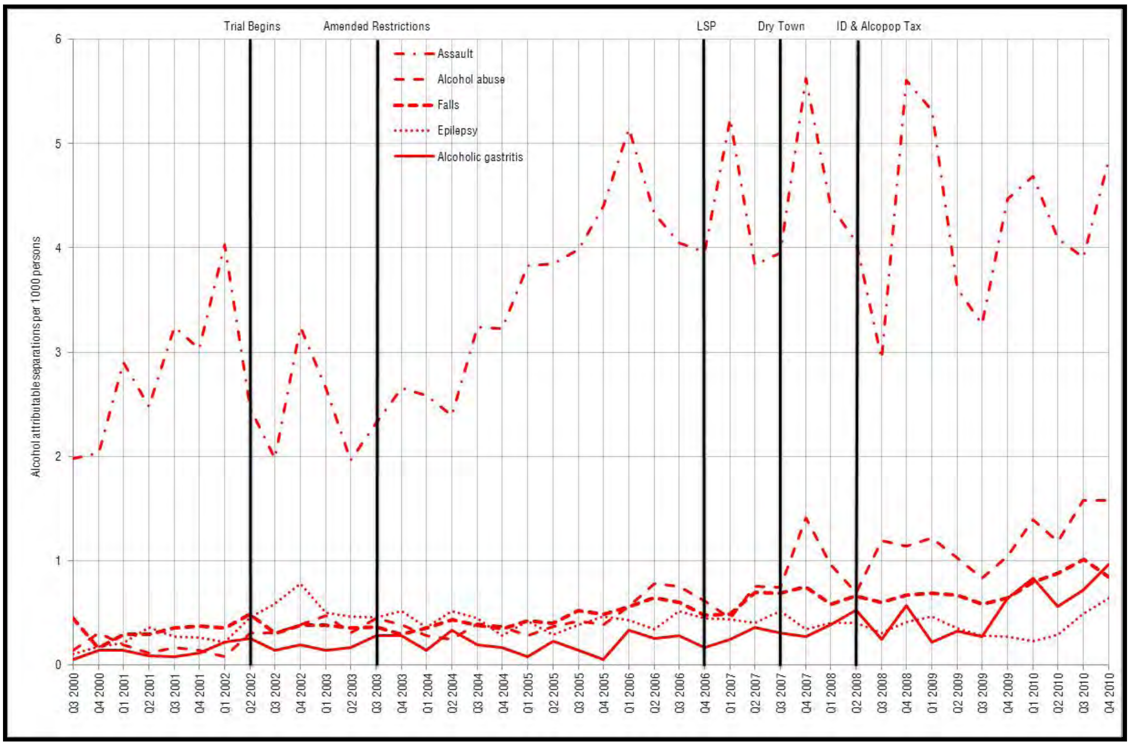


Figure 31: Highest contributors to hospitalisation separation rates for alcohol-attributable conditions by quarter, Alice Springs Hospital, July 2000 – December 2010

Summary: alcohol-attributable hospital separations

Overall there were substantial differences between Alice Springs and Darwin over the study period in hospital separation rates for both all conditions and alcohol-attributable conditions. Those for Royal Darwin Hospital remained reasonably steady across the entire study period while those for Alice Springs Hospital generally increased over time. Cross-correlations between wholesale price and separation rates for different categories of alcohol-attributable conditions showed significant negative correlations with rates for, (a) acute conditions (excluding assaults), (b) conditions with high alcohol-attributable ætiologic fractions, (c) conditions (excluding assaults) with medium level alcohol-attributable ætiologic fractions, and (d) conditions that were wholly alcohol-attributable.

The negative correlations indicated that as the price of alcohol increased, the rates of hospital separations for these alcohol-attributable conditions decreased. There were positive correlations between estimated per capita alcohol consumption and different sub-groups of hospitalisation separations but they were restricted to conditions with high or medium (excluding assault) level alcohol-attributable ætiologic fractions, and conditions that were wholly attributable to alcohol. Time-series forecasting showed that in the time period after introduction of the LSP, there were many quarters in which the observed rates of admission for alcohol-attributable conditions was less than expected had previous trends continued. However, as the reduction did not become significant until Q2 2007 and took until Q3 2008 to be maintained, it is difficult to know if it was a delayed effect of the LSP restrictions or a more immediate effect of any of the later restrictions (i.e. Dry Town, ID, 'alcopops tax' etc.). Notably, however, the rate did not decrease significantly after the introduction of any of those additional restrictions. Poisson regression also showed significant decreases in the ratio of separations for alcohol-attributable to non-alcohol-attributable conditions in some quarters after the introduction of the LSP, particularly in 2009. During the Trial Restrictions period, Poisson regression showed significant decreases in the ratio of separations for alcohol-attributable conditions for nearly all quarters when compared with the quarter prior to the introduction of the Trial.

Further analysis was conducted using categories of hospital separations based on conditions commonly associated with particular patterns of drinking – acute conditions largely associated with short term drinking to intoxication and chronic conditions typically associated with long term exposure – as well as level of alcohol-attributable ætiologic fraction (high/medium/low/wholly). Overall, the significantly lower rates of observed separations for all alcohol–attributable conditions compared to those forecast after the introduction of the LSP was made up of declines in acute cases, particularly of assaults. When considering separations for conditions based upon level of alcohol ætiologic fraction there was no evidence of significant change in the rate of separations for conditions wholly attributable to alcohol (e.g. alcohol abuse, alcoholic gastritis, alcoholic psychosis, alcoholic liver cirrhosis) but significant declines were seen in rates of separations for conditions with medium level (most, but not all, attributable to assaults) and low level alcohol-attributable ætiologic fractions. A disparate proportion of the burden of separations for alcohol-attributable conditions recorded by the Alice Springs Hospital occurred among the Indigenous population and much of this was underpinned by hospitalisation for assault.

Emergency Department Presentations

Unlike hospital separations, which are coded by specially trained staff, emergency department (ED) presentations are coded by doctors or nurses under time pressure and without review. Information obtained from interviews with key health informants also indicated that there were different levels of awareness about the importance of recording assaults and the involvement of alcohol in presentations, and that there were significant numbers of overseas staff who had differing emphases in training. All these factors may have influenced the consistency and quality of records over time and for these reasons ED data are likely be less accurate than hospital separation data.

Furthermore, due to changes over time in the recording procedures within both the Alice Springs Hospital and Royal Darwin Hospital Emergency Departments, ICD-10 coded data were only available from Q3 2002 onwards. A further limitation was that the ED data included a 'Principal Diagnosis' but rarely included a code for 'external causes' applicable to injuries or poisonings. Thus it was not possible to tell whether a particular injury such as a fracture (the principal diagnosis) was the result of a fall, road crash, assault or some other external cause and whether alcohol was involved. For this reason, such injuries are not included and, in this section, estimates of ED presentations attributable to alcohol consist largely of chronic disease categories. It was possible, however, to identify injuries that were potentially alcohol-related using triage codes assigned by nurses. These triage data were applied in the separate analyses of assaults, on page 88.

The pattern of total emergency department (ED) presentations per 1000 persons (Figure 32) was similar to that for total hospital separations. This is to be expected since many patients who are hospitalised are admitted through ED. However, some differences are to be expected as many more patients attend ED than are hospitalised. The difference in the patterns over time for Alice Springs Hospital and Royal Darwin Hospital are less pronounced than for hospital separations, with slight increases over the study period for both sites.

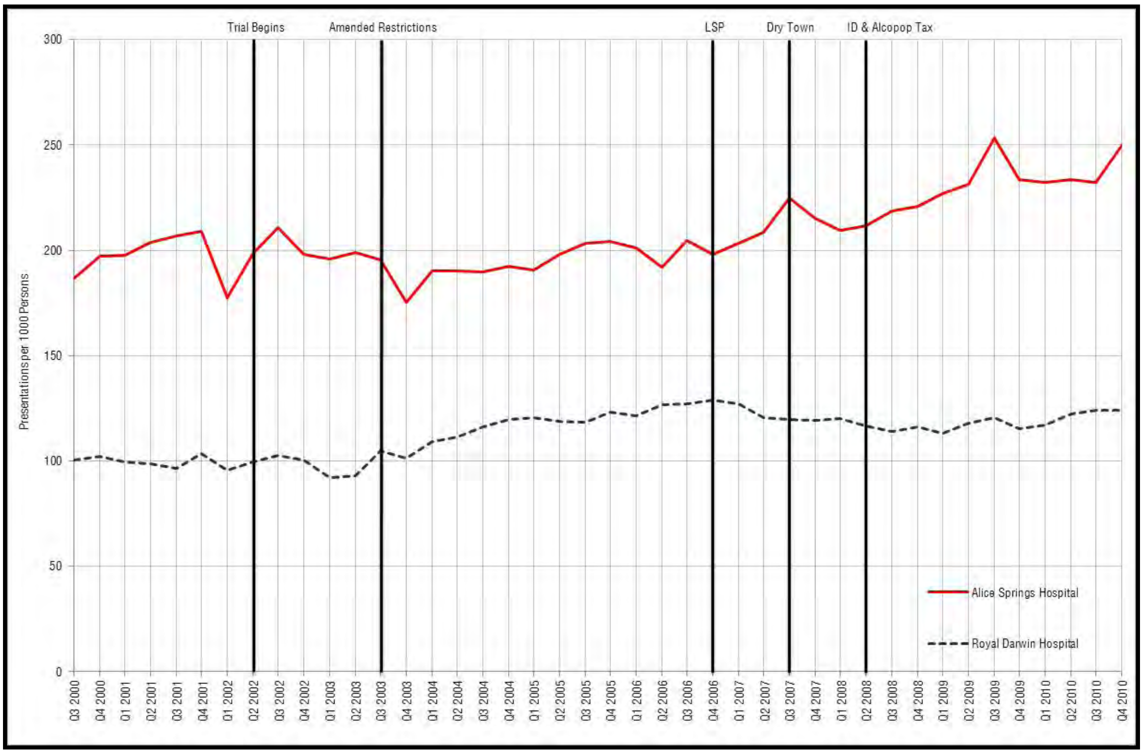


Figure 32: Total Emergency Department presentations per 1000 persons by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

From Q3 2002 onwards, ED presentations per 1000 persons for non-injury alcohol-attributable conditions (Figure 33) conformed closely to the general trend apparent for hospital separation rates (Figure 16). Over the study period, the rate of ED presentations at Alice Springs Hospital for non-injury alcohol-attributable conditions doubled from 3.5 to 7.0 per 1000 persons – although the Q4 seasonal high observed in other years did not occur when the LSP was introduced in Q4 2006. In Darwin, although the rate of presentations for alcohol-attributable conditions was less than a quarter of that in Alice Springs, it too doubled over the study period from 0.8 to 1.5 per 1000 persons.

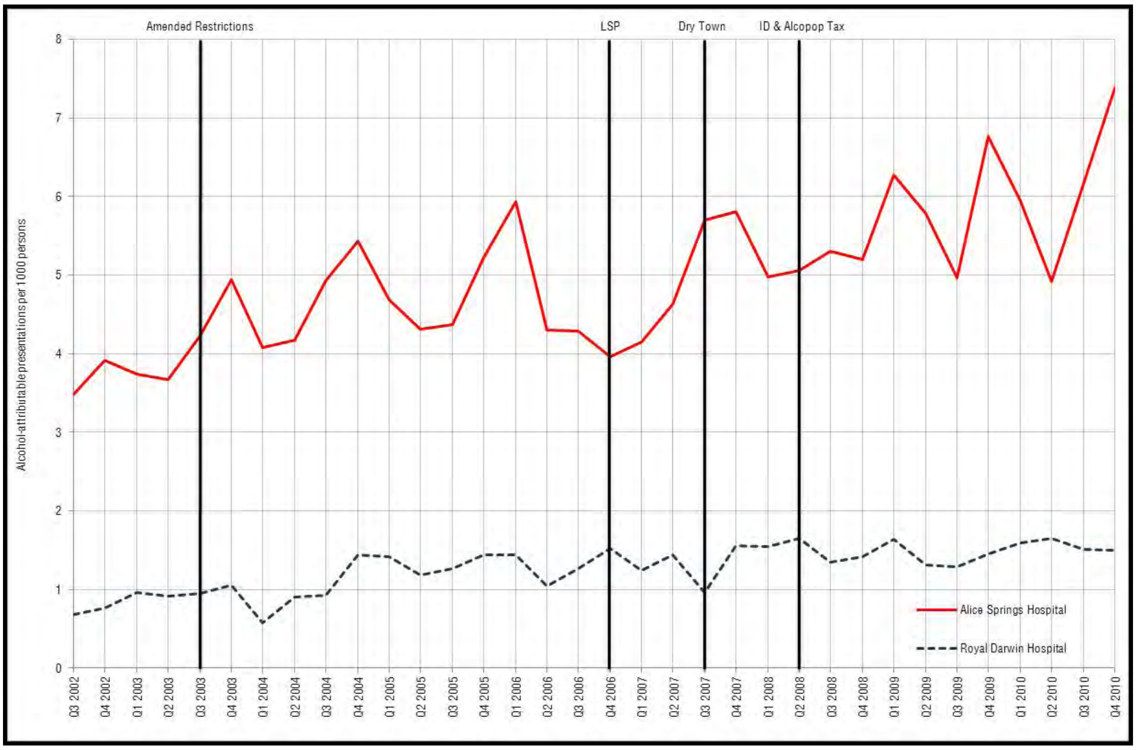


Figure 33: Emergency Department presentations per 1000 persons for non-injury alcohol-attributable conditions by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2002 – December 2010

Consumption, price, restrictions and emergency department presentations

It was expected that there would be a positive association between estimated per capita consumption of alcohol and ED presentations and a negative association between price and ED presentations. However, over the entire study period, when included as an independent variable, per capita consumption in Central Australia was a significant negative predictor (estimate = -1.11, $p<.001$) of ED presentations for alcohol-attributable conditions (ARIMA(0,0,0)(0,0,0) model, Stationary R^2 = .492, MAPE = 9.027%, and MaxAPE = 28.87%). The significant association occurred at the third lag, indicating that increases in ED presentations for non-injury alcohol-attributable conditions occurred three quarters after a reduction in per capita consumption. There was also a significant positive association at lag 4 (i.e. changes in presentations occurred a year after changes in price) between Central Australian wholesale price per litre (estimate = .814, $p<.01$) and ED presentations [ARIMA(0,0,1)(0,0,0)] model, Stationary R^2 = .515, MAPE = 9.12%, and MaxAPE = 22.07% . Thus, regardless of the decline in per capita consumption evident towards the end of the study period (Figure 2) or changes in price (Figure 12), ED presentations for non-injury alcohol-attributable conditions continued to increase over the time course.

As data were only available from Q3 2002, time-series modelling was more limited than that applied to the hospital separation data and ruled out any testing of the impact of the Trial Restrictions. As shown in Table 26, many of the restrictions were significant when entered individually into the expert modelling process as event variables (restrictions). Apart from takeaways being restricted to containers of two litres or less, which showed a negative correlation, indicating that there was a reduction in alcohol-attributable ED presentations, all the other restrictions produced positive estimates. This indicates that regardless of the restrictions, the underlying trend in alcohol-attributable non-injury related ED presentations in Alice Springs continued to rise.

Table 26: Time-series model details for restrictions that were significant predictors of ED presentations for non-injury alcohol-attributable conditions

Restriction	Estimate	Lag	Sig	ARIMA	Stationary R^2	MAPE	MaxAPE
Takeaways >2 litres	-.286	0	p<.01	(0,0,1)(0,0,0)	.558	9.17%	29.78%
LSP	.176	0	p<.05	(0,0,1)(0,0,0)	.471	10.4%	39.77%
One Per Person Per Day	.229	0	p<.01	(0,0,1)(0,0,0)	.526	10.42%	31.53%
Income Management & Longnecks Ban	.261	0	p<.001	(0,0,1)(0,0,0)	.596	9.57%	27.15%
Town Camps Dry	.235	0	p<.001	(0,0,1)(0,0,0)	.543	10.23%	29.44%
Dry Town	.238	0	p<.01	(0,0,1)(0,0,0)	.550	10.08%	27.5%
ID & Alcopops	.229	0	p<.01	(0,0,1)(0,0,0)	.526	10.42%	31.53%

A forecast model was developed using data from Q3 2003 to Q3 2006 to predict ED presentations at Alice Springs Hospital for the period following introduction of the LSP. The best model was a simple seasonal model with Stationary R^2 = .668, MAPE = 5.92%, and MaxAPE = 18.99% indicating that the main underlying trend was a regular seasonal pattern. However, in the period after the introduction of the LSP, in many quarters, the observed values reached significantly higher levels than the predicted values (Figure 34 and Table 27). Counter to the trend for separation rates for alcohol-attributable conditions, ED presentations for non-injury alcohol-attributable conditions tended to increase rather than decrease following the restrictions. In part, this may be due to the fact that these analyses rely almost entirely on ED presentations for chronic conditions (e.g. cancer, alcohol dependence, epilepsy) which may take many years to respond to changes in alcohol availability and drinking prevalence.[71]

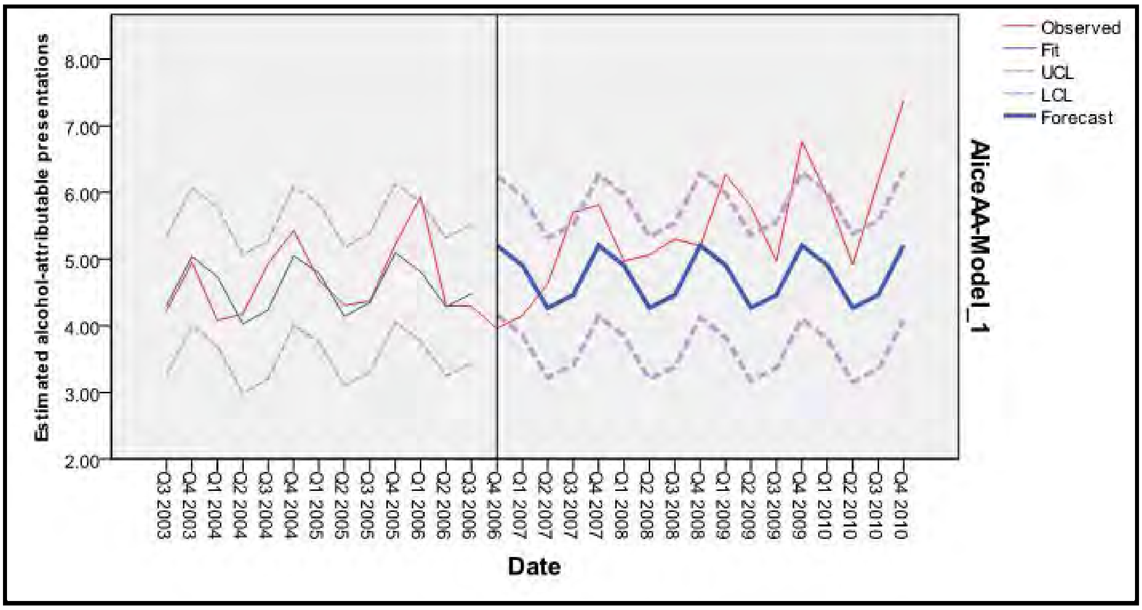


Figure 34: Emergency Department presentation rates for non-injury alcohol-attributable conditions, Alice Springs Hospital, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 27: Observed values, predicted values and confidence limits, Emergency Department presentation rates for non-injury alcohol-attributable conditions, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	3.96*	5.20	4.17	6.24
Q1 2007	4.15	4.91	3.86	5.95
Q2 2007	4.63	4.27	3.22	5.32
Q3 2007	5.70*	4.46	3.41	5.52
Q4 2007	5.81	5.20	4.15	6.26
Q1 2008	4.97	4.91	3.84	5.97
Q2 2008	5.06	4.27	3.20	5.34
Q3 2008	5.30	4.46	3.39	5.54
Q4 2008	5.20	5.20	4.13	6.28
Q1 2009	6.27*	4.91	3.82	5.99
Q2 2009	5.78*	4.27	3.18	5.36
Q3 2009	4.97	4.46	3.37	5.56
Q4 2009	6.76*	5.20	4.11	6.30
Q1 2010	5.95	4.91	3.80	6.01
Q2 2010	4.92	4.27	3.16	5.38
Q3 2010	6.17*	4.46	3.35	5.58
Q4 2010	7.38*	5.20	4.09	6.32

Significant *p<.05

Emergency department presentations by Indigenous status

Hospital separations data demonstrated a wide gulf between Indigenous and non-Indigenous populations, and ED presentations appeared to be underpinned by a similarly degree of disparity. Indigenous people presented to the Alice Springs Hospital Emergency Department for non-injury alcohol-attributable conditions at a rate almost ten times greater than non-Indigenous people (Figure 35).

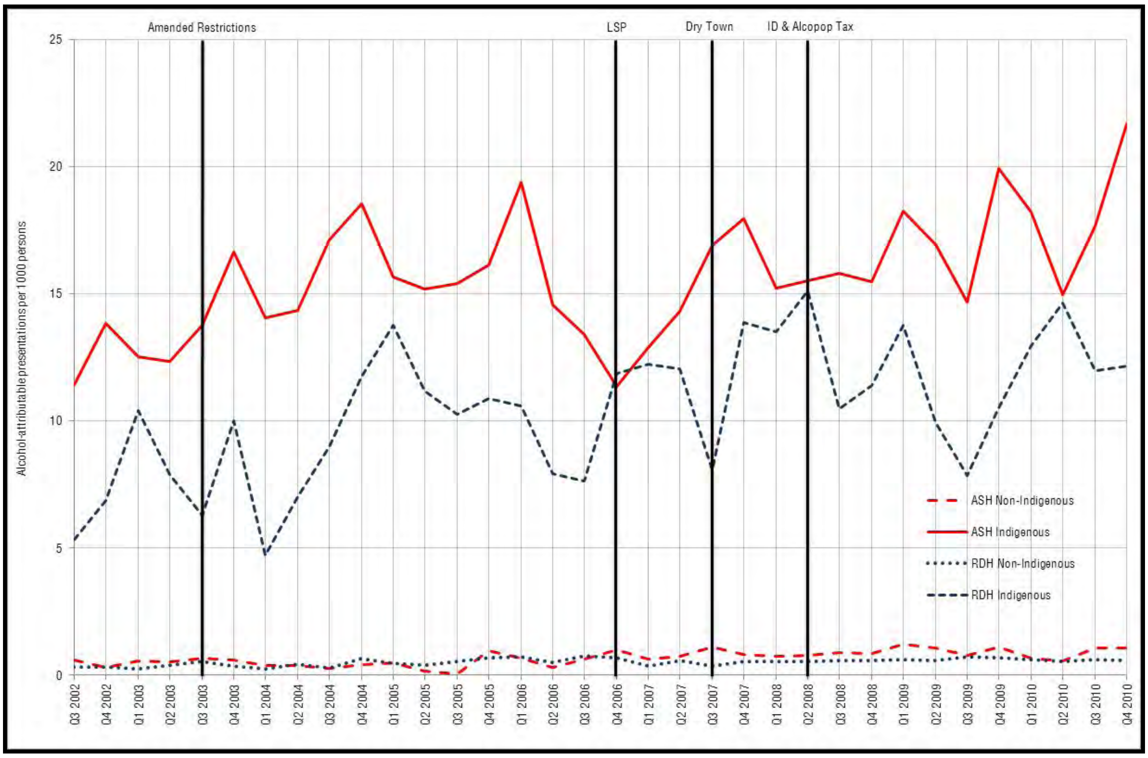


Figure 35: Indigenous and non-Indigenous Emergency Department presentations per 1000 persons for non-injury alcohol-attributable conditions by quarter, Alice Springs Hospital (ASH) and Royal Darwin Hospital (RDH), July 2002 – December 2010

Time-series models were created for non-injury alcohol-attributable ED presentations at Alice Springs Hospital using Indigenous status. The model of best fit for Indigenous presentations was a Simple Seasonal model with good fit (Stationary R^2 = .567) and reasonable average error (MAPE = 10.07%). A good model for non-Indigenous presentations was not able to be specified. As the predictive time-series models generated to test the effects of the LSP were not well specified they have not been reported.

Emergency department triage data

While the time series of ED data that included ICD-10 coded presentations was limited, triage codes were available for the entire study period. These were recorded by nursing staff as part of the triage process, thereby necessarily determined quickly and not usually subject to rigorous scrutiny or cross-checking with final clinic notes. Thus, a triage code may differ from the final diagnosis recorded after a patient has been assessed fully by medical staff. However, on investigation, a good correspondence (84%) was found between triage coded assaults and the final ICD-10 primary diagnosis code allocated to the admission (i.e. S and T codes). Triage coded assaults were therefore examined in further detail.

Figure 36 shows the trends in assaults identified at triage for Alice Springs Hospital and Royal Darwin Hospital. The ED assault trends were very similar to those that required hospital admission (Figure 42). This is to be expected as emergency patients first pass through the ED. The magnitude of the difference in population rates between Alice Springs and Darwin is also consistent with the hospital separations data. Nevertheless, assaults recorded by triage nurses confirm the large difference in the burden of violent injury experienced by the Indigenous and non-Indigenous populations of the Northern Territory, especially in Central Australia (Figure 37). These series are examined in greater detail in the following section specifically addressing assault.

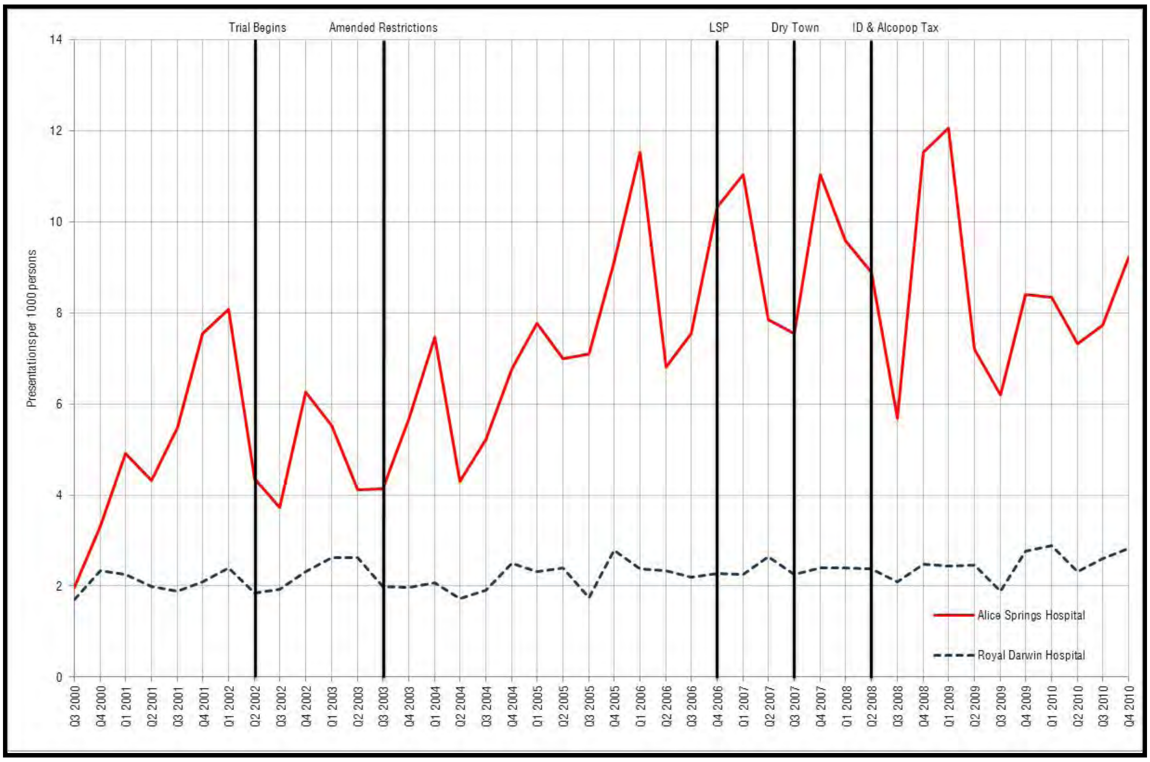


Figure 36: Emergency Department presentations per 1000 persons flagged at triage as assault by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

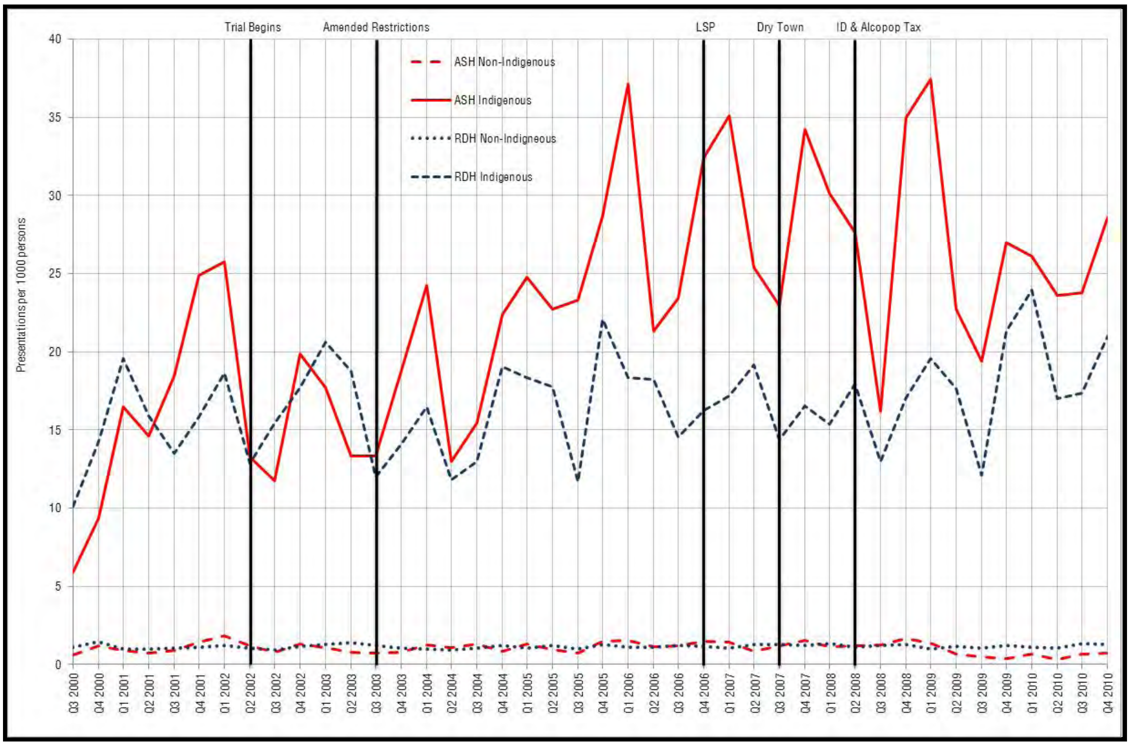


Figure 37: Emergency Department presentations per 1000 persons flagged at triage as assault by Indigenous status by quarter, Alice Springs Hospital (ASH) and Royal Darwin Hospital (RDH), July 2000 – December 2010

Results from the analyses of non-injury alcohol-attributable ED presentations above suggest that, generally, rates were increasing more quickly than expected after the introduction of the LSP and subsequent restrictions. However, as these series were dominated by chronic conditions, it was particularly important to examine, in further detail, assaults recorded by triage staff and to determine whether ED presentations for this common type of injury might have been influenced by the LSP. As indicated in Figure 37 and Table 28, once all of the restrictions were in place (i.e. from Q1 2008 onwards), there were significant declines in the number of triage assault presentations per 1000 persons compared to the forecast trend during most quarters.

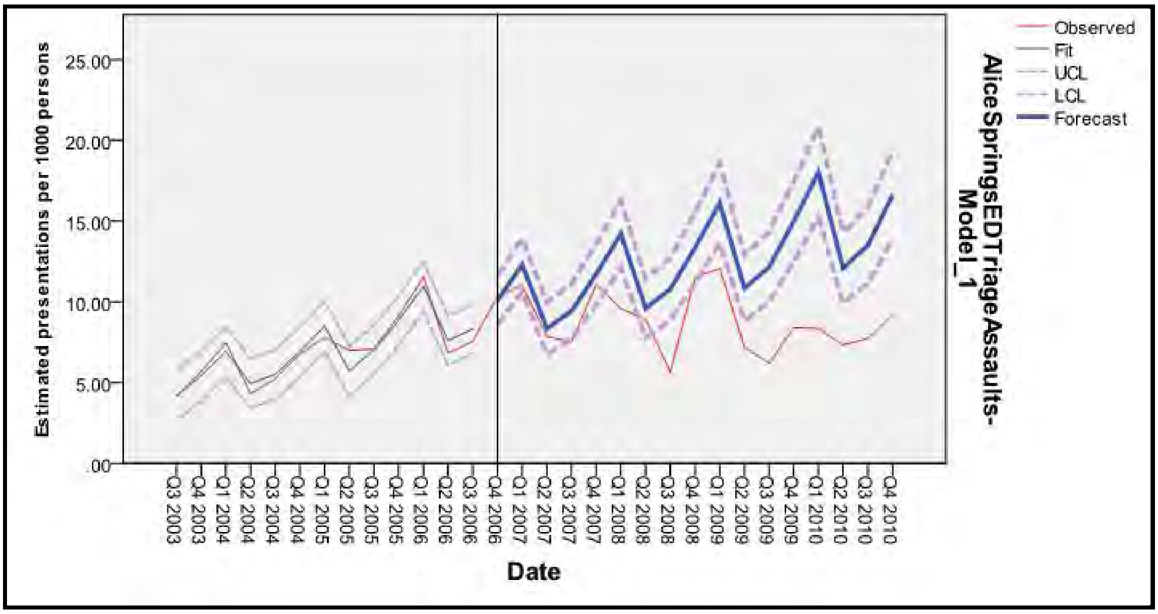


Figure 38: Emergency Department presentations per 1000 persons for assault based on triage data, Alice Springs, observed and forecast values post-LSP, based on a model constructed from Q3 2003 – Q3 2006

Table 28: Observed values, predicted values and confidence limits for Emergency Department presentations per 1000 persons for assault based on triage data, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	10.33	10.09	8.57	11.62
Q1 2007	11.05	12.30	10.66	13.93
Q2 2007	7.85	8.34	6.74	9.95
Q3 2007	7.54	9.43	7.72	11.15
Q4 2007	11.05	11.73	9.84	13.61
Q1 2008	9.58*	14.21	12.12	16.30
Q2 2008	8.89	9.59	7.77	11.41
Q3 2008	5.68*	10.79	8.84	12.74
Q4 2008	11.52	13.36	11.16	15.55
Q1 2009	12.06*	16.12	13.65	18.59
Q2 2009	7.19*	10.84	8.83	12.85
Q3 2009	6.20*	12.15	9.99	14.32
Q4 2009	8.40*	14.99	12.52	17.46
Q1 2010	8.34*	18.03	15.23	20.83
Q2 2010	7.32*	12.09	9.90	14.28
Q3 2010	7.73*	13.51	11.15	15.87
Q4 2010	9.23*	16.62	13.90	19.34

Significant *p<.05

The ED triage data also included flags for wholly alcohol-attributable conditions and some highly alcohol-attributable conditions – alcohol intoxication, alcohol withdrawal and haematemesis (the vomiting of blood). Alice Springs Hospital and Royal Darwin Hospital quarterly presentation rates for these conditions combined are shown in (Figure 39) and the quarterly presentation rates for each condition are shown in Figure 40. At the time of the introduction of the LSP there was a large decline in ED presentations for these highly alcohol-attributable conditions in Alice Springs. This was almost entirely due to a fall in presentations for haematemesis. Key informants suggested that this may have been related to a switch from consumption of high alcohol content cask wine to full strength (but lower alcohol content) beer among heavy drinkers. However, six months after the ID and 'alcopops tax' were introduced, a large rise in cases flagged as alcohol intoxication occurred and thereafter continued to climb. It is important to note, though, that the average number of cases per quarter due to haematemesis (13), alcohol intoxication (9) and withdrawal (8) combined were small (30) – compared to assault where the average number of total presentations was 254 per quarter – thus their overall contribution to alcohol-related health harm was relatively small.

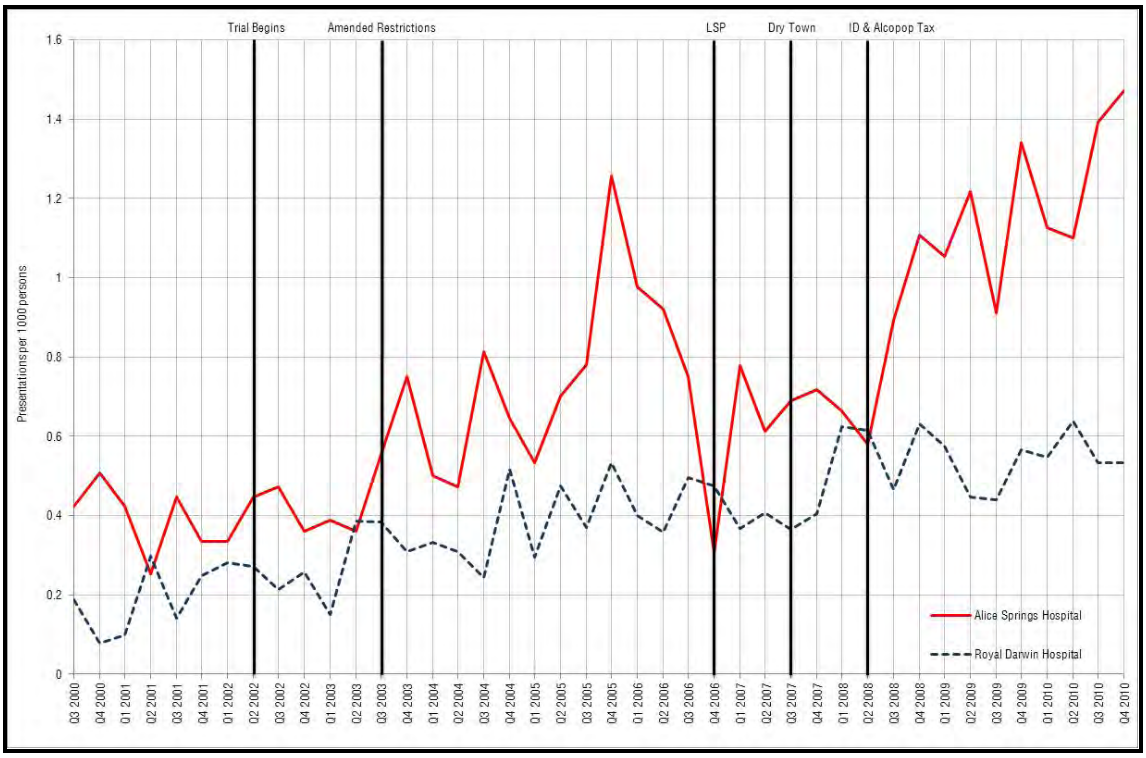


Figure 39: Emergency Department presentations per 1000 persons flagged at triage as alcohol intoxication, alcohol withdrawal and haematemesis by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

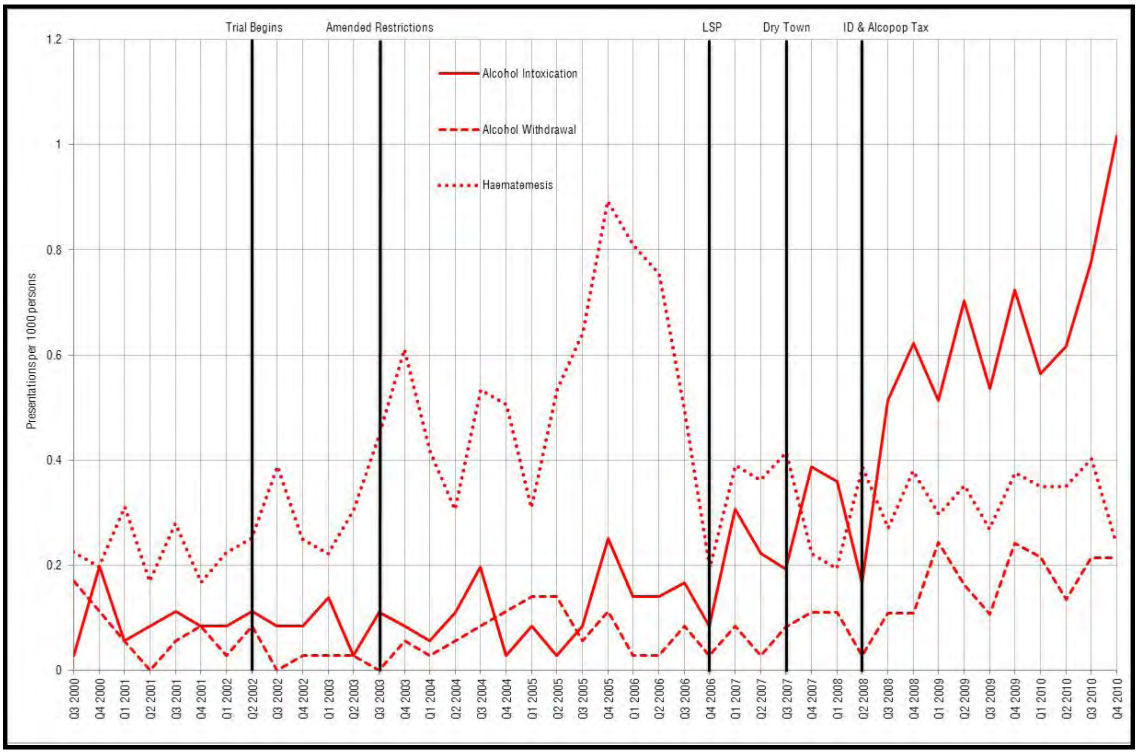


Figure 40: Emergency Department presentations per 1000 persons flagged at triage as alcohol intoxication, alcohol withdrawal and haematemesis by quarter, Alice Springs Hospital, July 2000 – December 2010

Other injury categories flagged at triage that possibly may be related to assault include concussion, fracture, laceration, stab wound, and different types of trauma (chest, face, hand, head, limb, multiple). The combined quarterly presentation rates for these injuries at Alice Springs Hospital and Royal Darwin Hospital are presented in Figure 41. Although there was some variation over time, the rates in both regions were similar at the beginning and end of the study period. Notably, the magnitude of the difference in quarterly rates between the two regions was less disparate than for assaults (Figure 37) and other alcohol-related conditions (Figure 39), particularly throughout 2006 – 2008. This suggests that perhaps the external causes of these flagged injury cases were less likely to involve alcohol. It was suggested by key health informants that ED workers may have become more aware of assaults, asked more direct questions about whether a patient had been assaulted and/or were more likely to record presentations as assaults over the entire period.

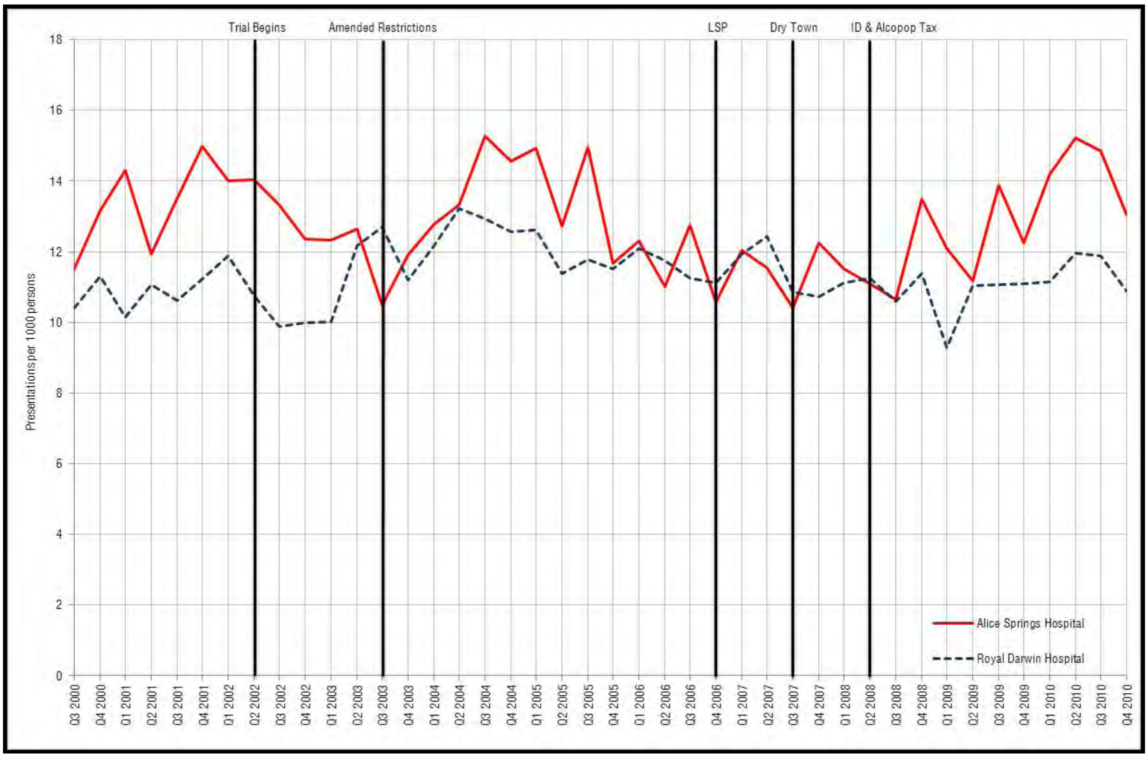


Figure 41: Emergency department presentations per 1000 persons for other potential indicators of assault by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

Emergency Department summary

The disparity in total presentations between Alice Springs and Darwin EDs was smaller than that seen for hospital separations, with a general rise in quarterly rates over the study period for both departments. Alice Springs ED presentation rates also showed substantial seasonal fluctuation. Both per capita consumption (a three quarter leading indicator) and wholesale price per litre (a four quarter leading indicator) appeared to explain some variability in alcohol-attributable ED attendances but the associations were largely negative. Moreover, most restrictions, including the LSP, appeared to be associated with significant increases in ED presentation rates for chronic conditions. This indicates that, over the time period examined, the underlying increasing trend in alcohol-attributable ED presentation rates for largely chronic conditions, was unresponsive to the restrictions or changes in per capita consumption. It is important to note that chronic diseases which tend to arise from constant, ongoing exposure to alcohol, may also take many years to respond to changes in alcohol availability and consumption.[71]

The differences in rates of harm experienced by the Indigenous and Non-Indigenous populations was just as large for ED presentations as for hospital separations. Nursing triage records indicated that assaults were a major contributor to ED presentations. Time-series forecasting showed that quarterly rates of presentations for assault were significantly lower after the introduction of restrictions from Q1 2008 onwards when compared with the predicted trend. ED presentations for haematemesis dropped sharply with the introduction of the LSP, however, there was also a large increase in the number of cases of alcohol intoxication subsequent to the introduction of the ID system & 'alcopops tax'.

Trends in Assaults: A Comparison of Hospital, ED and Police Data Sources

After wholly alcohol-attributable conditions, assaults have one of the highest levels of alcohol involvement of any condition in the NT. They also contribute substantially to the total burden of harm within the Alice Springs community. For this reason, and as assaults were the only common indicator reported in the hospital separation, ED presentation and Police incident data, a comparison of these was made.

The quarterly rate of hospital separations for assault in Darwin remained fairly steady over the entire study period, while in Alice Springs it generally increased. In Alice Springs these rates were at their lowest during the Trial period, increased following the Amended Restrictions and then appeared to plateau (albeit at a higher rate), after the introduction of the LSP – although large fluctuation between quarters was evident (Figure 42).

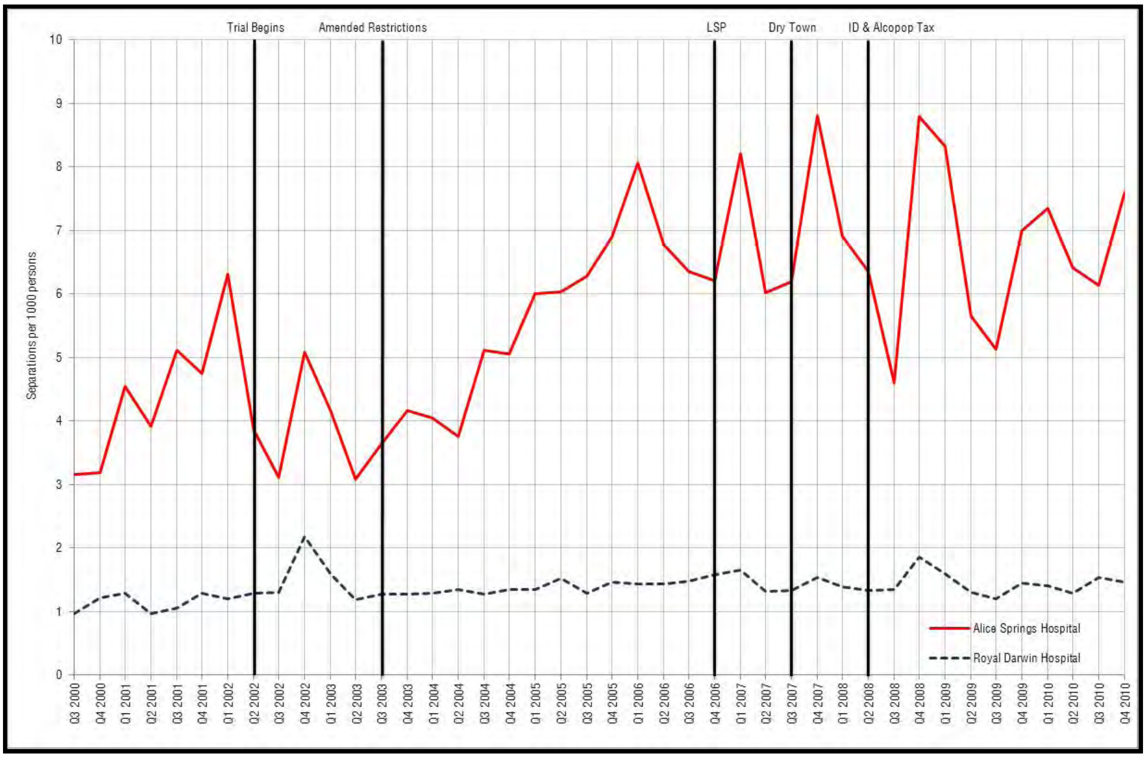


Figure 42: Hospital separations for assault per 1000 persons by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

Figure 43 compares rates of assaults per 1000 persons in Alice Springs from the various data sources. The total rate of assault incidents reported by the Police was the highest of the data sets as it included large numbers of minor assaults that would not have required hospitalisation. The rate of ED attendance for assault (as indicated by triage flag) was also higher than the rate of hospital separations, as all admissions into the hospital for assault first pass through the Emergency Department and not all assault injuries are serious enough to require hospitalisation.

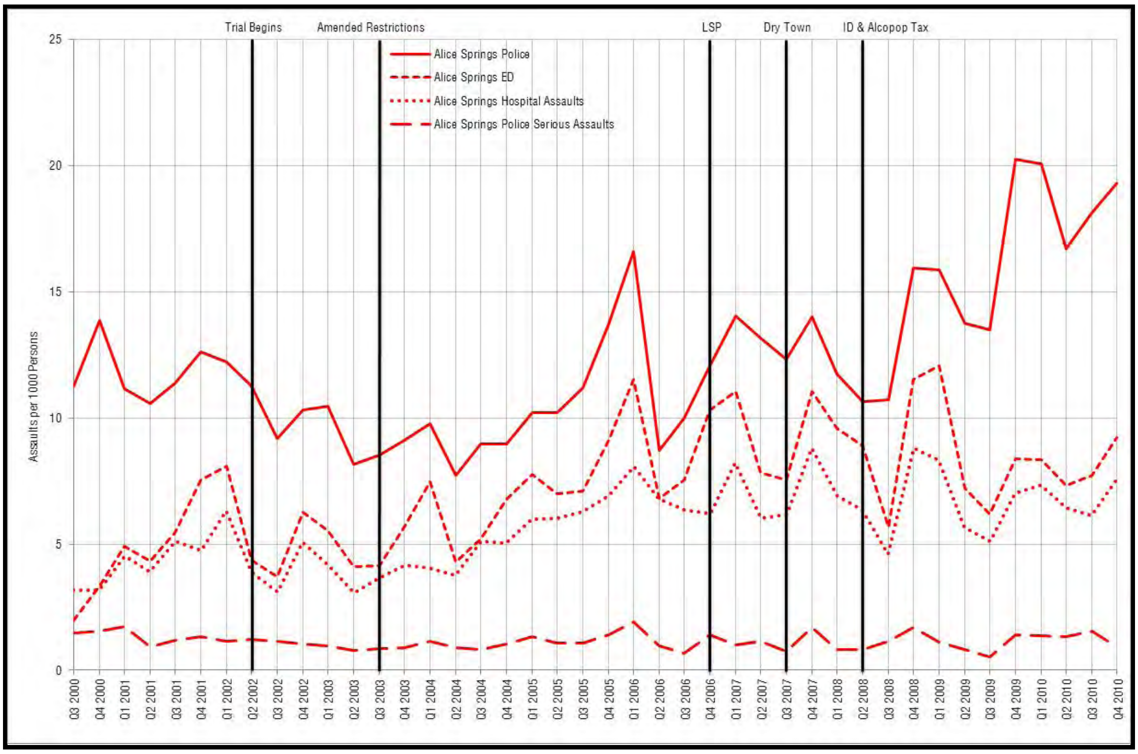


Figure 43: Comparison of assaults per 1000 persons from different sources by quarter, Alice Springs, July 2000 – December 2010

The trend shown in Figure 43 after the introduction of the LSP was subjected to forecast analysis. The period from the end of the first restrictions (Q3 2003) until the final quarter before the commencement of the LSP (Q3 2006) comprised the 'before' period from which the forecast expected series was modelled. Table 28 (Alice Springs Hospital ED), Table 29 (Alice Springs Hospital) and Table 30 (Alice Springs Hospital separations) show the predictions made by the expert modeller for the remainder of the period. These are represented in graphical format in Figure 44, which shows the expected versus observed trends in assaults subsequent to the LSP using the various data sources.

It is interesting to note that the models based on hospital and ED assaults were more accurately specified than those derived from police data (lower values for average error (MAPE) (Table 31). The observed quarterly assault rates deviate significantly at many quarters from the forecast rates for both the hospital admission and ED data but not for the police data. It appears therefore, that injuries from violent assault declined after the LSP. However, for reasons discussed in more detail in (Chapter 7) police reporting of incidents tended to increase (but not significantly).

Table 29: Observed values, predicted values and confidence limits for alcohol-related assaults per 1000 persons, Alice Springs Police

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	7.93	8.47	5.83	11.10
Q1 2007	9.79	9.83	7.17	12.48
Q2 2007	9.28	7.90	5.24	10.57
Q3 2007	8.52	8.87	6.19	11.55
Q4 2007	10.80	9.58	6.88	12.28
Q1 2008	7.98	10.94	8.22	13.66
Q2 2008	7.64	9.02	6.28	11.75
Q3 2008	6.76*	9.98	7.23	12.73
Q4 2008	9.91	10.69	7.93	13.46
Q1 2009	10.24	12.05	9.27	14.83
Q2 2009	9.37	10.13	7.33	12.93
Q3 2009	8.57	11.10	8.28	13.91
Q4 2009	13.41	11.81	8.98	14.64
Q1 2010	13.95	13.16	10.32	16.01
Q2 2010	11.30	11.24	8.38	14.10
Q3 2010	12.62	12.21	9.33	15.09
Q4 2010	13.00	12.92	10.03	15.81

Significant *p<.05

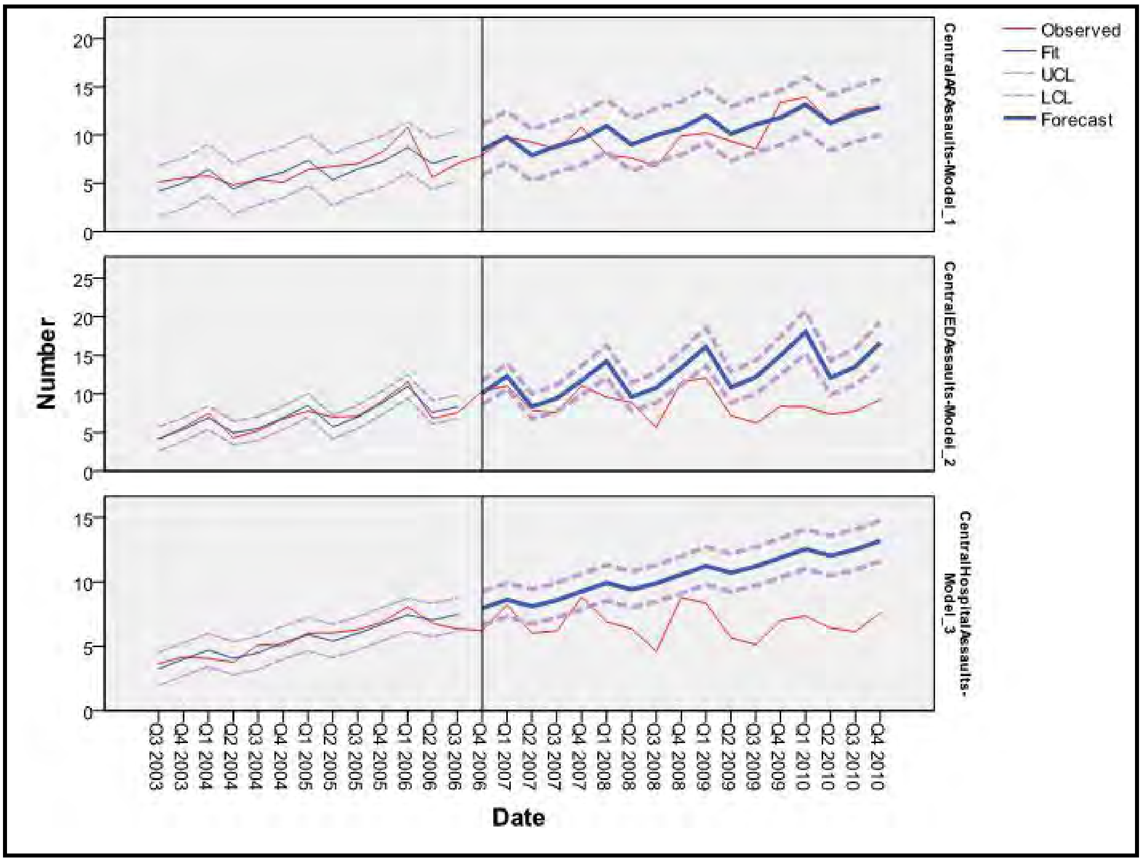
Table 30: Observed values, predicted values and confidence limits for assault separations per 1000 persons, Alice Springs Hospital

Quarter	Observed	Predicted	Lower Confidence Limit	Upper Confidence Limit
Q4 2006	6.21*	7.94	6.65	9.23
Q1 2007	8.21	8.61	7.30	9.92
Q2 2007	6.01*	8.09	6.76	9.42
Q3 2007	6.19*	8.57	7.22	9.92
Q4 2007	8.81	9.25	7.89	10.62
Q1 2008	6.90*	9.93	8.54	11.31
Q2 2008	6.35*	9.41	8.00	10.81
Q3 2008	4.60*	9.88	8.46	11.31
Q4 2008	8.79*	10.57	9.12	12.01
Q1 2009	8.33*	11.24	9.78	12.70
Q2 2009	5.65*	10.72	9.24	12.20
Q3 2009	5.12*	11.20	9.70	12.69
Q4 2009	7.00*	11.88	10.36	13.39
Q1 2010	7.35*	12.55	11.02	14.08
Q2 2010	6.41*	12.03	10.48	13.58
Q3 2010	6.13*	12.51	10.94	14.07
Q4 2010	7.60*	13.19	11.61	14.77

Significant *p<.05

Table 31: Predictive time-series model parameters for assaults per 1000 persons from different sources based on data from Q3 2003-Q3 2006

Variable	Model Type	Stationary R^2	MAPE	MaxAPE
Police alcohol-related assaults	Winters' Additive	.686	13.86	25.03
ED assaults	Winters' Multiplicative	.846	7.24	18.30
Hospital assaults	Winters' Additive	.569	7.98	17.53



*Number on the Y-axis refers to count of assaults per 1000 persons

Figure 44: Comparison of observed and forecast values for Q4 2006 until Q4 2010 based on models created from Q3 2003 to Q3 2006 for alcohol-related Police incidents, Emergency Department presentations and hospital separations, Alice Springs.

Assaults by Indigenous status and gender

The disparity between Indigenous and non-Indigenous alcohol-attributable harms is particularly apparent when hospital separations for assault only are considered. As shown in Figure 45, the greatest burden of assault per 1000 persons occurred among the Central Australian Indigenous population.

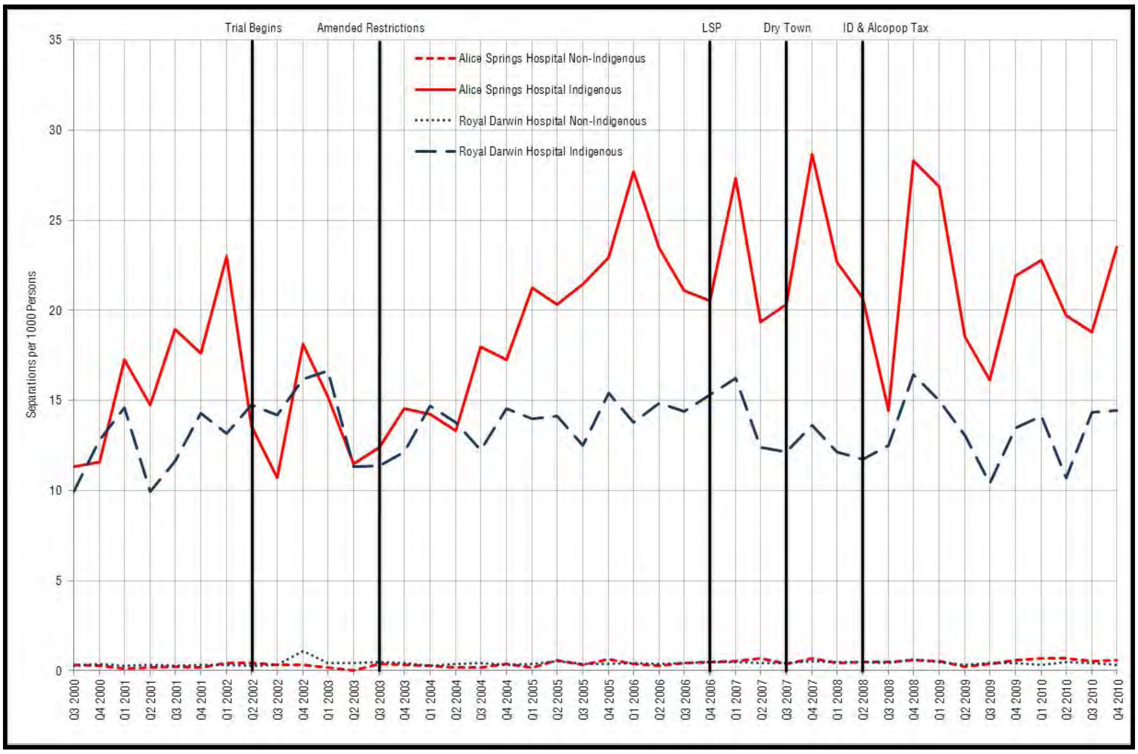


Figure 45: Hospital separations for assault per 1000 persons by Indigenous Status by quarter, Alice Springs Hospital and Royal Darwin Hospital, July 2000 – December 2010

As individual estimates for Indigenous populations by gender were not available the count of separations was used to examine the relationship between it and Indigenous status and gender. As shown in Figure 46, the rate of treatment of Indigenous females in Alice Springs Hospital (i.e. Central Australia) was conspicuously high, and at times, more than double that for Indigenous males. Throughout 2004 to 2006, the rate of separations for Indigenous females grew rapidly. After the introduction of the LSP, the increasing trend appeared to cease and stabilisation occurred at a mean rate of about 175 separations per quarter – although there were wide fluctuations.

This change was confirmed by forecast analysis using Q3 2003 to Q3 2006 as the reference period (Figure 47). The model showed significant deviations between observed and expected quarterly numbers of Indigenous female hospitalisations for most quarters from Q4 2006 onwards with observed values being lower. There were no significant differences between observed and expected trends for Indigenous males and non-Indigenous males and females (results not shown).

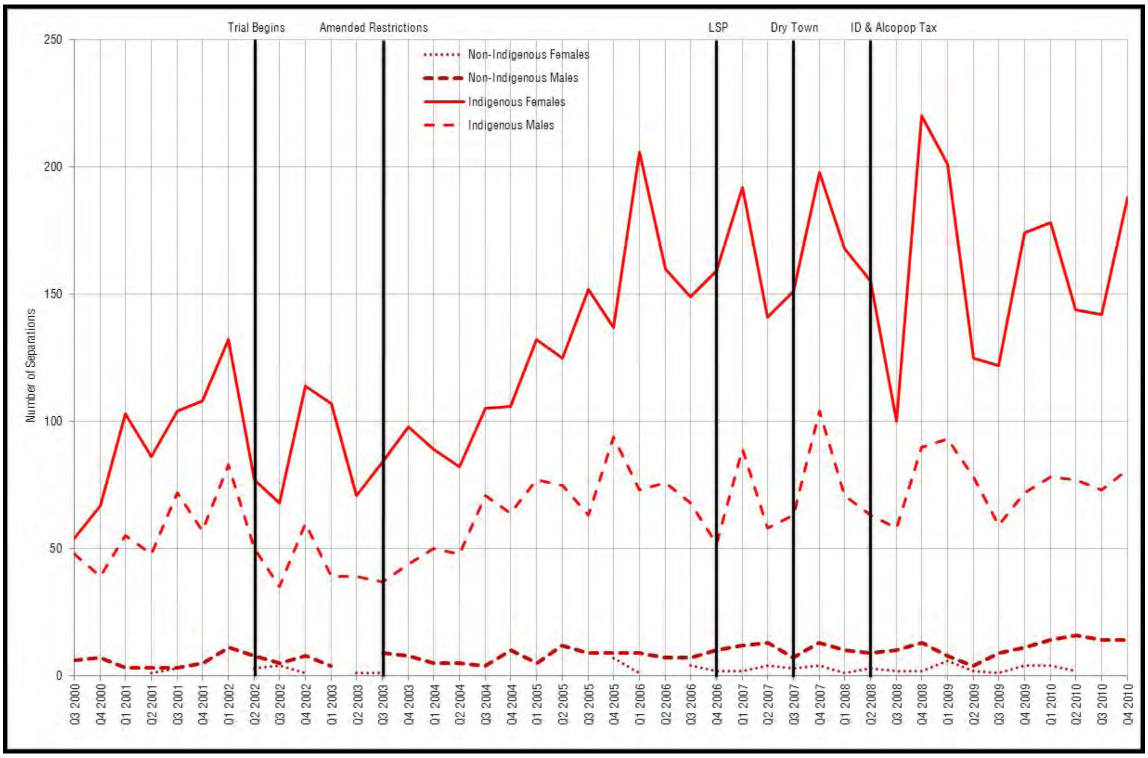


Figure 46: Number of hospital separations for assault by gender and Indigenous status by quarter, Alice Springs Hospital, July 2000 – December 2010

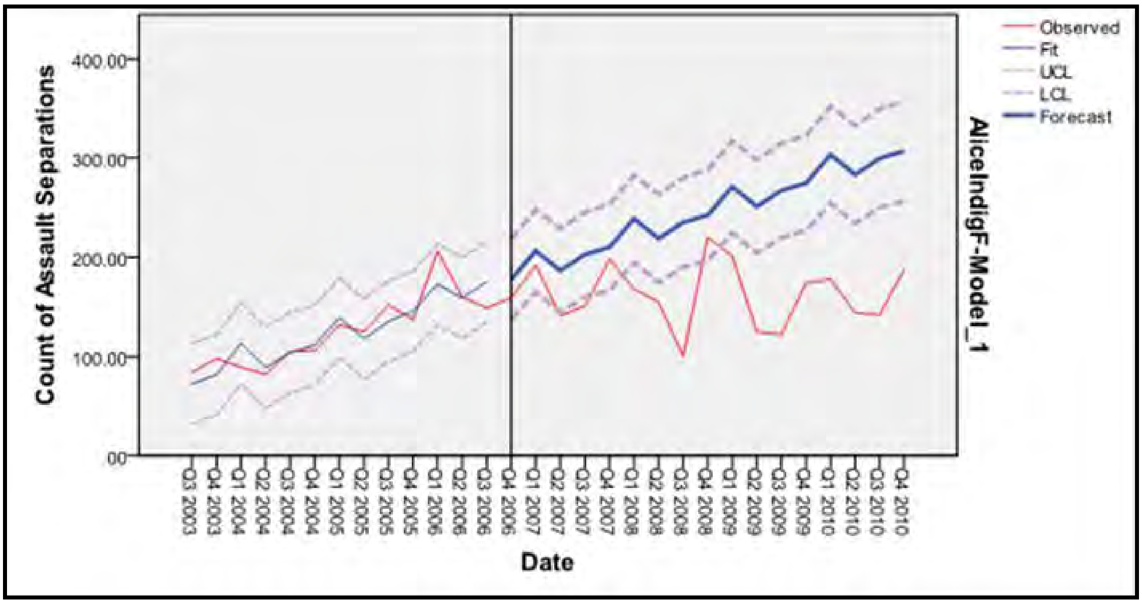


Figure 47: Number of hospital separations for assault for Indigenous females in Alice Springs, observed and forecast values based on a time-series model using data from Q3 2003 – Q3 2006

Summary of assault data

After the introduction of the LSP the rates of assault recorded at Alice Springs Hospital and ED were lower than expected had the pre-LSP trend continued. A similar reduction was not observed in assaults recorded by Alice Springs Police but this was likely due to increased focus and awareness of police on alcohol-related issues leading to heightened detection and recording of assault incidents. The three different sources of data on assaults can be viewed as representing a continuum of severity. For instance: police reported assaults included a broad cross-section of seriousness including many minor incidents; ED presentations included serious injuries requiring further hospitalisation but also included less serious injuries which could be treated with minimal medical attention; and finally, assaultive injuries requiring hospitalisation (i.e. admission to a ward) are generally serious in nature. The Indigenous population of Central Australia, and women in particular, were clearly subject to higher levels of assaultive injury than their non-Indigenous counterparts. Introduction of the LSP reduced the rapidly increasing trend towards higher rates of assault among Indigenous women apparent from 2004 to 2006.

7. Crime and Public Order

Police data have been widely used over many years by analysts and researchers to examine impacts of alcohol policy and have been recommended as suitable for the monitoring and evaluation of alcohol interventions.[6,18,47] However, the application of police data to the evaluation of interventions requires caution and the assistance of key informants with expert knowledge to help validate assumptions and interpret outcomes. During this study, in various interviews with police representatives, it became apparent that Northern Territory police data may not be a stable or straight forward proxy measure for studying the effects of the restrictions on alcohol-related harm within the Alice Springs community. The principal reason for this was that the number of incidents reported by police was strongly influenced by a range of factors – including changes in legislation, policy and practice, police staffing levels, and in the focus of policing activities at any one time – all of which present major challenges when interpreting the data.

North Territory police data are stored in the PROMIS computer software system. This system underwent various changes over the study period. These changes and the different areas within the reporting system in which offences may be entered can also influence the data provided. For example, there were suggestions that changes in the PROMIS system in 2007 may have led to an increase in the number of assaults being recorded. Also, apart from drink driving offences, there are generally no formal tests for the involvement of alcohol in offences – with the presence of alcohol being left to the discretion of the reporting officer.

Due to their serious nature and the additional investigative work required, homicides have been used in other studies as a reliable indicator of crime and public order harms related to alcohol. However, in the North Territory, the number of these was too low and the variability between intervals over time was too high to enable them be used as a suitable statistical indicator.

The categories of Police data that were available for analysis included assaults, domestic violence, anti-social behaviour, protective custody and drink driving. Within each of these categories there was a variety of incident types and data on them included the date and time of each incident. In some cases these data needed to be cleaned as there were small changes over time to the names of some incident types and codes associated with them.

It is important to note that for calculation of incident rates for the Alice Springs and Darwin-Palmerston areas the population denominators used were those for the town of Alice Springs and for Darwin City with Palmerston & East Arm. This ensured that the actual populations being policed by the respective stations were used, as there are separate police stations located in surrounding areas.

Assaults

Quarterly rates for all recorded assault incidents for both Alice Springs and Darwin are presented in (Figure 48). Overall, in Alice Springs the rate shows a general increase, albeit with some fluctuation. There was a gentle decline from Q3 2000 through to Q2 2004, a large increase from then until Q1 2006. In Q2 2006 there was a large fall which was followed by a steady increase until Q3 2008 and then a more rapid increase at the end of the study period.

Every assault recorded in the PROMIS system has a field for whether or not the reporting officer perceived it to be alcohol-related. Based on this, the trend for assaults recorded as alcohol-related was very similar to the pattern for all assaults. In Alice Springs, over the study period, the proportion of assaults recorded as alcohol-related in Alice Springs varied from 58 to 76 per cent but for most of the period ranged from 60 to 70 per cent. The proportion of assaults recorded as alcohol-related was lower in Darwin & Palmerston ranging from 40 to 60 per cent.

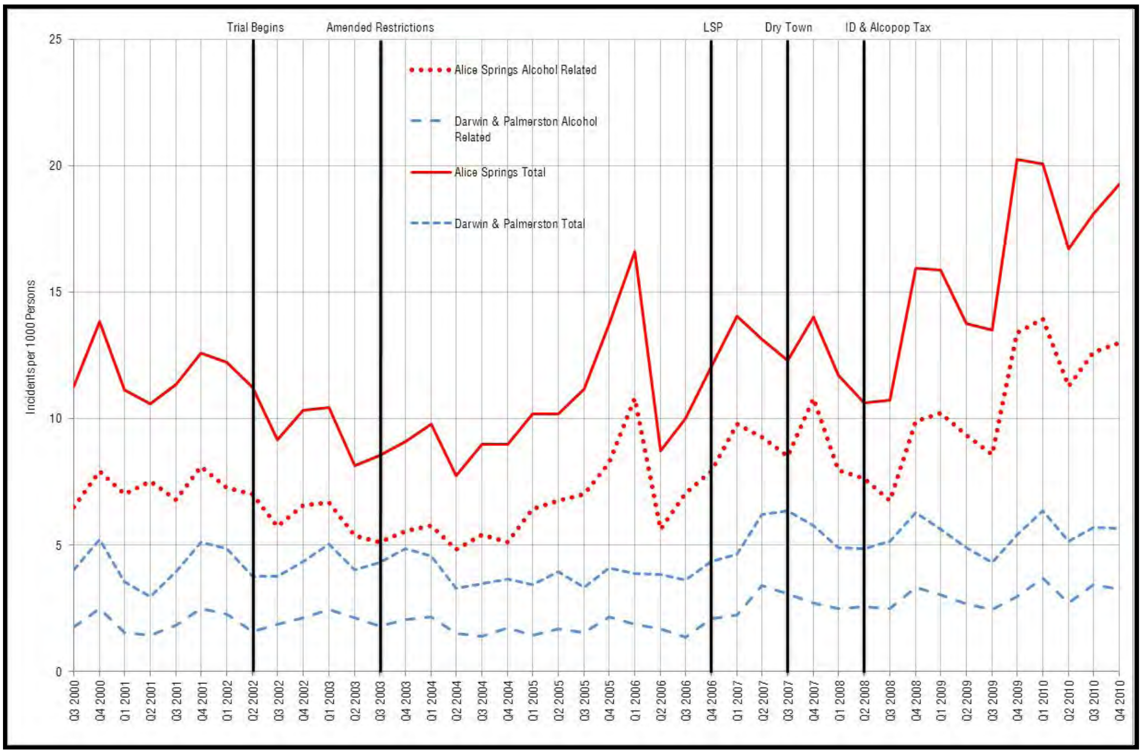


Figure 48: Total assault incidents and incidents recorded by police as alcohol-related per 1000 persons by quarter, Alice Springs and Darwin & Palmerston, July 2000 to December 2010

An initial baseline model was constructed to fit the temporal series of alcohol-related assaults in Alice Springs over the whole time period. The model described by the expert modeller was a simple seasonal model of average fit (Stationary R^2 = .554) with an average error above 10% (MAPE = 11.68%) and a large maximum error (MaxAPE = 52.11%) indicating that this series was difficult to model over the entire period. The independent associations between estimated per capita consumption and price with overall numbers of alcohol-related assaults (as the dependent variable) were tested. Estimated per capita alcohol consumption was not a significant predictor of alcohol-related assaults. However, wholesale price per litre was a significant negative predictor (estimate = -1.574, $p<.001$) at a lag of five quarters, apparently suggesting that the effect of a change in the wholesale price per litre on assaults was not apparent until five quarters later. This was indicated from an ARIMA(1,1,0)(0,1,0) model (Stationary R^2 =.431) with an average error over 10% (MAPE = 13.65%) and a very high maximum error (MaxAPE= 72.24%). However, the poor fit of the model indicates that other factors not tested here are likely to better explain the trend in alcohol-related assaults.

When examining the effects of the restrictions, only the Dry Town intervention was found to be significant (estimate = .325, $p<.05$), using an ARIMA(1,1,0)(0,1,0) model. Although the test of significance for the impact of the Dry Town was valid, given the low fit of the model (Stationary R^2 = .248) and the very large maximum error (MaxAPE = 102.77%), again, there were likely to have been other important factors, unknown and not tested here, likely to better explain the observed trend in alcohol-related assaults.

As with the health harms data, when the types of assault incidents were considered, there were major differences in the underlying patterns between Alice Springs (Figure 49) and Darwin & Palmerston (Figure 50). The ratio of 'Common Assault' to 'Serious Assault Not Resulting in Injury' was very different in the two districts. Alice Springs had a much greater proportion of assaults not resulting in injury, ruling out the use of Darwin & Palmerston as a suitable control region. In both locations 'Serious Assaults Resulting in Injury' was the only category that remained reasonably constant over the entire period (Figure 52).

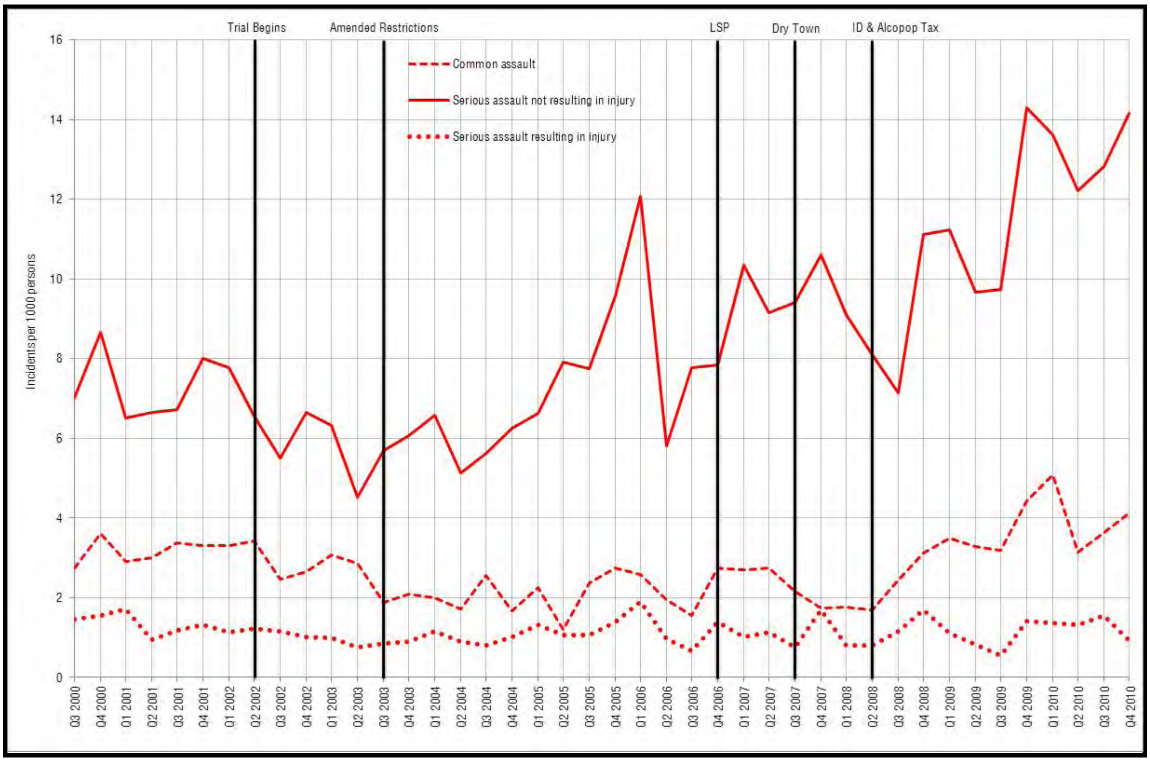


Figure 49: Types of assault incidents per 1000 persons by quarter, Alice Springs, July 2000 – December 2010

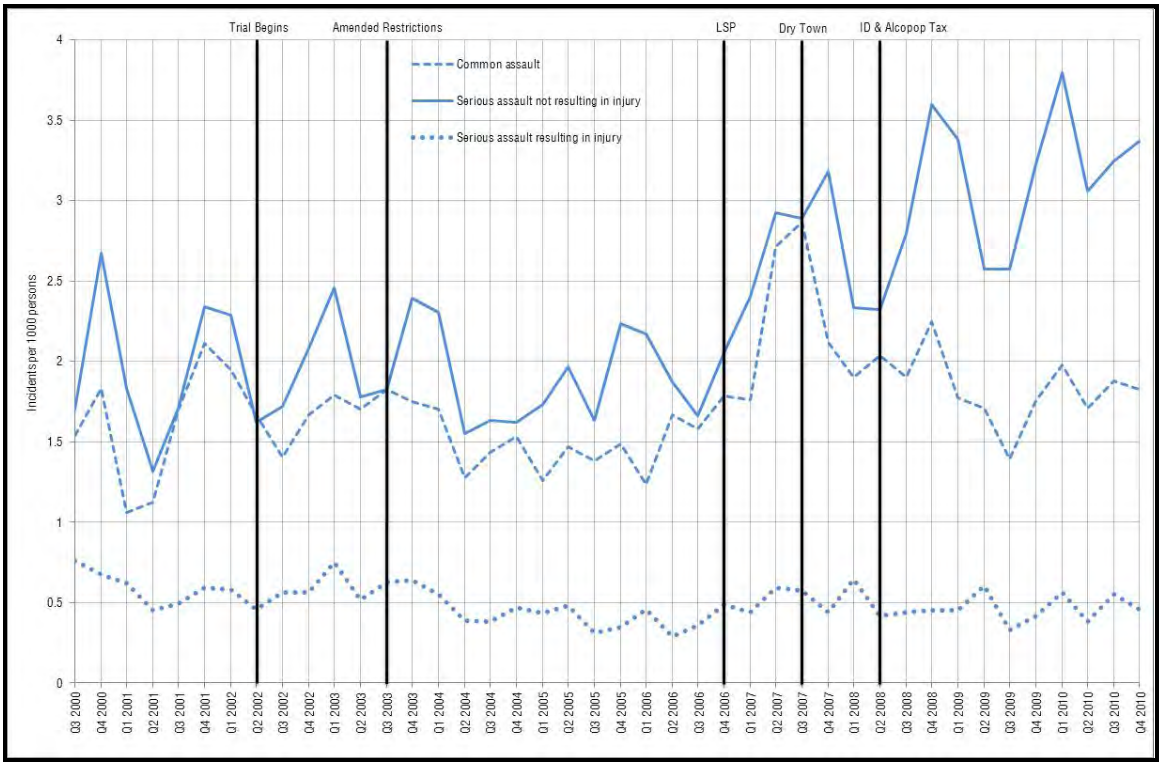


Figure 50: Types of assault incidents per 1000 persons by quarter, Darwin & Palmerston, July 2000 – December 2011

Keeping in mind the complexities inherent in interpreting police offence data, Poisson regression was applied to both assaults and serious assaults by comparing the ratio between alcohol-related incidents and non-alcohol-related incidents for each quarter. Reference periods were set as the quarter immediately preceding the introduction of restrictions and compared to estimates for subsequent quarters to determine if the ratio changed significantly.

For assaults during the Trial Restrictions, no significant change was indicated in any quarter, including immediately after its introduction and after the later Amended Restrictions (results not shown). In relation to the LSP, Poisson regression indicated that, compared to the reference quarter (Q3 2006), the ratio of alcohol to non-alcohol-related assaults was significantly lower in Q4 2006 (IRR = 0.804, p <.05) due to non-alcohol-related assaults increasing more quickly than alcohol-related assaults (Figure 51). The second quarter following the LSP (Q1 2007) did not differ significantly from the reference period (Table 32).

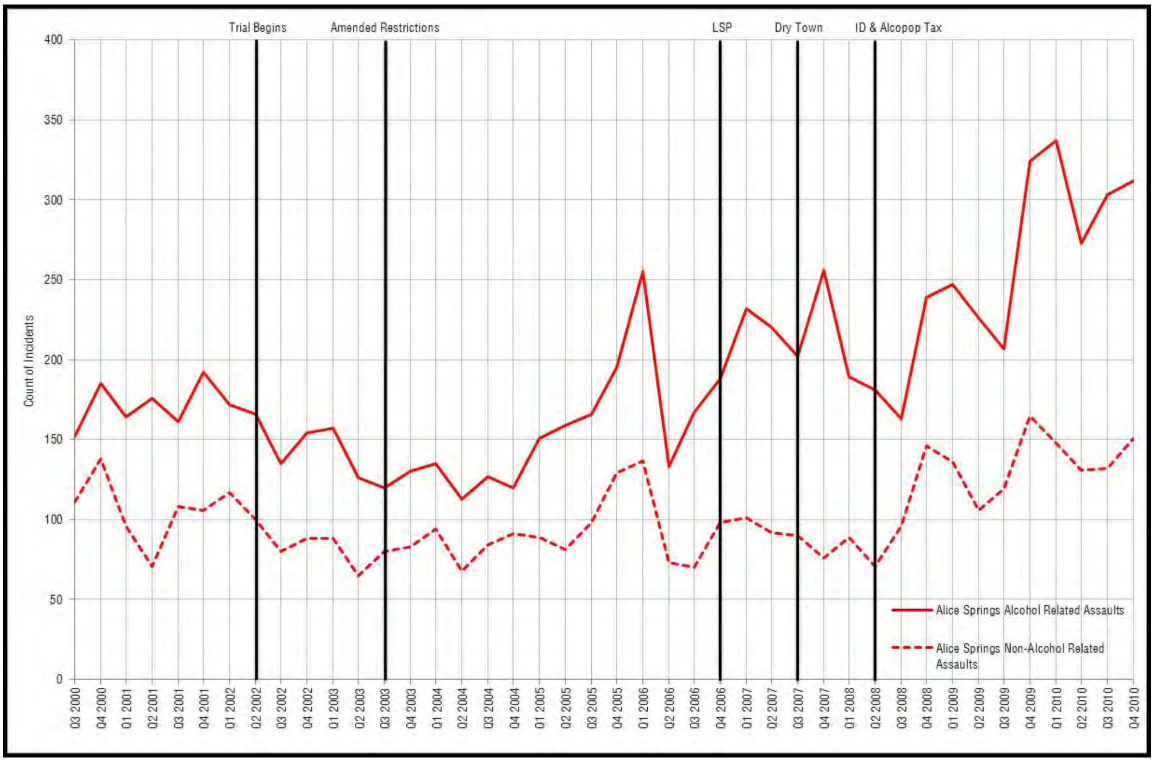


Figure 51: Numbers of alcohol-related and non-alcohol-related assault incidents by quarter, Alice Springs Police, July 2000 – December 2010

Table 32: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related assaults before and after the LSP (Q3 2006 reference quarter)

	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2006	Reference quarter					
Q4 2006	0.804	0.086	-2.05	0.040*	0.65	0.99
Q1 2007	0.962	0.098	-0.37	0.709	0.79	1.17

*Significant p<.05

After the introduction of the ID & 'alcopops tax', assaults showed a non-significant increase in Q2 2008 (IRR = 1.20, ns) which was then followed by significant decreases in the incidence rate ratio in Q3 2008 (IRR= 0.80, $p < 0.05$) and Q4 2008 (IRR= 0.77, $p < 0.05$) (Table 33). However, these declines were not maintained throughout and only in Q3 2009 was a significant decline recorded (IRR = 0.82, p<.05) while Q1, Q2 and Q4 of 2009 showed no significant change.

Table 33: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related assaults before and after the ID & 'alcopops tax' (Q1 2008 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2008	Reference quarter					
Q2 2008	1.200	0.125	1.76	0.079	0.98	1.47
Q3 2008	0.780	0.085	-2.09	0.036*	0.65	0.99
Q4 2008	0.770	0.075	-2.67	0.008*	0.64	0.93
Q1 2009	0.855	0.083	-1.62	0.106	0.71	1.03
Q2 2009	1.003	0.100	0.04	0.968	0.83	1.22
Q3 2009	0.819	0.082	-1.98	0.047*	0.67	1.00
Q4 2009	0.924	0.085	-0.86	0.392	0.77	1.11

*Significant p<.05

Serious Assaults

Interviews with police indicated that there were major changes to the way that violent incidents were recorded between 2005 and 2007. In light of this, they suggested that incidents of serious assault might be a more reliable indicator as they are generally investigated more extensively and documented more thoroughly. Again, it was apparent that there was a greater degree of seasonal variation present in the pattern of assaults in Alice Springs than in Darwin. The serious assault series was not particularly suited to ARIMA time series modelling due to small numbers of cases and large variation among intervals (Figure 52) therefore Poisson regression was used to investigate this series. The ratio of alcohol to non-alcohol-related serious assault incidents during each quarter subsequent to the beginning of a restriction were compared to the appropriate reference quarter. There was notably large quarterly variation in both the alcohol and non-alcohol-related series, particularly in the second half of the study period (Figure 53).

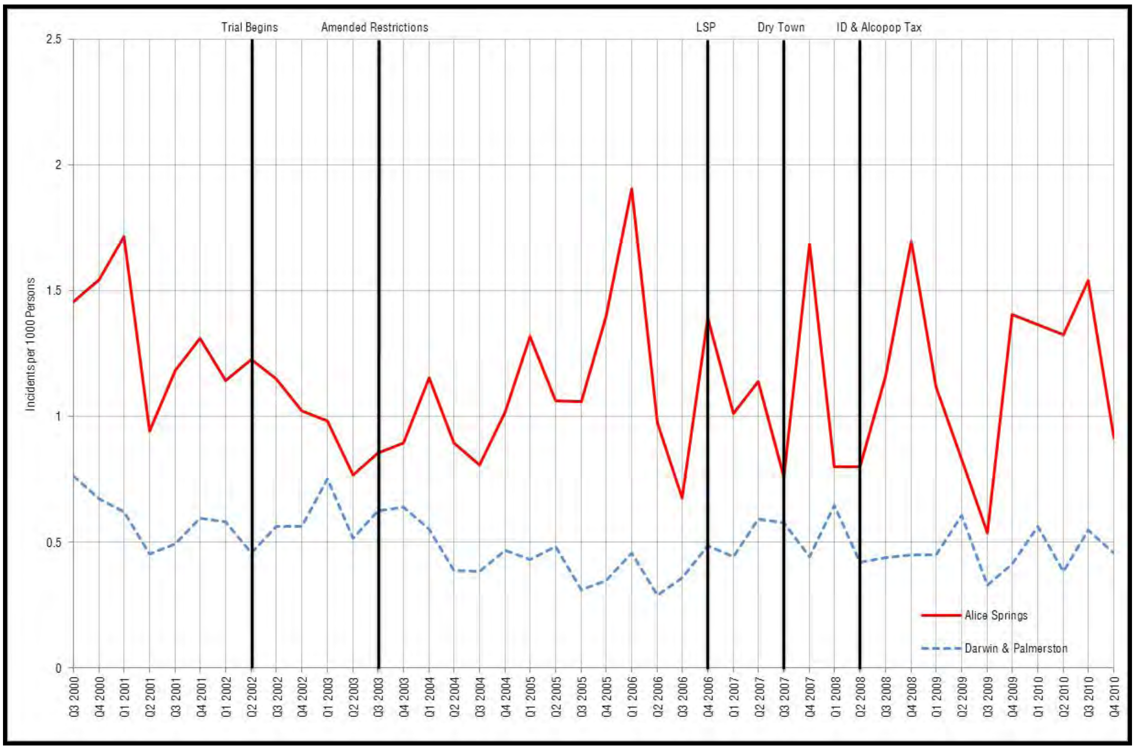


Figure 52: Serious assault incidents per 1000 persons, Alice Springs and Darwin & Palmerston Police, July 2000 – December 2010

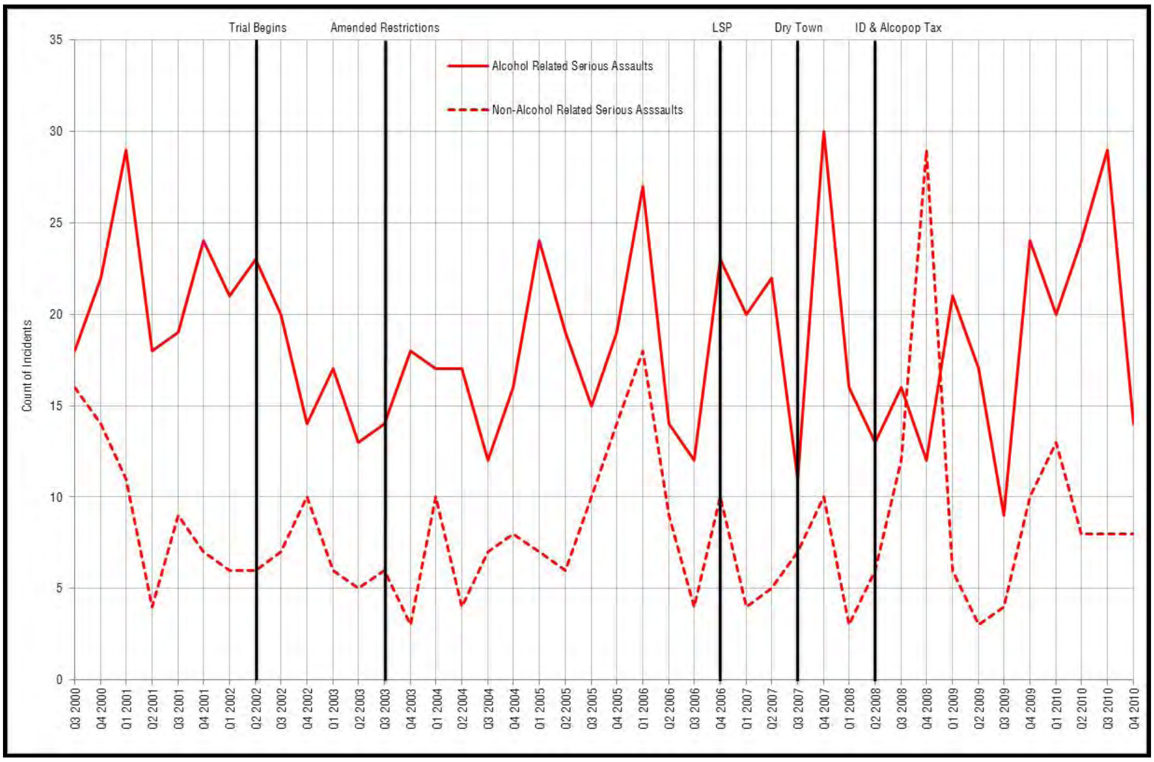


Figure 53: Numbers of alcohol-related and non-alcohol-related serious assault incidents by quarter, Alice Springs, July 2000 – December 2010

For the Trial Restrictions, Poisson regression indicated that – compared to the reference quarter (Q1 2002) – the ratio of alcohol to non-alcohol-related serious assaults was significantly lower for only one quarter in Q4 2002 (IRR= 0.4, p <.05). The other quarters did not differ significantly to the reference period (Table 34).

Table 34: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related serious assaults before and after the Trial Restrictions (Q1 2002 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2002	Reference quarter					
Q2 2002	1.095	0.331	0.3	0.763	0.61	1.98
Q3 2002	0.816	0.255	-0.65	0.516	0.44	1.51
Q4 2002	0.400	0.138	-2.66	0.008*	0.20	0.79
Q1 2003	0.810	0.264	-0.65	0.517	0.43	1.53
Q2 2003	0.743	0.262	-0.84	0.400	0.37	1.48

*Significant p<.05

Following the Amended Restrictions in Q3 2003, there was one quarter where the ratio between alcohol and non-alcohol-related serious assaults was significantly higher in Q4 2003 (IRR = 2.57, p<.05). However, after that, there were no further significantly different quarters in that period (Table 35).

Table 35: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related serious assaults before and after the Trial restriction amendment (Q3 2003 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2003	Reference quarter					
Q4 2003	2.571	0.916	2.65	0.008*	1.28	5.17
Q1 2004	0.729	0.263	-0.88	0.380	0.36	1.48

*Significant p<.05

There were no significant changes directly after the introduction of the LSP (Table 36). With the introduction of the Dry Town restrictions there was a single quarter (Q3 2007) with a significant reduction (IRR = .36, p<.05) in the ratio of alcohol-related and non-alcohol-related serious assaults (Table 37).

Table 36: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related serious assaults before and after the LSP (Q3 2006 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2006	Reference quarter					
Q4 2006	0.767	0.273	-0.75	0.456	0.38	1.54
Q1 2007	1.667	0.609	1.40	0.162	0.81	3.40

*Significant p<.05

Table 37: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related serious assaults before and after the Dry Town restrictions (Q2 2007 reference quarter)

Quarte	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q2 2007	Reference quarter					
Q3 2007	0.357	0.132	-2.79	0.005*	0.17	0.74
Q4 2007	0.682	0.191	-1.36	0.172	0.39	1.18
Q1 2008	1.212	0.398	0.59	0.558	0.63	2.31

*Significant p<.05

From the introduction of the ID & 'alcopops tax' restrictions there were significant (p<.05) reductions in the IRR for seven of the eleven quarters except Q1 & Q2 2009 and Q2 & Q3 of 2010 (Table 38). Changes in the counts of both alcohol-related and non-alcohol-related incidents were responsible for these reductions. For example, there was a particularly large spike in non-alcohol-related assaults in Q3 and Q4 of 2008 (Figure 53) with a similar, although smaller, increase in Q4 2009 and Q1 2010. In Q3 2009 there was a large drop in alcohol-related serious assaults recorded (Figure 54).

Table 38: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related serious assaults before and after the ID & 'alcopops tax' (Q1 2008 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2008	Reference quarter					
Q2 2008	0.406	0.152	-2.41	0.016*	0.20	0.84
Q3 2008	0.250	0.088	-3.92	0.000*	0.13	0.50
Q4 2008	0.078	0.030	-6.69	0.000*	0.034	0.16
Q1 2009	0.656	0.218	-1.27	0.204	0.34	1.26
Q2 2009	1.063	0.370	0.17	0.862	0.54	2.10
Q3 2009	0.422	0.176	-2.07	0.038*	0.19	0.95
Q4 2009	0.450	0.145	-2.47	0.013*	0.24	0.85
Q1 2010	0.288	0.097	-3.71	0.000*	0.15	0.56
Q2 2010	0.563	0.182	-1.78	0.075	0.30	1.06
Q3 2010	0.680	0.212	-1.24	0.215	0.37	1.25
Q4 2010	0.328	0.120	-3.05	0.002*	0.16	0.67

*Significant p<.05

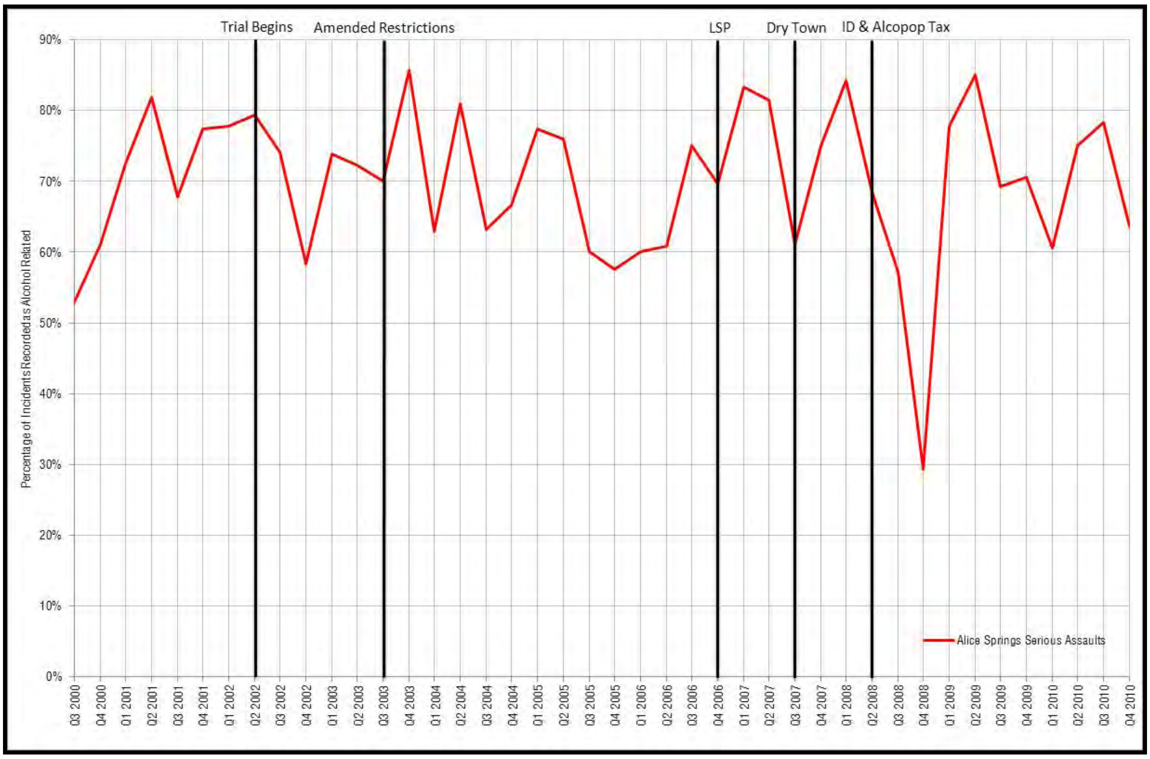


Figure 54: Percentage of serious assaults recorded as alcohol-related by quarter, Alice Springs, July 2000 – December 2010

Domestic Violence

The series for domestic violence in Alice Springs and Darwin & Palmerston appear fairly similar overall, both rising slowly until Q1 2007 then remaining relatively stable until about Q2 2008. Then, from Q4 2008 onwards there was a very large increase in Alice Springs while Darwin remained steady. Police officers suggested two main reasons for the large increase in Alice Springs. First, in the past, victims of assault were required to consent to police pressing charges before a prosecution was made. However in March 2009 the *Domestic and Family Violence Act* was passed under which mandatory reporting of domestic violence was introduced and under which police can press charges without the victim's consent. There was also a change in police powers which allowed them to issue 'on-the-spot' domestic violence orders. With more domestic violence orders being issued overall, there was a concomitant increase in the number of breaches and, hence, more overall domestic violence incidents were reported by police. Our expert sources attributed the differences between Alice Springs and Darwin & Palmerston to both underlying differences in the populations and different policing practices.

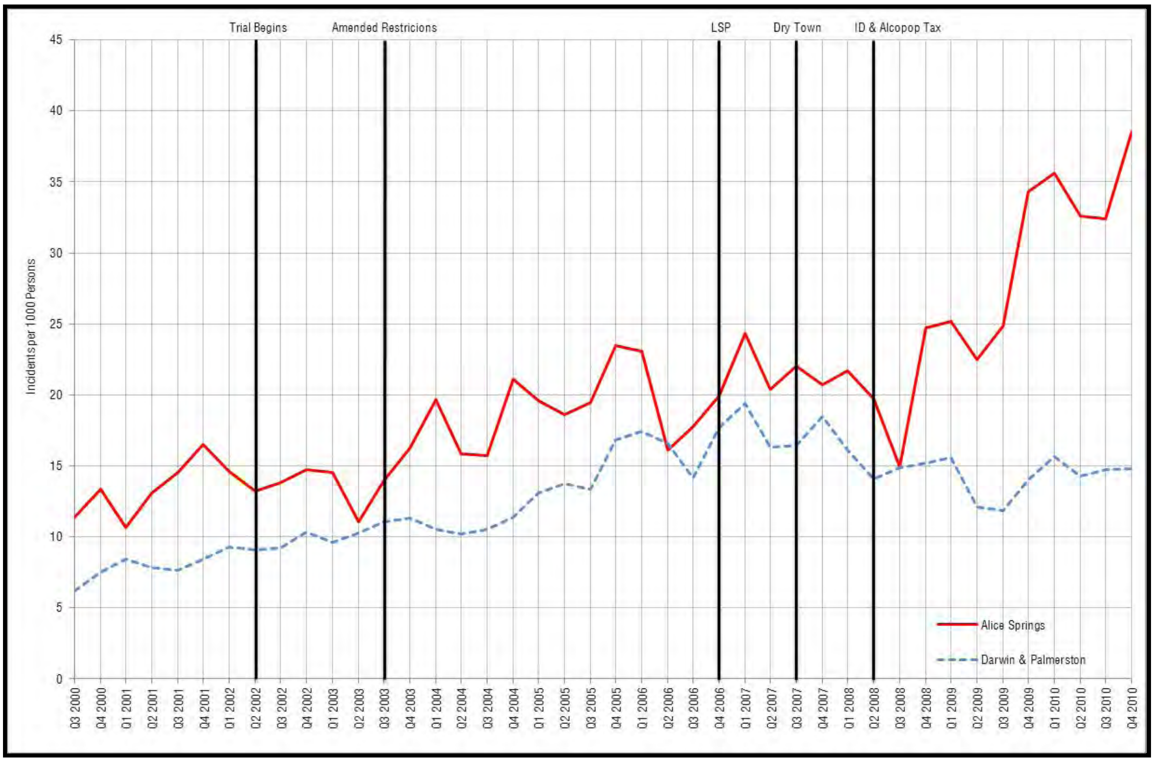


Figure 55: Domestic violence incidents per 1000 persons by quarter, Alice Springs and Darwin & Palmerston, July 2000 – December 2010

The breakdown of the types of domestic violence incidents in Alice Springs was examined where the incident category had been restricted to 'person'. In this case 'Disturbance–Domestic' was by far the largest category of incidents recorded. Domestic disturbances accounted for the most of the increase in Alice Springs from Q4 2008 onwards (after a drop in Q3 2008), and were recorded almost eight times more frequently than the next most common category, 'Breach–DVO' (Domestic Violence Order). As the major changes influencing the increase in the number of recorded domestic violence incidents were un-related to alcohol consumption, no further statistical analyses were undertaken.

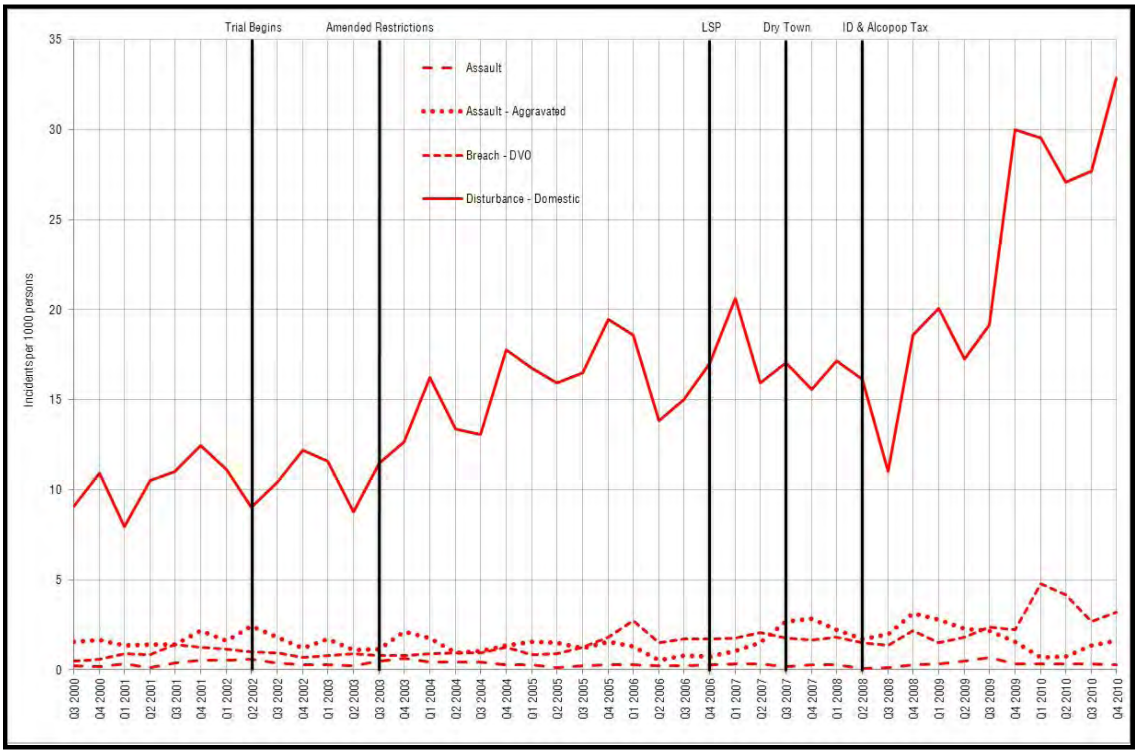


Figure 56: Main categories of domestic violence incidents per 1000 persons by quarter, Alice Springs, July 2000 – December 2010

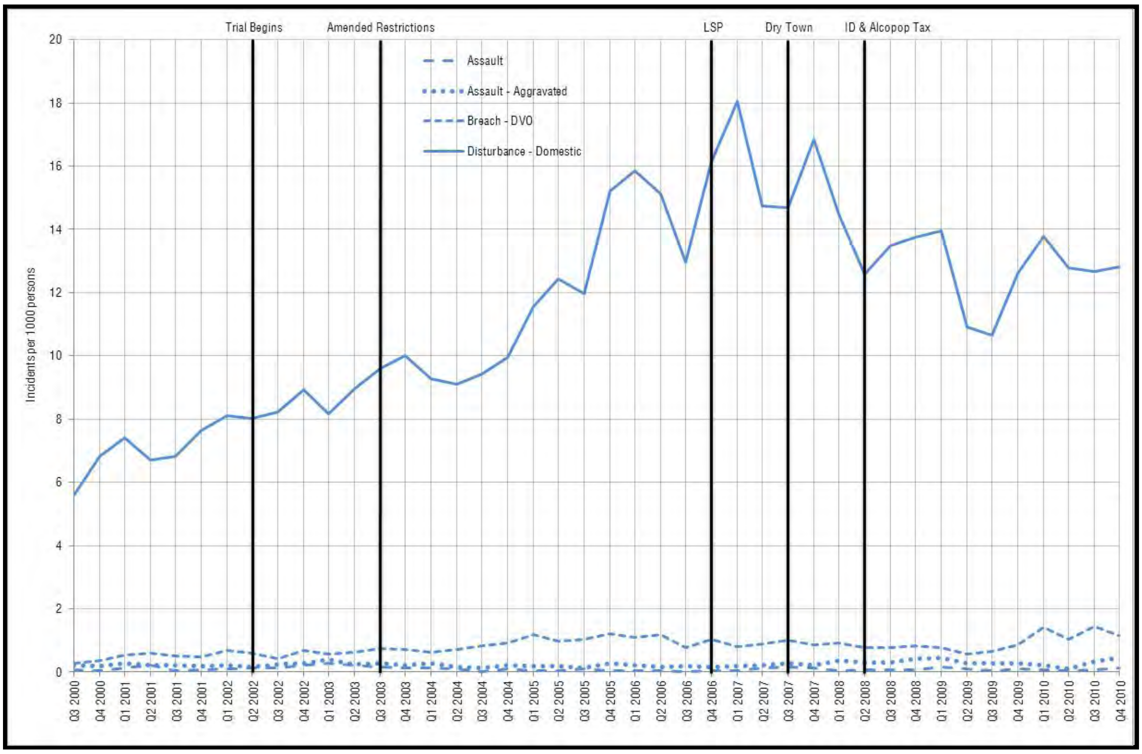


Figure 57: Main categories of domestic violence incidents per 1000 persons by quarter, Darwin & Palmerston, July 2000 – December 2010

Anti-social Incidents

Among the categories of incidents recorded, the Police officers interviewed regarded 'Anti-Social Incidents' as the category most likely to be influenced by policing practice and they advised that the results of any statistical analyses would require careful interpretation. It is noteworthy that Figure 58 shows a decline in anti-social incidents in Alice Springs during the period of the Trial Restrictions. Moreover, the proportion of all anti-social incidents in Alice Springs recorded by police as alcohol-related (Figure 59) decreased to less than 30 per cent until the second quarter after the end of the Trial (Q4 2003). After that time, both the total rate of anti-social incidents and the proportion reported as alcohol-related increased rapidly.

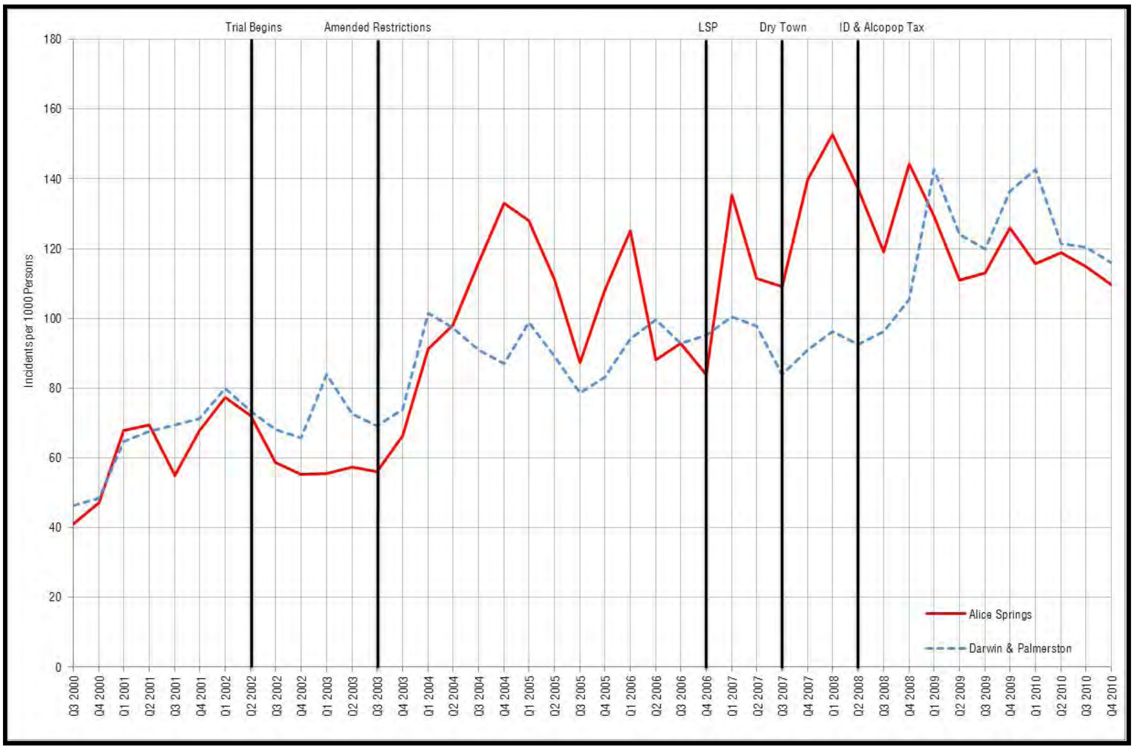


Figure 58: Anti-social incidents per 1000 persons by quarter, Alice Springs and Darwin & Palmerston July 2000 – December 2010

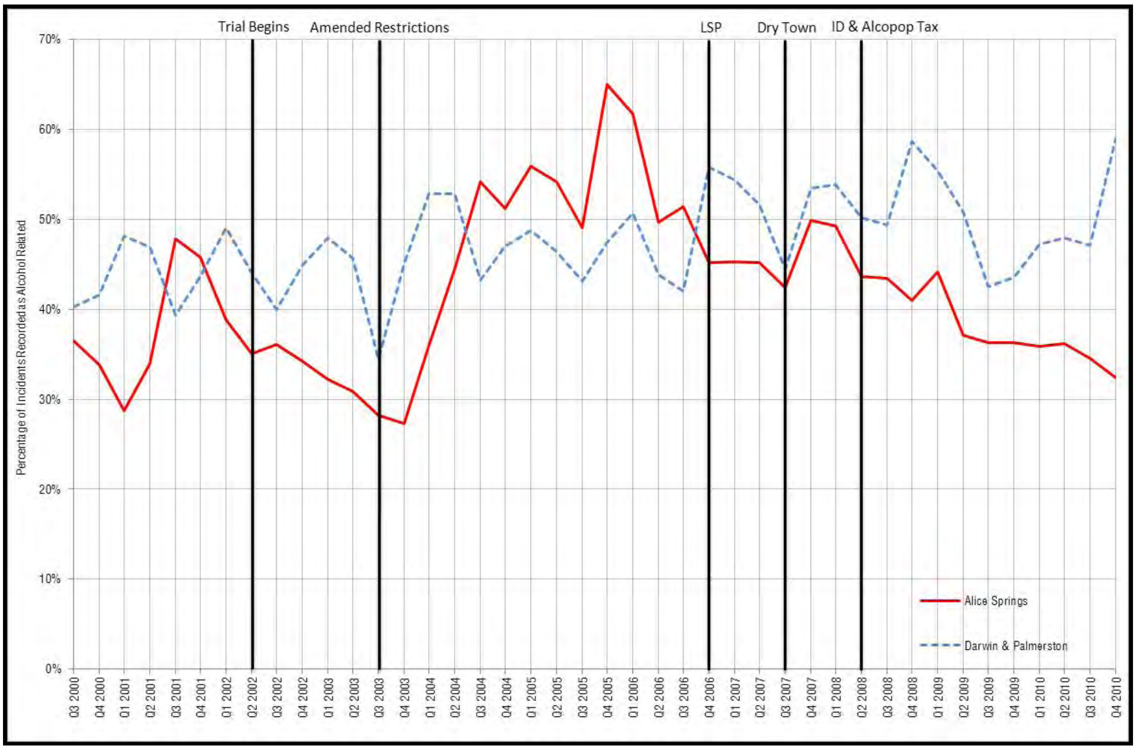


Figure 59: Percentage of anti-social incidents recorded as alcohol-related by quarter, Alice Springs and Darwin & Palmerston, July 2000 – December 2010

Results of Poisson regression analyses indicated that compared to the reference quarter (Q1 2002) there was a significant fall in the ratio of alcohol to non-alcohol-related anti-social incidents after the implementation of the Trial Restrictions in Q2 2002 and for all subsequent quarters until the Amended Restrictions in Q3 2003 (Table 39). This was partially influenced by a drop in non-alcohol-related incidents but more so by a larger drop in alcohol-related incidents (Figure 60). Furthermore, soon after the Trial Restrictions were amended in Q3 2003 there was a significant increase in the incidence rate ratio compared to the reference quarter for all quarters from Q1 2004 onwards, indicating that the proportion of alcohol-related anti-social incidents was higher (Table 40) because of a large and rapid increase in the number of alcohol-related incidents from under 500 per quarter to over 1500 per quarter (Figure 60). There was also a significant drop in the ratio compared with the reference quarter (Q3 2006) at the beginning of the LSP, with the exception of Q4 2007, and for all quarters until the end of the series (Table 41). This was the period directly after the introduction of the Dry Town legislation and before the ID and ‘alcopops tax’. This drop was underpinned by a decrease in the alcohol-related anti-social incidents, as non-alcohol-related incidents remained relatively steady (Figure 60).

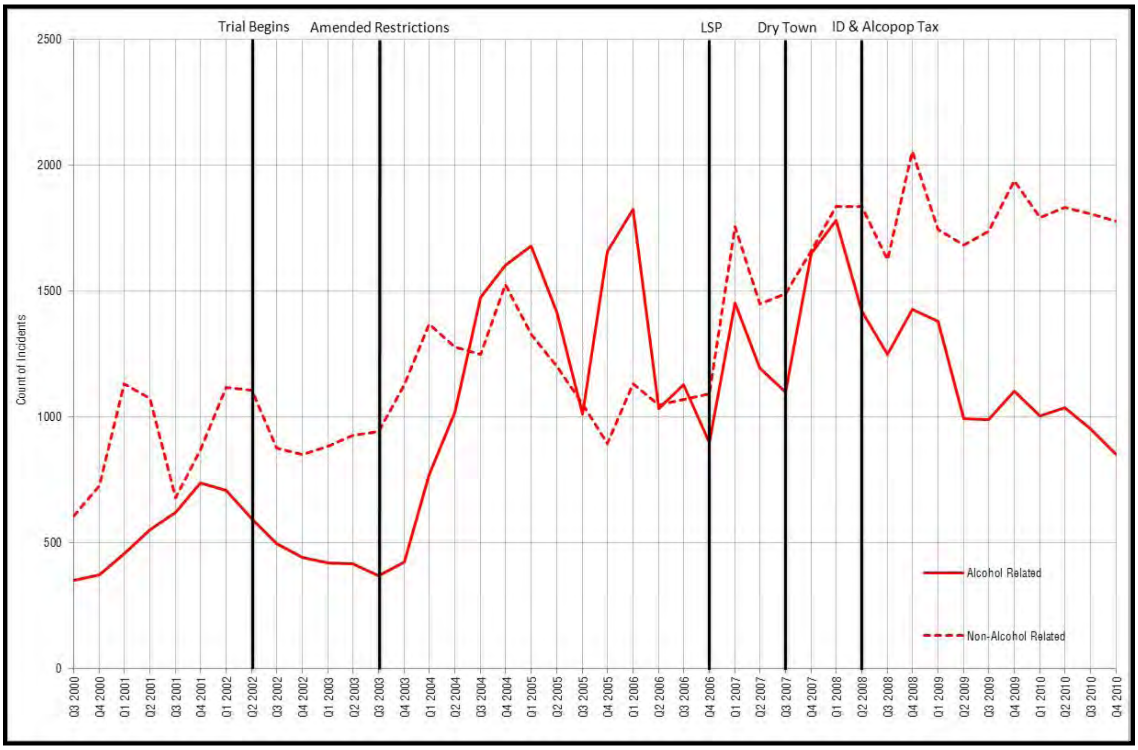


Figure 60: Numbers of alcohol related and non-alcohol-related anti-social incidents by quarter, Alice Springs, July 2000 – December 2010

It is not known, to what extent numbers of police reported anti-social incidents might have been influenced by changes in police reporting practices. Typically, however, the introduction of restrictions leads toward a sharpened focus on alcohol-related incidents by police. This may often result in artefactual increases in police reporting due to heightened awareness and increased targeting of activity.[10] However, this does not appear to be the case here, as the results of Poisson regression analyses are consistent with what would be expected to occur had the Trial Restrictions and the LSP reduced alcohol-related anti-social incidents in Alice Springs. That is, the overall rate of reported incidents declined and the proportion of the total incidents attributed to alcohol by police also declined.

Table 39: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related anti-social incidents before and after the Trial Restrictions (Q1 2002 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2002	Reference quarter					
Q2 2002	0.848	0.047	-2.96	0.003*	0.76	0.95
Q3 2002	0.888	0.052	-2.03	0.042*	0.79	0.99
Q4 2002	0.821	0.050	-3.26	0.001*	0.72	0.92
Q1 2003	0.746	0.046	-4.75	0.000*	0.66	0.84
Q2 2003	0.704	0.044	-5.68	0.000*	0.62	0.79
Q3 2003	0.618	0.040	-7.51	0.000*	0.54	0.70

*Significant p<.05

Table 40: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related anti-social incidents before and after the Amended Restrictions (Q3 2003 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2003	Reference quarter					
Q4 2003	0.956	0.068	-0.64	0.525	0.83	1.10
Q1 2004	1.433	0.091	5.68	0.000*	1.27	1.62
Q2 2004	2.037	0.124	11.73	0.000*	1.81	2.29
Q3 2004	3.017	0.175	18.99	0.000*	2.69	3.38
Q4 2004	2.676	0.154	17.06	0.000*	2.39	2.00
Q1 2005	3.226	0.185	20.4	0.000*	2.88	3.61
Q2 2005	3.007	0.176	18.86	0.000*	2.68	3.37
Q3 2005	2.452	0.150	14.76	0.000*	2.18	2.76
Q4 2005	4.723	0.271	27.01	0.000*	4.22	5.29
Q1 2006	4.116	0.235	24.82	0.000*	3.68	4.60
Q2 2006	2.517	0.152	15.24	0.000*	2.24	2.83

*Significant p<.05

Table 41: Poisson regression results estimating the incidence rate ratio of alcohol-related and non-alcohol-related anti-social incidents before and after the LSP (Q3 2006 reference quarter)

Quarter	IRR	Std. Err.	Z	P>z	95% Confidence Interval	
Q3 2006	Reference quarter					
Q4 2006	0.780	0.035	-5.57	0.000*	0.71	0.85
Q1 2007	0.784	0.031	-6.14	0.000*	0.73	0.85
Q2 2007	0.780	0.032	-5.98	0.000*	0.72	0.85
Q3 2007	0.699	0.030	-8.46	0.000*	0.64	0.76
Q4 2007	0.942	0.036	-1.55	0.120	0.87	1.02
Q1 2008	0.920	0.035	-2.22	0.026*	0.85	0.99
Q2 2008	0.732	0.029	-7.82	0.000*	0.68	0.79
Q3 2008	0.727	0.030	-7.76	0.000*	0.67	0.79

*Significant p<.05

Protective Custody

Police recorded protective custody incidents were also described by Police officers as being particularly susceptible to changes in policy, law and practice. As shown in Figure 61, from 2008, there were extreme fluctuations in the rate of protective custody orders issued by police in Alice Springs and these tended to coincide with internal policing changes described by interviewees. For example, the large increases in 2008 were attributed to a change in practice such that intoxicated people were taken into protective custody at an earlier stage of intoxication in an effort to interrupt potential offending opportunities. The large drop in 2010 was explained as being a result of a change in the interpretation of Section 128 of the *Police Administration Act* whereby a change in the definition of 'serious' was perceived as leading to increased danger to officers and thus less people were taken in to protective custody. For these reasons, no further analyses of these data were undertaken.

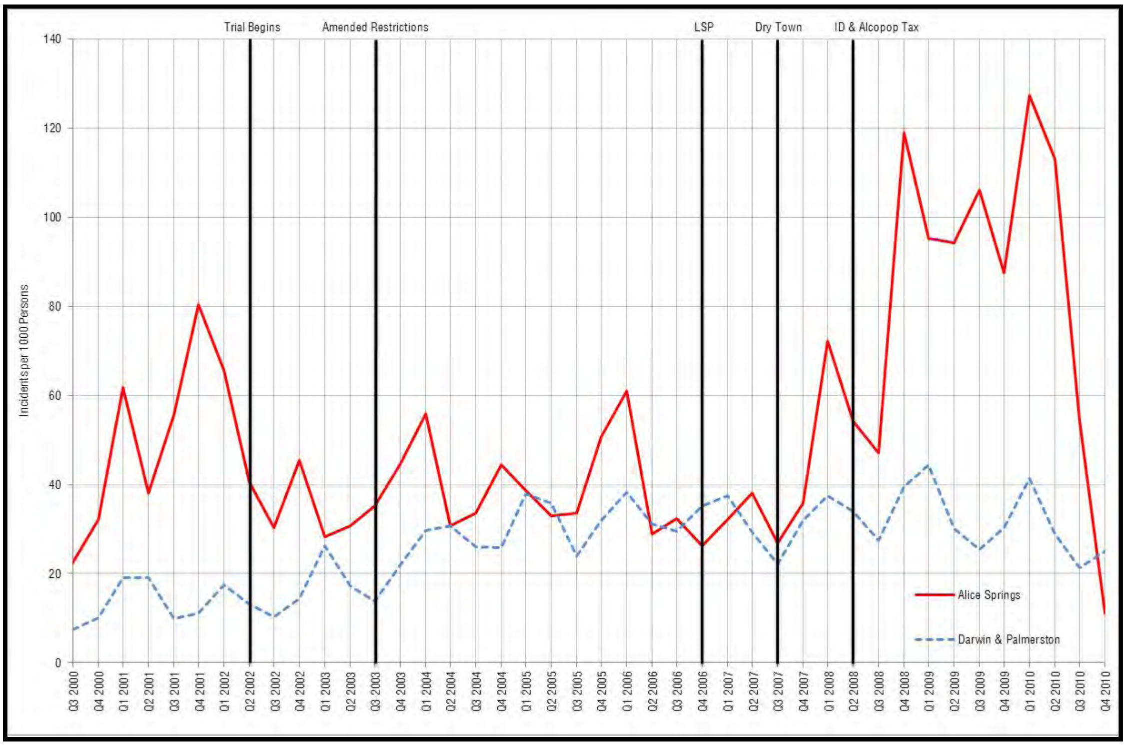


Figure 61: Protective custody incidents per 1000 Persons by quarter, Alice Springs and Darwin & Palmerston, July 2000 – December 2010

Drink Driving

Drink driving offences reported by police were also available and were tested with Poisson regression. Figure 62 shows the rate of drink driving incidents per 1000 persons – including persons actually driving or about to drive but excluding those people who refused tests. The variation in drink driving offence rates from quarter to quarter in Alice Springs was substantial, and again, police interviewees noted that this is an offence category which may be particularly susceptible to changes in policing practices, including the allocation of resources to traffic patrol and random breath testing. In fact, drink driving offences may be prone to increase rather than decrease subsequent to alcohol focused interventions as police road traffic patrol and testing activity rises, therefore increasing the likelihood of detecting offenders. If increased efforts are suitably large and sustained and increased numbers of drink drivers apprehended, over time, a decline in drink driver crashes would be expected to occur.[72] Unfortunately, however, drink driver crashes (a subset of all drink driving offences) were not provided as part of the police data and we were unable to explore this.

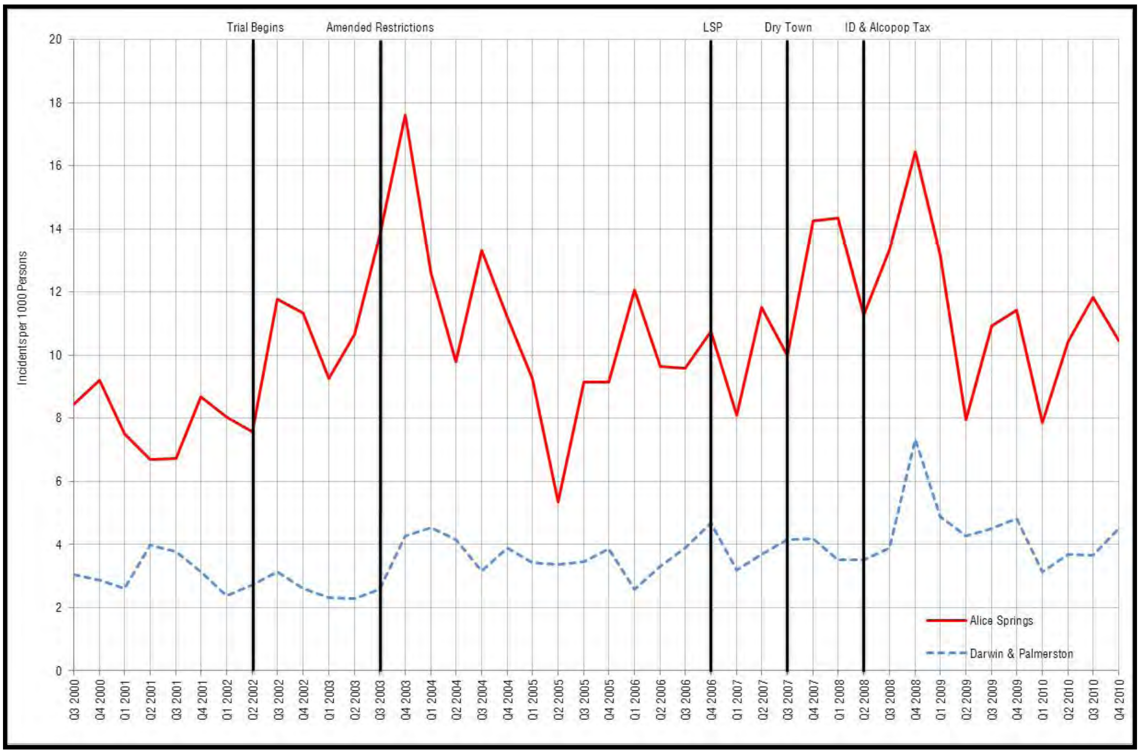


Figure 62: Police reported drink driving incidents per 1000 persons by quarter, Alice Springs and Darwin & Palmerston, July 2000 – December 2010

Given that all drink driving incidents are necessarily alcohol-related, when performing the Poisson regression analyses the numbers of incidents for each quarter were compared to a reference quarter to determine whether there had been significant changes. For the Trial Restrictions Poisson regression analysis indicated that, compared to the reference quarter (Q1 2002), the number of drink driving incidents was significantly higher ($p < .05$) for Q3 2002 and Q4 2002 and then again in Q2 and Q3 of 2003 (Table 42). The other quarters did not differ significantly to the reference quarter.

Table 42: Poisson regression results estimating the incidence rate ratio of drink driving incidents before and after the Trial Restrictions (Q1 2002 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2002	Reference quarter					
Q2 2002	0.942	0.098	-0.57	0.567	0.77	1.16
Q3 2002	1.453	0.137	3.96	0.000*	1.21	1.75
Q4 2002	1.400	0.133	3.54	0.000*	1.16	1.69
Q1 2003	1.142	0.113	1.34	0.181	0.94	1.39
Q2 2003	1.316	0.127	2.85	0.004*	1.09	1.59
Q3 2003	1.694	0.155	5.77	0.000*	1.42	2.03

*Significant p<.05

After the Amended Restrictions took effect – following the trend from the Trial period – there was one more quarter in which there was a significant increase (Q4 2003: IRR 1.28, p<.001). However, after that, the number of drink driving incidents was significantly (p < 0.001) lower than the reference quarter in Q2 2004 and then from Q1 2005 to Q3 2006, except for Q2 2006.

Table 43: Poisson regression results estimating the incidence rate ratio of drink driving incidents before and after the Trial restriction amendments (Q3 2003 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2003	Reference quarter					
Q4 2003	1.280	0.095	3.31	0.001*	1.11	1.48
Q1 2004	0.916	0.074	-1.09	0.277	0.78	1.07
Q2 2004	0.711	0.061	-3.94	0.000*	0.60	0.84
Q3 2004	0.972	0.077	-0.36	0.721	0.83	1.14
Q4 2004	0.817	0.068	-2.44	0.015*	0.69	0.96
Q1 2005	0.677	0.059	-4.45	0.000*	0.57	0.80
Q2 2005	0.391	0.041	-8.93	0.000*	0.32	0.48
Q3 2005	0.671	0.059	-4.54	0.000*	0.56	0.80
Q4 2005	0.671	0.059	-4.54	0.000*	0.56	0.80
Q1 2006	0.885	0.072	-1.5	0.133	0.75	1.04
Q2 2006	0.708	0.061	-3.99	0.000*	0.60	0.84
Q3 2006	0.705	0.061	-4.03	0.000*	0.59	0.84

*Significant p<.05

With the introduction of the LSP there was no immediate change apparent in quarterly drink driving rates – although, when compared to the reference quarter, in Q2 2007 there was a significant increase (IRR = 1.20, p<.05) (Table 44). When the Dry Town restrictions were introduced there was also no immediate change, but there were significant increases in both Q4 2007 and Q1 2008 (p<.05) (Table 45). After the introduction of the ID & 'alcopops tax' restrictions there were some large variations. Initially there was a significant decrease (IRR = .79, p<.05) in drink driving incidents in Q2 2008, followed by a significant (IRR = 1.17, p<.05) increase in Q4 2008, and then stabilising at significantly (p<.05) lower values from Q2 2009 onwards (Table 46).

Table 44: Poisson regression results estimating the incidence rate ratio of drink driving incidents before and after the LSP (Q3 2006 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2006	Reference quarter					
Q4 2006	1.123	0.103	1.27	0.202	0.94	1.34
Q1 2007	0.846	0.083	-1.71	0.088	0.70	1.03
Q2 2007	1.203	0.108	2.05	0.040*	1.01	1.43

*Significant p<.05

Table 45: Poisson regression results estimating the incidence rate ratio of drink driving incidents before and after the Dry Town restrictions (Q2 2007 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q2 2007	Reference quarter					
Q3 2007	0.868	0.077	-1.59	0.111	0.73	1.03
Q4 2007	1.238	0.101	2.62	0.009*	1.06	1.45
Q1 2008	1.245	0.101	2.7	0.007*	1.06	1.46

*Significant p<.05

Table 46: Poisson regression results estimating the incidence rate ratio of drink driving incidents before and after the ID and 'alcopops tax' restrictions (Q1 2008 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence	Interval
Q1 2008	Reference quarter					
Q2 2008	0.785	0.064	-2.96	0.003*	0.67	0.92
Q3 2008	0.947	0.074	-0.70	0.484	0.81	1.103
Q4 2008	1.168	0.086	2.10	0.036*	1.01	1.35
Q1 2009	0.935	0.073	-0.86	0.391	0.80	1.09
Q2 2009	0.565	0.051	-6.33	0.000*	0.47	0.67
Q3 2009	0.776	0.064	-3.08	0.002*	0.66	0.91
Q4 2009	0.812	0.066	-2.57	0.010*	0.69	0.95
Q1 2010	0.559	0.051	-6.42	0.000*	0.47	0.67
Q2 2010	0.741	0.062	-3.60	0.000*	0.63	0.87
Q3 2010	0.835	0.067	-2.24	0.025*	0.71	0.97
Q4 2010	0.738	0.061	-3.65	0.000*	0.63	0.87

*Significant p<.05

Road crash injury hospital separations

As indicated above, police data on drink driver crashes were not available to us. As an alternative to these data, we analysed separations from Alice Springs Hospital for both pedestrians and non-pedestrian road crash injuries. It should be noted, however, that the presence of alcohol was not confirmed in these data and only a proportion of all cases would have been attributable to alcohol. The quarterly counts of both road crash injury separations and non-road crash separations are plotted in Figure 63. Overall road crash injury separations constituted less than two per cent of total separations and there were large variations in the percentage by quarter (Figure 64). This variation was largely underpinned by the changes in the number of road crash injury separations as the number of non-road crash separations increased at a fairly stable rate apart from dips in Q2 2003, Q1 2008 and Q2 2009.

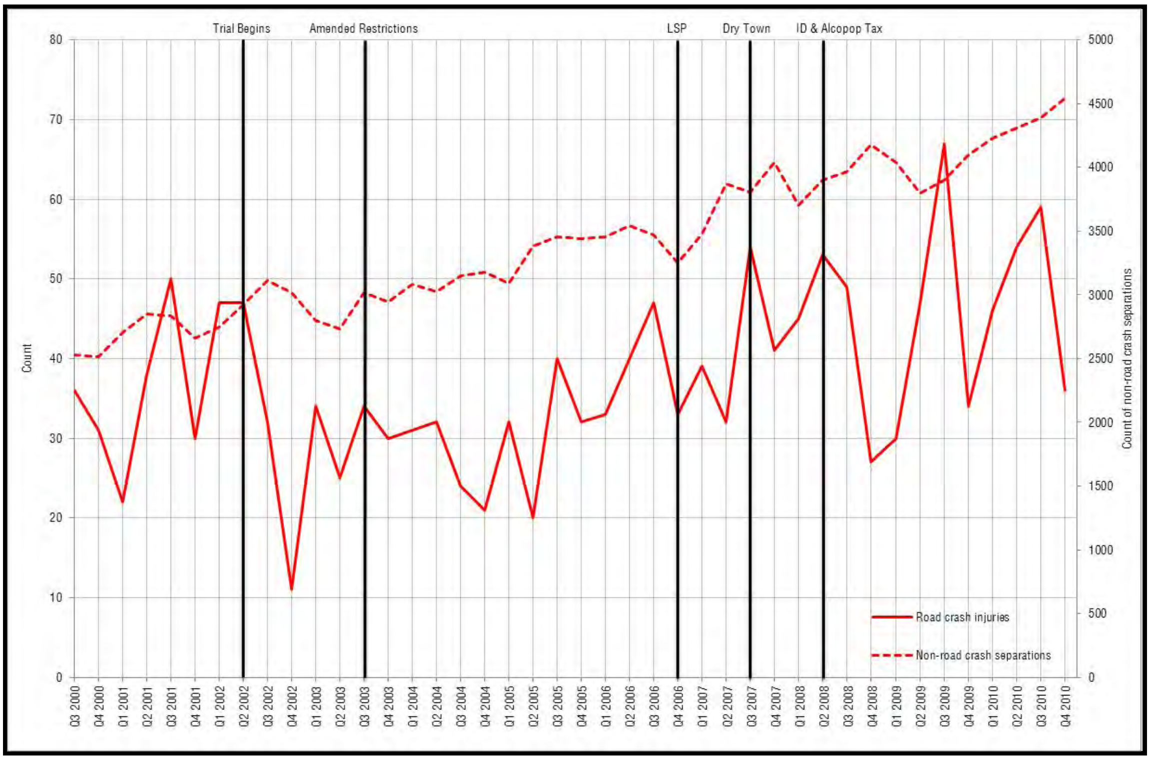


Figure 63: Numbers of road crash injury and non-road crash hospital separations by quarter, Alice Springs Hospital, July 2000 – December 2010

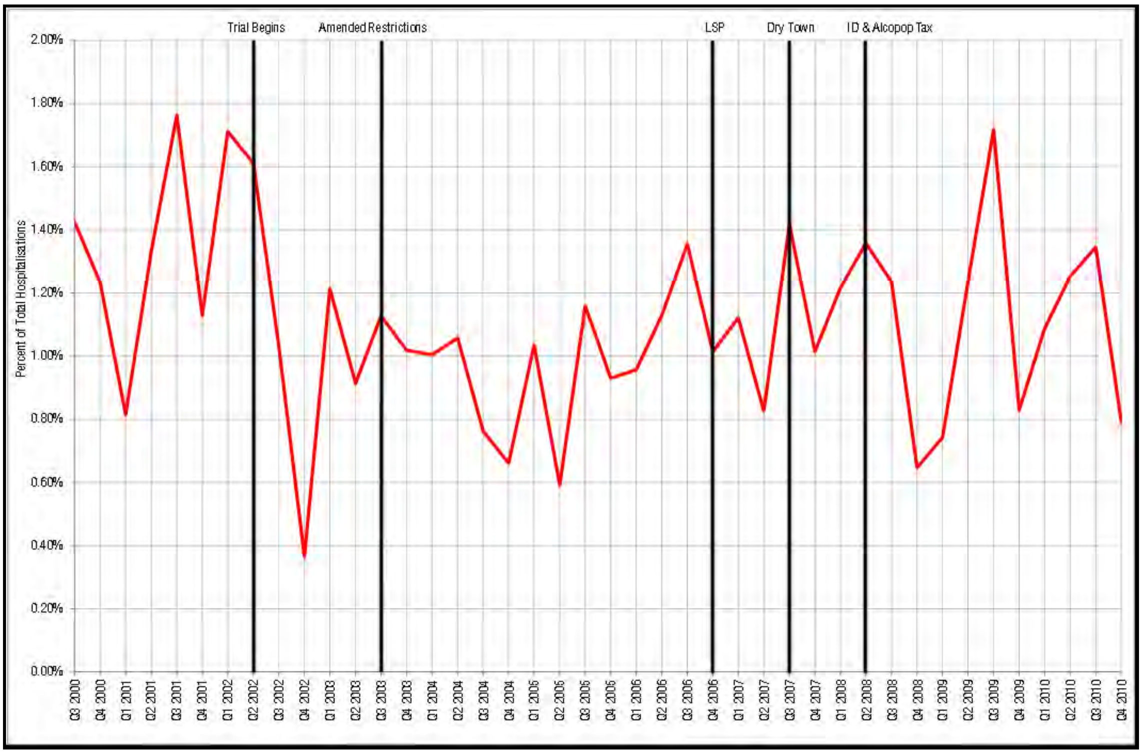


Figure 64: Road crash injury separations as a percentage of total hospital separations by quarter, Alice Springs Hospital, July 2000 – December 2010

Poisson regression was conducted comparing quarterly ratios of road crash injury and non-crash injury separations at Alice Springs Hospital to the reference quarter Q1 2002. During the period from the introduction of the Trial Restrictions until introduction of the LSP, compared to the reference quarter, there were significant reductions ($p<.05$) in the IRR for 13 of the 16 quarters (Table 47). This is largely indicative of declines in road crash injuries relative to non-road crash injuries. This contrasts with drink driving incidents reported by police which were significantly higher during the Trial Restrictions (Table 42). However, for the period after the introduction of the Amended Restrictions both drink-driving incidents and road crash injury hospital separations were significantly lower when compared with their respective reference quarters.

The pattern revealed by Poisson regression for the period after the LSP indicated that only a few quarters experienced significant declines in the ratio of road crash injury to non-road crash separations when compared to the reference quarter (Q3 2006): Q2 2007 (IRR = 0.61, $p<.05$), Q4 2008 (IRR = .48, $p<.05$) and Q1 2009 (IRR = .55, $p<.05$) (Table 48). Again this is the opposite of the results from the police drink driving incident data which showed some increases in the reported number of incidents after the LSP and the Dry Town restrictions and then some significant decreases from Q2 2009 onwards.

Table 47: Poisson regression results estimating the incidence rate ratio of road crash injury and non-road crash separations before and after the Trial Restrictions (Q1 2002 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q1 2002	Reference quarter					
Q2 2002	0.941	0.194	-0.30	0.767	0.63	1.41
Q3 2002	0.601	0.1378	-2.22	0.026*	0.38	0.94
Q4 2002	0.213	0.071	-4.62	0.000*	0.11	0.41
Q1 2003	0.709	0.160	-1.53	0.127	0.46	1.10
Q2 2003	0.534	0.132	-2.53	0.011*	0.33	0.87
Q3 2003	0.658	0.148	-1.86	0.063	0.42	1.02
Q4 2003	0.595	0.139	-2.22	0.026*	0.38	0.94
Q1 2004	0.587	0.136	-2.30	0.021*	0.37	0.92
Q2 2004	0.618	0.142	-2.10	0.036*	0.39	0.97
Q3 2004	0.446	0.112	-3.22	0.001*	0.27	0.73
Q4 2004	0.386	0.101	-3.62	0.000*	0.23	0.65
Q1 2005	0.605	0.139	-2.19	0.028*	0.39	0.95
Q2 2005	0.346	0.092	-3.98	0.000*	0.20	0.58
Q3 2005	0.677	0.146	-1.81	0.070	0.44	1.03
Q4 2005	0.543	0.125	-2.66	0.008*	0.35	0.85
Q1 2006	0.559	0.127	-2.56	0.010*	0.36	0.87

*Significant p<.05

Table 48: Poisson regression results estimating the incidence rate ratio of road crash injury and non-road crash separations before and after the LSP (Q1 2002 reference quarter)

Quarter	IRR	Std. Err.	z	P>z	95% Confidence Interval	
Q3 2006	Reference quarter					
Q4 2006	0.749	0.170	-1.27	0.203	0.48	1.17
Q1 2007	0.828	0.179	-0.87	0.382	0.54	1.27
Q2 2007	0.610	0.140	-2.16	0.031	0.39	0.96
Q3 2007	1.047	0.209	0.23	0.818	0.71	1.55
Q4 2007	0.749	0.160	-1.35	0.176	0.49	1.14
Q1 2008	0.898	0.187	-0.52	0.605	0.60	1.35
Q2 2008	1.003	0.201	0.01	0.990	0.68	1.48
Q3 2008	0.911	0.186	-0.45	0.650	0.61	1.36
Q4 2008	0.477	0.115	-3.06	0.002	0.30	0.77
Q1 2009	0.548	0.128	-2.57	0.010	0.35	0.87
Q2 2009	0.913	0.188	-0.44	0.658	0.61	1.37

*Significant p<.05

Summary of Results From Police Incident Data

Use of homicide data to measure the impact of restrictions in Alice Springs was precluded because the number was too low and variability between intervals over time was too high to subject them to statistical analyses. Analyses of other Police incident data showed that, over the study period, there were extreme fluctuations in protective custody and drink driving incidents, and there had been statistically significant increases in domestic violence and protective custody incidents. However, we were advised by officers from the NT Police that the frequency of these incidents was particularly susceptible to changes in policing policy and the allocation of resources and in the case of domestic violence to changes in the law. For these reasons, they advised that changes in the data were more likely to be indicative of Police activity than they were of the likely impact of restrictions.

As we did not have data on drink driver crashes, we examined hospital separation data on the ratio of road crash injuries (not all of which would have been alcohol-related) to non-road crash injuries. The numbers of the former were small and subject to considerable fluctuation. Following introduction of the Trial Restrictions there were significant reductions in 13 of the 16 following quarters but there were no significant changes associated with any of the other restrictions and no firm conclusions can be drawn about the relationship of these to the restrictions.

There was a statistically significant negative relationship between the wholesale price of alcohol and alcohol-related assaults – i.e. with increases in price there appeared to be a decline in assaults. However, a lag between the apparent effect and the poor fit of the time series model indicates that this was probably an artefact of unidentified confounding factors.

Despite the findings summarised above, however it was found that:

- after the introduction of the ID & 'alcopops tax' restrictions, the ratio of alcohol-related to non-alcohol-related serious assaults was significantly lower in seven of eleven quarters (through a combination both of increases in non-alcohol-related incidents and decreases in alcohol-related incidents); and,
- following both the Trial Restrictions and introduction of the LSP there were significant reductions in the percentage of anti-social behaviour incidents that were alcohol-related and which appear to be related to those restrictions.

8. Summary

Since the introduction of a Trial of additional licensing restrictions in April 2002, a number of supplementary alcohol control measures have been implemented in Alice Springs. Given the sometimes contentious nature of such restrictions and the often polarised attitudes to them within the community, there is keen interest in evaluations of their impact. There is a set of indicators – that are generally agreed upon internationally – for measuring the impact of such control measures and the data necessary to do so are available for the Northern Territory. However, practically there are some difficulties in evaluating the Alice Springs restrictions 'on the ground'. First rigorous evaluation requires a considerable time series of data measurements both prior and subsequent to the introduction of the control measures, in order to minimise the impact of short-term fluctuations. In Alice Springs the various restrictions were introduced in relatively rapid succession with the result that adequate time series for many are not available. Second, the restrictions were generally introduced as packages; that is they were introduced as sets of individual control measures and it is difficult to separately identify their individual impacts. This means that in some instances it was not possible to statistically test the significance of particular measures. Nevertheless, there are sufficient data to draw robust conclusions regarding the effectiveness, or otherwise, of some of the key controls.

In this summary chapter, we first make some comments on methodological lessons that can be drawn from the study and their implications for similar studies. We then consider what the project tells us about the impact of particular sets of restrictions and then, finally look at the broad findings of the study.

Methodological issues

There has been considerable concern about identifying the most appropriate population denominator for use in estimating per capita consumption (including adequate reflection of the contribution of tourists) – to ensure that consumption is not over- or under-estimated. In the past, two approaches to this have been taken: first, taking the ABS's Estimates of Residential Population and then adding numbers of tourists based on survey data; and second, utilising the Enumerated Populations at each census and making extrapolations from them. In this study, we developed population denominators based on both methods. We found that – in the Northern Territory case – the former entailed considerably more work but the difference in estimates was generally less than two per cent and made little difference in estimates of per capita consumption. Thus, for convenience, we have used it in this study. The measure is appropriate for use in the Northern Territory because the Census coincides with the peak tourist season and thus adequate account is taken of tourist numbers. However, the recommendation to use Enumerated Population is not applicable where this condition does not apply (which is over most of southern Australia).

Where available, wholesale sales of particular beverage types (as is recorded by the Northern Territory Licensing Commission) converted to litres of pure alcohol has long been regarded as the best estimate at the state and territory level of alcohol consumption. Recently, the accuracy of these data has been questioned as it is asserted that they do not included mail-order and internet purchases of alcohol which are used to circumvent restrictions on availability. This is only partially true, as those sales which are shipped within a state or territory are included in that jurisdiction's wholesale returns. This aside however, it has been estimated that internet sales account for a little less than two per cent of total alcohol sales. Thus, even if such sales in the NT were double that national estimate (which is unlikely) their impact on estimates of per capita consumption would be negligible. Furthermore, the NT wholesale sales data indicate that those who were unable to purchase cheap cask table and fortified wine shifted to full strength beer which was purchased locally.

While wholesale sales data provide a good estimate of consumption, it is important to remember that they are not the same thing. This has implications for assessing the impact of restrictions. For example, if a restriction is to be imposed on the sale of wine in casks of more than two litres, retailers do not cease their purchases on the date that the restriction comes into effect. Rather, anticipating the restriction, they decrease their wholesale purchases and sell-off existing stock. Thus, as our data show, wholesale sales will decline prior to the introduction of such a restriction while actual consumption may not. For this reason, using this particular example, when assessing the impact of the restriction it is important to look at its impact on wholesale sales in the period immediately prior to its introduction.

An attempt was made to ascertain the average quarterly retail price per litre for alcoholic beverages by sampling newspaper advertisements. However, this method was time-consuming and the range of beverages advertised was not as extensive as the total range of beverages on sale. On the other hand, data on the wholesale price of beverages is based on actual sales, there is a much stronger empirical basis for estimates of average price per litre of pure alcohol, and this was well correlated with our estimates of retail price based on advertisements. This suggest that wholesale price data is a reasonable proxy measure for retail prices and, given its relative ease of access, we have used it as such.

There are clearly concerns within the community about the impact of alcohol on criminal and anti-social behaviour. Police incident data are held to be a convenient measure of this and, indeed, these data have been recommended as a key indicator in the evaluation and monitoring of alcohol control measures. However, as this study shows, in a jurisdiction such as the Northern Territory with a relatively small population some of the more robust measures (such as homicides) occur too infrequently to be used in statistical analyses and there is a variety of policy and procedural measures which impact upon the data and confound identification of any clear impact of control measures on particular offences. For these reasons, considerable care needs to be exercised when attempting to correlate changes in incident rates with changes in alcohol control measures.

Impact of specific control measures

2002 Trial restrictions

In anticipation of the introduction of the Trial there was a reduction in wholesale sales of wine in casks of >2 litres resulting in an increase in the average wholesale price of pure alcohol from about $70 to $80 per litre, with a corresponding decline in estimated per capita consumption of more than one litre per person. However, following the introduction of the restrictions, retailers began offering for sale two litre casks of fortified wine. This led to a decrease in the average wholesale price per litre and an increase in consumption. However, consumption did not rise to the level it had reached prior to the reduction in sale of wine in casks of >2 litres.

Following the introduction of the Trial Restrictions, the number of drink driving incidents recorded was significantly higher than previously, but it is difficult to ascertain whether this was due to an increase in drink driving or an increase in police vigilance. In contrast, there was an apparent reduction in hospitalisations for road crash injuries, but the numbers were small and this needs to interpreted with caution. There was also a reduction in the proportion of anti-social incidents that were alcohol related. While this measure is susceptible to changes in policing practice, the evidence suggest that the reduction was a result of the restrictions. More certainly, however, the apparent reductions in consumption and increases in price associated with the Trial Restrictions were accompanied by reductions in all alcohol-attributable hospital separations.

2003 Amended Restrictions

The major change introduced under Amended Restrictions of July 2003 was the removal the restriction on the sale of wine in casks of >2 litres. The reintroduction of this lower priced beverage and the continued sale of lower priced fortified wine led to an overall decrease in average price per litre of pure alcohol and an increase in per capita consumption. Accompanying this, for many subsequent quarters, there were significant increases in both the ratio between alcohol-attributable and non-alcohol-attributable hospital separations and the ratio of alcohol to non-alcohol related anti-social incidents recorded by the police. The number of drink driving incidents was significantly lower but, again, the likely cause of this is difficult to interpret.

2006 Alcohol Court Act NT

While the *2006 Alcohol Court Act* may have had positive impact for some individuals, we were not able to identify any statistically significant impact at the population level of this measure on estimated consumption of pure alcohol.

2006 Liquor Supply Plan/ Alcohol Management Plan

The Liquor Supply Plan was the set of restrictions most amenable to statistical testing – due to the longer period prior to its introduction for which data were available with no changes in restrictions – and it was the one for which the evidence demonstrated the most significant positive outcomes. The ban on sales of table wine in containers of >2 litres and on fortified wine in containers of >1 litre led to a significant increase in the wholesale price per litre of pure alcohol and an associated decrease in per capita consumption from about 4.0 to 3.5 litres per quarter. As a result of the restrictions on cask and fortified wine sales, there was some substitution of full-strength beer for them. However, this substitution was not complete – as attested by the overall decline in consumption.

These changes were accompanied by significant reductions in health and social harms. While there was no significant change in the number of wholly alcohol-attributable conditions, overall there was a significant decrease in the rate of all alcohol-attributable hospital separations. This was made up of significant decreases in a range of important indicators including acute conditions, and conditions with both medium and low level alcohol-attributable ætiologic fractions.

There was an increase in rate of alcohol-attributable presentations to the Alice Springs Emergency Department for chronic conditions. However, as these take a relatively long time period to become manifest it is unlikely that this is related to the restrictions. Unfortunately, the data were not available to measure the impact of the LSP on most acute conditions – that is, those most likely to be impacted upon in the short-term. Nevertheless, there was a significant decrease in triage recorded assaults – which are an important indicator of acute presentations at the ED. There was also a significant decreases in hospitalisation for assault amongst Indigenous females and in the proportion of alcohol related anti-social incidents recorded by Alice Springs Police.

2007 Northern Territory Emergency Response Act

While the *Northern Territory Emergency Response Act* might have had some impact in those communities that had not previously declared themselves 'dry', as with the NT *2006 Alcohol Court Act*, we were not able to identify any statistically significant impact at the population level of this measure on estimated consumption of pure alcohol in Central Australia.

2007 Alice Springs Restricted Area (Dry Town)

The impact of the 'Dry Town' intervention was difficult to test, due to the proximity in the time of its introduction to that of the Liquor Supply Plan. There were no changes in the subsequent three quarters in the ratio of hospital separations for alcohol to non-alcohol-attributable conditions In this period there were also increases in ED presentations, alcohol-related assault incidents recorded by the police, and the number of drink driving incidents. However, it is difficult to draw any firm conclusions from these analyses.

2008 Introduction of Photographic ID and the 'Alcopops Tax'

Due to the fact that the Photographic ID measure (which was introduced in Alice Springs) and the 'alcopops tax' (which was introduced across the Northern Territory) were implemented in such close proximity to each other, their impact had to be measured jointly. In Greater Darwin, at about the same time some outlets voluntarily agreed not to sell wine in casks of >2 litres, and this was also a condition imposed upon another outlet. Together, in Greater Darwin the tax and these restrictions led to a significant increase in the average wholesale price per litre of pure alcohol and a significant decrease in consumption. There was also a significant negative relationship between the Photographic ID and the 'alcopops tax and consumption in Central Australia but it was difficult to disentangle this from the effects of the LSP.

Following introduction of the Photographic ID and 'alcopops tax' measures, hospital separation rates for all alcohol-attributable conditions continued the levelling trend that occurred following introduction of the LSP. However, while also continuing a trend which commenced after introduction of the LSP, the rate of ED presentations coded as assault-related at triage declined significantly. Paralleling this, there were a significant decreases in the proportion of serious assaults recorded by the Police as alcohol related, and similar but less frequent decreases in the proportion of assaults that were alcohol related.

General findings

Alcohol consumption

Over the whole of the study period, estimated annual per capita consumption of pure alcohol among persons aged ≥15 years ranged between 1.25 and 1.76 times the national average in Central Australia and between 1.40 and 1.59 times the national average in Greater Darwin. In Central Australia, despite fluctuations, over the study period there was a decline in estimated per capita consumption of pure alcohol from about 4.0 to about 3.5 litres per quarter.

There were insufficient data to statistically model the impact of the 2002 Trial Restrictions and their subsequent modification in Central Australia. However, modelling demonstrates that the Liquor Supply Plan had a significant impact on consumption – with the observed trend in estimated per capita consumption being significantly lower than that forecast on the basis of trend prior to the LSP.

In Central Australia, within the overall decline in estimated per capita consumption, there were marked changes in the types of beverages that contributed to it. Most of the change occurred in relation to cask wine, fortified wine, and full strength beer, and some substitution between beverage types took place. The most obvious of the substitutions was that of fortified wine for cask wine following introduction of the Trial Restrictions. However, the substitution of one for the other was not complete. From Q3 2000 to Q2 2001 combined per capita consumption of cask and fortified wine averaged 1.3 litres each quarter. However, from the introduction of the Trial Restrictions in Q2 2002 up until Q2 2005 this dropped to an average of about 1.0 litre per quarter.

Prior to the introduction of the 2002 Trial Restrictions, per capita consumption of full-strength beer averaged about 1.5 litres. After the introduction of the trial it began to fall reaching a low point of about 1.0 litre just prior to the introduction of the LSP when full-strength beer began to be substituted for cask table and fortified wines that were banned at that time. Even so, it then only climbed back to the level of consumption prior to the introduction of the Trial Restrictions, that is 1.5 litres per capita per quarter. Thus most of the reduction in consumption in Central Australia was the result of the reduction in cask wine and fortified wine consumption.

In Greater Darwin, estimated per capita consumption of pure alcohol among persons aged ≥15 years steadily increased from 3.21 litres in Q3 2000 to 4.37 litres in Q2 2008 when sales of wine in four and five litre casks were restricted and the 'alcopops tax' came into effect. Thereafter it declined to 3.71 litres in Q4 2010. This decline was statistically significant with the observed trend being significantly lower than that forecast on the basis of the trend prior to the restrictions. This decline occurred in the absence of the Photographic ID control that was introduced in Central Australia at the same time.

At the outset of the study, cask wine consumption in the Greater Darwin region was about 0.35 litres per person and increased to about 0.65 litres in Q2 2008. It dropped significantly to about 0.5 litres in Q3 2008 and continued to decline to about 0.4 litres at the end of the study period. This decline was the result of the restrictions on the availability of table wine in four and five litre casks. Bottled wine consumption was steady from Q3 2000 to Q2 2004 at a little under 0.4 litres per person, after which it began to increase, reaching a peak of about 0.6 litres by the end Q4 2010. However, this increase in bottled wine consumption did not offset the decrease in consumption of cask wine. Unlike Central Australia, consumption of fortified wine in Greater Darwin contributed little to overall consumption.

In Greater Darwin, beer of all types was the most commonly consumed alcoholic beverage. Over the study period, estimated per capita consumption rose marginally from about 1.8 to 1.9 litres per quarter. Full-strength beer accounted for most of this – just over 1.4 litres. The balance was made up of low and mid strength beer combined and, as in Central Australia, over the study period their relative contribution was reversed with mid-strength beer rising to about 0.5 litres and low strength beer declining to about 0.1 litres per person.

In Greater Darwin, consumption of standard and mixed spirits combined increased steadily over the study period from about 0.8 to about 1.1 litres per person and they accounted for a little over 24 per cent of all alcoholic beverages consumed. Over the same period, consumption of standard spirits rose from about 0.6 to about 0.75 litres. From Q3 2000 to Q1 2008 consumption of mixed spirits doubled from about 0.2 to 0.4 litres. However, after the introduction of the 'alcopops tax' in Q2 2008 it dropped to about 0.3 litres, but was nevertheless 50 per cent greater than at the start of the study period.

Alcoholic Beverage Prices

In Central Australia, there was a significant negative cross-correlation between the quarterly average wholesale price per litre of pure alcohol and estimated per capita consumption. That is, as price increased, consumption decreased. This relationship was also tested using time series analysis which confirmed the results of the cross-correlation analysis.

Cross-correlation and time series analysis were also used to test relationships in the data for Greater Darwin. Both methods demonstrated a similar negative correlation – with quarterly average wholesale price being accompanied by reductions in per capita consumption.

At least one of the restrictions making up the Alice Springs Liquor Supply Plan (including changes to takeaway times, and limiting the volume of, and times at which, cask table and fortified wines could be purchased) was found to be statistically significant in reducing estimated per capita consumption. The principal change effected by the LSP was a switch from cask wine to more expensive and lower alcohol content full strength beer. This switch was unlikely to have been caused by the other restrictions implemented at the same time that were focused on limiting hours of sale at licensed premises.

At least one of either enforcement of the 'one per person per day' restriction, the introduction of ID cards and/or the 'alcopops tax', also had significant effects on reducing consumption. That the 'one per person per day' restriction and the 'alcopops tax' were price related, and as it appears that initially the ID card restriction was only partially effective, suggests that the decline in estimated per capita consumption was largely price related.

As these findings suggested that restrictions underpinned by changes based on price had a significant effect on consumption, the direct impact of restrictions on price was explored. There were too few observation periods prior to introduction of the Trial Restrictions to reliably test the direct impact of those restrictions on price. However, the impact of the price-related restrictions associated with the Liquor Supply Plan were found to have a statistically significant impact in reducing estimated per capita consumption.

In Greater Darwin the average wholesale price per litre of pure alcohol was decreasing prior to Q3 2008. At that time the availability of wine in four litre casks was reduced and the 'alcopops tax' was introduced and a statistically significant increase followed, accompanied by a decrease in estimated per capita consumption. That this decrease was achieved in the absence of the Photographic ID control also lends weight to the view that the impact of restrictions introduced in Alice Springs at this time was largely price-related.

Hospital separations

The relationships between wholesale price per litre of pure alcohol and alcohol-attributable hospital separations were generally stronger than those between per capita consumption and separations.

Only conditions with high and medium level alcohol-attributable ætiologic fractions (excluding assaults) were found to be significantly positively correlated with consumption: indicating that as consumption rose so did hospitalisations for these conditions although many quarters later.

The significant results related to wholesale price were generally negative, indicating that as price increased there were decreases in the rates of: acute alcohol-attributable separations (excluding assaults); conditions with high alcohol-attributable ætiologic fractions; conditions with medium level alcohol-attributable ætiologic fractions excluding assault; and separations for wholly alcohol-attributable conditions. Predictive time-series models also demonstrated that following introduction of the LSP observed values were significantly lower than the forecast values in Q2 and Q3 of 2007 and from Q1 2008 onwards.

Poisson regression generally produced congruent results but also identified significant decreases in: the proportion of alcohol-attributable separations for most of 2009; and the ratio of alcohol-attributable separations to non-alcohol-attributable separations during the Trial Restrictions when compared with the preceding quarter.

Further analyses were conducted using categorisations of alcohol-attributable hospital separations by commonly associated drinking pattern (i.e. acute conditions largely associated with short term drinking to intoxication and chronic, conditions which are typically associated with long term exposure) as well as level of alcohol-attributable aetiologic fraction (high/medium/low/wholly). After introduction of the LSP, there was no evidence of significant change in wholly alcohol-attributable conditions (e.g. alcohol abuse, alcoholic gastritis, alcoholic psychosis, alcoholic liver cirrhosis). However, observed trends were significantly lower than forecast trends in: acute cases, particularly assaults; and conditions had 'medium' and 'low' level alcohol-attributable aetiologic fractions.

A disparate proportion of the burden of separations for alcohol-attributable conditions recorded by the Alice Springs Hospital occurred among the Indigenous population and much of this was underpinned by hospitalisation for assault.

Emergency Department presentations

Data for alcohol-attributable emergency department presentations were restricted to the period from Q3 2003 onwards and did not contain sufficient information to accurately assess many acute conditions (including assault, road crashes, falls etc.). Analyses were therefore restricted primarily to presentations for chronic diseases. This was a significant limitation as it is acute rather than chronic conditions that are most likely to be responsive to alcohol restrictions in the time-frames under consideration.

Over the study period, Emergency Department presentations for alcohol-attributable chronic conditions doubled from 3.5 to 7.0 per 1000 persons. Although there was some negative impact upon this due to restrictions on the availability of takeaways >2 litres, the data indicate that this indicator continued to rise regardless of the restrictions and that after the introduction of the LSP the rate of increase exceed that compared to that expected had the pre-LSP trend continued.

A better indicator of the impact of restrictions than ED presentations for chronic conditions was Alice Springs Hospital ED presentations coded at triage as assault. In contrast to chronic conditions, and similar to alcohol-attributable hospital separations, after the introduction of the LSP, the observed rate of presentations per 1000 persons identified at triage as assault was significantly lower than that predicted on the basis of prior trends – especially from Q1 2008 onwards.

Assault data

Comparisons across data sets demonstrated that following the introduction of the LSP, the rates of hospital separations and Emergency Department presentations for assault were significantly lower than predicted based on previous trends. That this was not the case for Police assault data is probably attributable to changes in policing which resulted in identification or a greater number of incidents.

Both hospital separation and Emergency Department presentation data on assaults demonstrated significantly higher rates among both Indigenous males and Indigenous females than their non-Indigenous counterparts, and Indigenous people presented at the Emergency Department at rates almost ten times greater than those among non-Indigenous people. Among Indigenous females the quarterly rates of hospital separations for assaults increased rapidly from Q2 2004 but following introduction of the LSP these rates levelled off and were significantly lower than predicted based on the previous trend.

Crime and Public Order

Use of homicide data to measure the impact of restrictions in Alice Springs was precluded because the number was too low and variability between intervals over time was too high to subject them to statistical analyses. Analyses of other Police incident data showed that, over the study period, there were extreme fluctuations in protective custody and drink driving incidents, and there had been statistically significant increases in domestic violence and protective custody incidents. However, we were advised by officers from the NT Police that the frequency of these incidents was particularly susceptible to changes in policing policy and the allocation of resources and in the case of domestic violence to changes in the law. For these reasons, they advised that changes in the data were more likely to be indicative of Police activity than they were of the likely impact of restrictions.

As we did not have data on drink driver crashes, we examined hospital separation data on the ratio of road crash injuries (not all of which would have been alcohol-related) to non-road crash injuries. The numbers of the former were small and subject to considerable fluctuation. Following introduction of the Trial Restrictions there were significant reductions in 13 of the 16 following quarters but there were no significant changes associated with any of the other restrictions and no firm conclusions can be drawn about the relationship of these to the restrictions.

There was a statistically significant negative relationship between the wholesale price of alcohol and alcohol-related assaults – i.e. with increases in price there appeared to be a decline in assaults. However, a lag between the apparent effect and the poor fit of the time series model indicates that this was probably an artefact of unidentified confounding factors.

Despite the findings summarised above, however it was found that:

- after the introduction of the ID & 'alcopops tax' restrictions, the ratio of alcohol-related to non-alcohol-related serious assaults was significantly lower in seven of eleven quarters (through a combination both of increases in non-alcohol-related incidents and decreases in alcohol-related incidents); and,
- following both the Trial Restrictions and introduction of the LSP there were significant reductions in the percentage of anti-social behaviour incidents that were alcohol-related and which appear to be related to those restrictions.

Conclusion

The imposition of additional alcohol control measures has made a significant contribution to the reduction of estimated per capita consumption in Central Australia. The evidence demonstrates that the most effective of these measures have been those which indirectly increased the average price per litre of alcoholic beverages (i.e. the removal of lower priced cask table and fortified wines from the market) and which directly increased the average price (i.e. the so-called 'alcopops tax'). This finding with regard to the impact of price is consistent with the international evidence, and with evidence from the Greater Darwin region over the same time period.

The greatest statistically discernible impact of this reduction in consumption was a reduction in the rates of assaults – as evident in hospital separation and Emergency Department triage presentation data – and reductions in hospital separations for alcohol-attributable conditions.

While the evidence presented in this study shows that price-related alcohol restrictions have had a significant effect in reducing alcohol consumption, it also shows that price is not the only variable impacting upon levels of consumption and related-harm. That levels of consumption in Central Australia remain over 30 per cent higher than the national average, that some indicators of harm continued to rise (albeit at reduced rates), and that rates of some indicators are considerably greater among Indigenous than non-Indigenous residents of Central Australia indicates that significant demand factors are also driving the level of consumption. This evidence indicates that while alcohol control measures are an effective means of reducing consumption and related harm – as endorsed by Australian Governments under the *National Drug Strategy* – they need to be part of a comprehensive strategy that also aims to reduce harm and demand. In the latter regard, it is important that demand reduction strategies not be conceived too narrowly. As well as focusing on interventions specifically targeting alcohol use, such as prevention and health promotion, demand reduction strategies need also to focus on broad-based interventions which address the underlying social determinants of health and alcohol and other drug use, including early childhood development, education and employment programs.

9. Appendices

Appendix 1: Alcohol-attributable ætiologic fractions

Alcohol-attributable ætiologic fractions non-Indigenous males

	Acute/Chronic	High/Med/Low	Wholly AA	0–11	12–13	14–17	18–24	25–39	40–64	65+
Oropharyngeal Cancer	C	Med		0.0	0.0	0.248	0.447	0.457	0.476	0.281
Oesophageal Cancer	C	Low		0.0	0.0	0.322	0.517	0.515	0.522	0.409
Liver Cancer	C	Med		0.0	0.0	0.236	0.461	0.44	0.452	0.295
Laryngeal Cancer	C	Med		0.0	0.0	0.348	0.579	0.562	0.572	0.429
Female Breast Cancer	C	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcoholic Psychosis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Dependence	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Abuse	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Epilepsy	C	Low		0.0	0.0	0.273	0.623	0.575	0.599	0.257
Alcoholic Polyneuropathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hypertensive Disease	C	Low		0.0	0.0	0.041	0.141	0.135	0.151	0.026
Alcoholic Cardiomyopathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cardiac Arrhythmias	C	Low		0.0	0.0	0.224	0.4	0.384	0.386	0.31
Haemorrhagic Stroke	A	Med		0.0	0.0	0.153	0.331	0.311	0.32	0.2
Oesophageal Varices	C	Med		0.0	0.0	0.331	0.688	0.647	0.67	0.295
Gastro-Oesophageal Haemorrhage	A	Med		0.0	0.0	0.638	0.638	0.638	0.638	0.638
Alcoholic Gastritis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcoholic Liver Cirrhosis	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Unspecified Liver Cirrhosis	C	Low		0.0	0.0	0.331	0.688	0.647	0.67	0.295
Cholelithiasis	C	Low		0.0	0.0	-0.112	-0.286	-0.275	-0.278	-0.184
Pancreatitis Acute	A	Med		0.0	0.0	0.385	0.385	0.385	0.385	0.385
Pancreatitis, Chronic	C	High		0.0	0.0	0.912	0.912	0.912	0.912	0.912
Spontaneous Abortion	A	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intrauterine Growth Retardation/Low Birth Weight	A	Low		0.015	0.015	0.015	0.015	0.015	0.015	0.015
Psoriasis	C	Low		0.0	0.0	0.235	0.381	0.38	0.379	0.329
Hospitalisations: non-pedestrians from NAIP	A	High		0.335	0.335	0.335	0.335	0.335	0.335	0.335

Falls	A	Med		0.0	0.308	0.308	0.308	0.308	0.308	0.177
Fires: Injury	A	Med		0.0	0.19	0.19	0.19	0.19	0.19	0.19
Drowning	A	Med		0.0	0.264	0.264	0.264	0.264	0.264	0.264
Aspiration	A	High		0.0	0.165	0.165	0.165	0.165	0.165	0.165
Occupational Machine Injuries: Injury	A	Low		0.0	0.13	0.13	0.13	0.13	0.13	0.13
Intentional Self-Harm/Suicide	A	Med		0.0	0.076	0.198	0.383	0.365	0.372	0.265
Assault	A	Med		0.638	0.638	0.638	0.638	0.638	0.638	0.638
Child Abuse	A	Low		0.274	0.274	0.274	0.274	0.274	0.274	0.274
Ischaemic Stroke	A	Med		0.0	0.0	-0.005	0.055	0.046	0.061	-0.043
Alcoholic Pancreatitis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hospitalisations: pedestrians from NAIP	A	High		0.252	0.252	0.252	0.252	0.252	0.252	0.252
Ischaemic Heart Disease	A	Low		0.0	0.0	-0.098	-0.203	-0.197	-0.189	-0.179
All Alcohol Poisoning	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Colon Cancer	C	Low		0.0	0.0	0.209	0.39	0.39	0.402	0.259
Rectal Cancer	C	Low		0.0	0.0	0.058	0.126	0.125	0.129	0.08
Type II Diabetes Mellitus	C	Low		0.0	0.0	-0.02	-0.107	-0.081	-0.089	-0.019
Fœtal Alcohol Syndrome	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Source: Ridolfo and Stevenson[30]

Alcohol-attributable ætiologic fractions non-Indigenous females

	Acute/Chronic	High/Med/Low	Wholly AA	0–11	12–13	14–17	18–24	25–39	40–64	65+
Oropharyngeal Cancer	C	Med		0.0	0.0	0.475	0.432	0.437	0.35	0.267
Oesophageal Cancer	C	Low		0.0	0.0	0.497	0.503	0.49	0.445	0.388
Liver Cancer	C	Med		0.0	0.0	0.439	0.46	0.404	0.363	0.326
Laryngeal Cancer	C	Med		0.0	0.0	0.553	0.575	0.529	0.489	0.446
Female Breast Cancer	C	Low		0.0	0.0	0.138	0.134	0.119	0.093	0.074
Alcoholic Psychosis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Dependence	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Abuse	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Epilepsy	C	Low		0.0	0.0	0.629	0.646	0.546	0.484	0.456
Alcoholic Polyneuropathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hypertensive Disease	C	Low		0.0	0.0	0.059	0.008	-0.018	-0.067	-0.07
Alcoholic Cardiomyopathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cardiac Arrhythmias	C	Low		0.0	0.0	0.351	0.392	0.354	0.337	0.305
Haemorrhagic Stroke	A	Med		0.0	0.0	0.419	0.141	0.252	-0.107	-0.406
Oesophageal Varices	C	Med		0.0	0.0	0.684	0.701	0.594	0.529	0.506
Gastro-Oesophageal Haemorrhage	A	Med		0.0	0.0	0.638	0.638	0.638	0.638	0.638
Alcoholic Gastritis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcoholic Liver Cirrhosis	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Unspecified Liver Cirrhosis	C	Low		0.0	0.0	0.684	0.701	0.594	0.529	0.506
Cholelithiasis	C	Low		0.0	0.0	-0.232	-0.268	-0.239	-0.209	-0.168
Pancreatitis Acute	A	Med		0.0	0.0	0.385	0.385	0.385	0.385	0.385
Pancreatitis, Chronic	C	High		0.0	0.0	0.912	0.912	0.912	0.912	0.912
Spontaneous Abortion	A	Low		0.0	0.0	0.037	0.035	0.029	0.027	0.167
Intrauterine Growth Retardation/Low Birth Weight	A	Low		0.015	0.015	0.015	0.015	0.015	0.015	0.015
Psoriasis	C	Low		0.0	0.0	0.336	0.364	0.358	0.338	0.295
Hospitalisations: non-pedestrians from NAIP	A	High		0.133	0.133	0.133	0.133	0.133	0.133	0.133
Falls	A	Med		0.0	0.205	0.205	0.205	0.205	0.205	0.062
Fires: Injury	A	Med		0.0	0.19	0.19	0.19	0.19	0.19	0.19
Drowning	A	Med		0.0	0.264	0.264	0.264	0.264	0.264	0.264
Aspiration	A	High		0.0	0.165	0.165	0.165	0.165	0.165	0.165
Occupational Machine Injuries: Injury	A	Low		0.0	0.13	0.13	0.13	0.13	0.13	0.13

Intentional Self-Harm/Suicide	A	Med		0.0	0.0	0.349	0.379	0.334	0.307	0.276
Assault	A	Med		0.638	0.638	0.638	0.638	0.638	0.638	0.638
Child Abuse	A	Low		0.274	0.274	0.274	0.274	0.274	0.274	0.274
Ischaemic Stroke	A	Med		0.0	0.0	-0.353	-0.599	-0.553	-0.604	-0.499
Alcoholic Pancreatitis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hospitalisations: pedestrians from NAIP	A	High		0.173	0.173	0.173	0.173	0.173	0.173	0.173
Ischaemic Heart Disease	A	Low		0.0	0.0	-0.138	-0.186	-0.175	-0.175	-0.147
All Alcohol Poisoning	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Colon Cancer	C	Low		0.0	0.0	0.391	0.379	0.366	0.309	0.253
Rectal Cancer	C	Low		0.0	0.0	0.816	0.769	0.775	0.674	0.547
Type II Diabetes Mellitus	C	Low		0.0	0.0	-0.035	-0.072	-0.055	-0.069	-0.067
Fœtal Alcohol Syndrome	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Source: Ridolfo and Stevenson[30]

Appendix 2: Indigenous alcohol-attributable ætiologic fractions

Alcohol-attributable ætiologic fractions Indigenous males

	Acute/Chronic	High/Med/Low	Wholly AA	0–11	12–13	14–17	18–24	25–39	40–64	65+
Oropharyngeal Cancer	C	Med		0.0	0.0	0.572	0.572	0.572	0.572	0.572
Oesophageal Cancer	C	Low		0.0	0.0	0.559	0.559	0.559	0.559	0.559
Liver Cancer	C	Med		0.0	0.0	0.512	0.512	0.512	0.512	0.512
Laryngeal Cancer	C	Med		0.0	0.0	0.617	0.617	0.617	0.617	0.617
Female Breast Cancer	C	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Alcoholic Psychosis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Dependence	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Abuse	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Epilepsy	C	Low		0.0	0.0	0.702	0.702	0.702	0.702	0.702
Alcoholic Polyneuropathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hypertensive Disease	C	Low		0.0	0.0	0.242	0.242	0.242	0.242	0.242
Alcoholic Cardiomyopathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cardiac Arrhythmias	C	Low		0.0	0.0	0.386	0.386	0.386	0.386	0.386
Haemorrhagic Stroke	A	Med		0.0	0.0	0.368	0.368	0.368	0.368	0.368
Oesophageal Varices	C	Med		0.0	0.0	0.767	0.767	0.767	0.767	0.767
Gastro-Oesophageal Haemorrhage	A	Med		0.0	0.0	0.638	0.638	0.638	0.638	0.638
Alcoholic Gastritis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcoholic Liver Cirrhosis	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Unspecified Liver Cirrhosis	C	Low		0.0	0.0	0.767	0.767	0.767	0.767	0.767
Cholelithiasis	C	Low		0.0	0.0	-0.288	-0.288	-0.288	-0.288	-0.288
Pancreatitis Acute	A	Med		0.0	0.0	0.385	0.385	0.385	0.385	0.385
Pancreatitis, Chronic	C	High		0.0	0.0	0.912	0.912	0.912	0.912	0.912
Spontaneous Abortion	A	Low		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intrauterine Growth Retardation/Low Birth Weight	A	Low		0.015	0.033	0.033	0.033	0.033	0.033	0.033
Psoriasis	C	Low		0.0	0.0	0.36	0.36	0.36	0.36	0.36
Hospitalisations: non-pedestrians from NAIP	A	High		0.335	0.335	0.335	0.335	0.335	0.335	0.335
Falls	A	Med		0.0	0.308	0.308	0.308	0.308	0.308	0.177

Fires: Injury	A	Med		0.0	0.19	0.19	0.19	0.19	0.19	0.19
Drowning	A	Med		0.0	0.264	0.264	0.264	0.264	0.264	0.264
Aspiration	A	High		0.0	0.165	0.165	0.165	0.165	0.165	0.165
Occupational Machine Injuries: Injury	A	Low		0.0	0.13	0.13	0.13	0.13	0.13	0.13
Intentional Self-Harm/Suicide	A	Med		0.0	0.0	0.403	0.403	0.403	0.403	0.403
Assault	A	Med		0.638	0.638	0.638	0.638	0.638	0.638	0.638
Child Abuse	A	Low		0.274	0.274	0.274	0.274	0.274	0.274	0.274
Ischaemic Stroke	A	Med		0.0	0.0	0.154	0.154	0.154	0.154	0.154
Alcoholic Pancreatitis	A	High	Y	0.0	0.0	1.0	1.0	1.0	1.0	1.0
Hospitalisations: pedestrians from NAIP	A	High		0.252	0.252	0.252	0.252	0.252	0.252	0.252
Ischaemic Heart Disease	A	Low		0.0	0.0	-0.125	-0.125	-0.125	-0.125	-0.125
All Alcohol Poisoning	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Colon Cancer	C	Low		0.0	0.0	0.47	0.47	0.47	0.47	0.47
Rectal Cancer	C	Low		0.0	0.0	0.154	0.154	0.154	0.154	0.154
Type II Diabetes Mellitus	C	Low		0.0	-0.143	-0.143	-0.143	-0.143	-0.143	-0.143
Fœtal Alcohol Syndrome	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Source: Pascal *et al.*[32]

Alcohol-attributable ætiologic fractions Indigenous females

	Acute/Chronic	High/Med/Low	Wholly AA	0–11	12–13	14–17	18–24	25–39	40–64	65+
Oropharyngeal Cancer	C	Med		0.0	0.0	0.464	0.464	0.464	0.464	0.464
Oesophageal Cancer	C	Low		0.0	0.0	0.461	0.461	0.461	0.461	0.461
Liver Cancer	C	Med		0.0	0.0	0.39	0.39	0.39	0.39	0.39
Laryngeal Cancer	C	Med		0.0	0.0	0.503	0.503	0.503	0.503	0.503
Female Breast Cancer	C	Low		0.0	0.0	0.124	0.124	0.124	0.124	0.124
Alcoholic Psychosis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Dependence	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcohol Abuse	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Epilepsy	C	Low		0.0	0.0	0.577	0.577	0.577	0.577	0.577
Alcoholic Polyneuropathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hypertensive Disease	C	Low		0.0	0.0	0.072	0.072	0.072	0.072	0.072
Alcoholic Cardiomyopathy	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Cardiac Arrhythmias	C	Low		0.0	0.0	0.295	0.295	0.295	0.295	0.295
Haemorrhagic Stroke	A	Med		0.0	0.0	0.476	0.476	0.476	0.476	0.476
Oesophageal Varices	C	Med		0.0	0.0	0.634	0.634	0.634	0.634	0.634
Gastro-Oesophageal Haemorrhage	A	Med		0.0	0.0	0.638	0.638	0.638	0.638	0.638
Alcoholic Gastritis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alcoholic Liver Cirrhosis	C	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Unspecified Liver Cirrhosis	C	Low		0.0	0.0	0.634	0.634	0.634	0.634	0.634
Cholelithiasis	C	Low		0.0	0.0	-0.181	-0.181	-0.181	-0.181	-0.181
Pancreatitis Acute	A	Med		0.0	0.0	0.385	0.385	0.385	0.385	0.385
Pancreatitis, Chronic	C	High		0.0	0.0	0.912	0.912	0.912	0.912	0.912
Spontaneous Abortion	A	Low		0.0	0.0	0.056	0.056	0.056	0.056	0.056
Intrauterine Growth Retardation/Low Birth Weight	A	Low		0.033	0.033	0.033	0.033	0.033	0.033	0.033
Psoriasis	C	Low		0.0	0.0	0.293	0.293	0.293	0.293	0.293
Hospitalisations: non-pedestrians from NAIP	A	High		0.133	0.133	0.133	0.133	0.133	0.133	0.133
Falls	A	Med		0.0	0.205	0.205	0.205	0.205	0.205	0.062
Fires: Injury	A	Med		0.0	0.19	0.19	0.19	0.19	0.19	0.19
Drowning	A	Med		0.0	0.264	0.264	0.264	0.264	0.264	0.264
Aspiration	A	High		0.0	0.165	0.165	0.165	0.165	0.165	0.165
Occupational Machine Injuries: Injury	A	Low		0.0	0.13	0.13	0.13	0.13	0.13	0.13

Intentional Self-Harm/Suicide	A	Med		0.0	0.0	0.3	0.3	0.3	0.3	0.3
Assault	A	Med		0.638	0.638	0.638	0.638	0.638	0.638	0.638
Child Abuse	A	Low		0.274	0.274	0.274	0.274	0.274	0.274	0.274
Ischaemic Stroke	A	Med		0.0	0.0	-0.215	-0.215	-0.215	-0.215	-0.215
Alcoholic Pancreatitis	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hospitalisations: pedestrians from NAIP	A	High		0.173	0.173	0.173	0.173	0.173	0.173	0.173
Ischaemic Heart Disease	A	Low		0.0	0.0	-0.098	-0.098	-0.098	-0.098	-0.098
All Alcohol Poisoning	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Colon Cancer	C	Low		0.0	0.0	0.366	0.366	0.366	0.366	0.366
Rectal Cancer	C	Low		0.0	0.0	0.815	0.815	0.815	0.815	0.815
Type II Diabetes Mellitus	C	Low		0.0	0.0	-0.014	-0.014	-0.014	-0.014	-0.014
Fœtal Alcohol Syndrome	A	High	Y	1.0	1.0	1.0	1.0	1.0	1.0	1.0

Source: Pascal *et al.*[32]

Appendix 3 : Correspondence between alcohol-attributable ætiologic fraction categories and ICD-10 diagnostic codes

Category	External cause ICD-codes	Primary diagnosis ICD-codes
Oropharyngeal Cancer		C01-C06.9; C09-C10.9; C12-C14.9
Oesophageal Cancer		C15
Liver Cancer		C22
Laryngeal Cancer		C32
Female Breast Cancer		C50 AND sex=female
Alcoholic Psychosis		F10.3-F10.9
Alcohol Dependence		F10.2
Alcohol Abuse		F10.0; F10.1
Epilepsy		G40; G41
Alcoholic Polyneuropathy		G62.1
Hypertensive Disease		I10-I15.9
Alcoholic Cardiomyopathy		I42.6
Cardiac Arrhythmias		I47.1; I47.9; I48
Haemorrhagic Stroke		I60-I62.9; I69.0-I69.2
Oesophageal Varices		I85;I98.20; I98.21
Gastro-Oesophageal Haemorrhage		K22.6
Alcoholic Gastritis		K29.2
Alcoholic Liver Cirrhosis		K70
Unspecified Liver Cirrhosis		K74.3-K74.6; K76.0; K76.9
Cholelithiasis		K80
Acute Pancreatitis		K85
Chronic Pancreatitis		K86.1
Spontaneous Abortion		O03
Intrauterine Growth Retardation/Low Birth Weight		O36.5; P05; P07
Psoriasis		L40.0-L40.4; L40.8; L40.9
Hospitalisations: non-pedestrians from NAIP	V12.3-V12.9; V13.3-V13.9; V14.3-V14.9; V19.4-V19.6; V19.9; V20.3-V20.9; V21.3-V21.9; V22.3-V22.9; V23.3-V23.9; V24.3-V24.9; V25.3-V25.9; V26.3-V26.9; V27.3-V27.9; V28.3-V28.9; V29.4-V29.9; V30.4-V30.9; V31.4-V31.9; V32.4-V32.9; V33.4-V33.9; V34.4-V34.9; V35.4-V35.9; V36.4-V36.9; V37.4-V37.9; V38.4-V38.9; V39.4-V39.9; V40.4-V40.9; V41.4-V41.9; V42.4-V42.9; V43.4-V43.9; V44.4-V44.9; V45.4-V45.9; V46.4-V46.9; V47.4-V47.9; V48.4-V48.9; V49.4-V49.9; V50.4-V50.9; V51.4-V51.9; V52.4-V52.9; V53.4-V53.9; V54.4-V54.9; V55.4-V55.9; V56.4-V56.9; V57.4-V57.9; V58.4-V58.9; V59.4-V59.9; V60.4-V60.9;V61.4-V61.9;V62.4-V62.9;V63.4-V63.9;V64.4-V64.9;V65.4-	

	V65.9;V66.4-V66.9; V67.4-V67.9;V68.4-V68.9;V69.4-V69.9;V70.4-V70.9; V71.4-V71.9; V72.4-V72.9; V73.4-V73.9; V74.4-V74.9; V75.4-V75.9; V76.4-V76.9; V77.4-V77.9; V78.4-V78.9; V79.4-V79.9; V80.3-V80.5; V81.1; V82.1; V82.9; V83.0-V83.3; V84.0-V84.3; V85.0-V85.3; V86.0-V86.3; V87.0-V87.9; V89.2; V89.3; V89.9	
Falls	W00-W19.9	
Fires: Injury	X00-X09.9	
Drowning	W65-W74.9	
Aspiration	W78; W79	
Occupational Machine Injuries: Injury	W24-W31.9; W45; W49; W60	
Intentional Self-Harm/Suicide	X60-X84.9; Y87.0	
Assault	(X85-X89.9; Y00-Y09.9; Y87.1) & age 15 years and over	
Child Abuse	(X85-X99.9; Y00-Y09.9; Y87.1) & age 14 years and under	
Ischaemic Stroke		G45; I63; I65-I67.9; I69.3
Unspecified Stroke		I64; I69.4; I69.8
Alcohol Pancreatitis		K86.0
Hospitalisations: pedestrians from NAIP	V02.1-V02.9; V03.1-V03.9; V04.1-V04.9; V09.2-V09.3; V06.1	
Ischaemic Heart Disease		I20-I25.9
All Alcohol Poisoning	X45; Y15	T51.0; T51.1; T51.9
Heart Failure		I50; I51; I97.1
Colon Cancer		C18; C19
Rectal Cancer		C20
Type II Diabetes Mellitus		E11
Fœtal Alcohol Syndrome		Q86.0
Other heart conditions		I05-I09.9; Q20-Q24.9
Other RTIs 1	V10.0-V10.2; V11.0-V11.2; V12.0-V12.2; V13.0-V13.2; V14.0-V14.2; V15.0-V15.2; V16.0-V16.2; V17.0-V17.2; V18.0-V18.2; V19.0-V19.3; V20.0-V20.2; V21.0-V21.2; V22.0-V22.2; V23.0-V23.2; V24.0-V24.2; V25.0-V25.2; V26.0-V26.2; V27.0-V27.2; V28.0-V28.2; V29.0-V29.3; V30.0-V30.3; V31.0-V31.3; V32.0-V32.3; V33.0-V33.3; V34.0-V34.3; V35.0-V35.3; V36.0-V36.3; V37.0-V37.3; V38.0-V38.3; V39.0-V39.3; V40.0-V40.3; V41.0-V41.3; V42.0-V42.3; V43.0-V43.3; V44.0-V44.3; V45.0-V45.3; V46.0-V46.3; V47.0-V47.3; V48.0-V48.3; V49.0-V49.3; V50.0-V50.3; V51.0-V51.3; V52.0-V52.3; V53.0-V53.3; V54.0-V54.3; V55.0-V55.3; V56.0-V56.3; V57.0-V57.3; V58.0-V58.3; V59.0-V59.3; V60.0-V60.3; V61.0-V61.3; V62.0-V62.3; V63.0-V63.3; V64.0-V64.3; V65.0-V65.3; V66.0-V66.3; V67.0-V67.3; V68.0-V68.3; V69.0-V69.3; V70.0-V70.3; V71.0-V71.3; V72.0-V72.3; V73.0-V73.3; V74.0-V74.3; V75.0-V75.3; V76.0-V76.3; V77.0-V77.3; V78.0-V78.3; V79.0-V79.3; V81.0; V82.0; V83.5-V83.7; V83.9; V84.5-V84.7; V84.9; V85.5-V85.7; V85.9; V86.5-V86.7; V86.9; V88; V89.0-V89.1	
Other RTIs 2	V01.0; V02.0; V03.0; V04.0; V05.0; V06.0; V09.0-V09.1	
Tobacco-related conditions	C34.0-C34.39; C33; C34.8-C34.9; K25.0-K25.79; K25.9; K26.0-K26.79; K26.9; K27.0-K27.79; K27.9; K28.0-K28.79; K28.9; J40; J41.0; J41.1; J44.1; J42; J44.8-J44.99; J43.8; I71.0-I71.03; I71.1-I71.69; I71.8-I72.49; I72.8-I73.19; I79.2; I73.8-I74.39; I74.5; I74.8-I74.99; C65; C67.0-C67.99	

Appendix 4: Directly Derived Partial Alcohol-attributable Fractions, Original and Adjusted for Northern Territory Consumption Data

Condition	Source	Original PAAF	Revised NT Specific PAAF
Falls age < 65, male	Ridolfo & Stevenson 2001	0.220	0.308
Falls age < 65, female	Ridolfo & Stevenson 2001	0.140	0.205
Falls age > 65, male	Ridolfo & Stevenson 2001	0.120	0.177
Falls age > 65, female	Ridolfo & Stevenson 2001	0.040	0.062
Fire: deaths	Begg & Voss 2007	0.407	0.508
Fire: hospitalisations	Begg & Voss 2007	0.135	0.190
Other burns & scalds: deaths	Begg & Voss 2007	0.059	0.086
Other burns & scalds: hospitalisations	Begg & Voss 2007	0.036	0.053
Assault	English et al. 1995	0.470	0.638
Occupational machine injury: deaths	Driscoll 2001	0.051	0.078
Occupational machine injury: hospitalisations	English et al. 1995	0.070	0.130
Drowning	Driscoll 2004	0.190	0.264
Child abuse	English et al. 1995	0.160	0.274
Aspiration	Begg & Voss 2007	0.116	0.165
Pancreatitis, chronic	English et al. 1995	0.840	0.912
Pancreatitis, acute	English et al. 1995	0.240	0.385
Gastro-oesophageal haemorrhage	English et al. 1995	0.470	0.000

Source: South Australian Centre for Economic Studies[73]

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