Assessing the impact of Queensland's late-night alcohol restrictions using health system data

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Published

2021

Journal Title

Drug and Alcohol Review

Version

Accepted Manuscript (AM)

DOI

10.1111/dar.13182

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Running head: The health system impacts of late night restrictions

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/dar.13182

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Abstract

Introduction and Aims In an attempt to reduce alcohol-related harm in night-time entertainment precincts, the Queensland state government (Australia), introduced the Tackling Alcohol-Fuelled Violence strategy in July 2016, including restrictions on late-night service of alcohol and – later – compulsory ID scanners at venues. In this paper, we examined the impact of these changes on emergency department presentations and hospital admissions for alcohol-related harm. **Design and Methods** We used data on emergency department presentations (July 2009 – June 2019) and hospital admissions (July 2009 –December 2018). Interrupted time series models using seasonal auto-regressive integrated moving average methods were developed to test the impact of the policy change on presentations for alcohol intoxication, any injury or maxillofacial fractures, and admissions for rates of assault-related injuries or maxillofacial fractures. Analyses were conducted using state-wide Queensland data with a sub-analysis focussing on major Brisbane hospitals. **Results** The introduction of 3am last drinks and mandatory ID scanners had no significant impact on most outcome measures, either across the state or within Brisbane. State-wide, there was a significant decline in emergency department injury presentations following the introduction of mandatory ID scanners. **Discussion and Conclusions** The introduction of the Tackling Alcohol-Fuelled Violence strategy in Queensland Safe Night Precincts was potentially associated with a small reduction in injury presentations to emergency departments. The lack of other impacts may relate to the relative lack of specificity in health system data, challenges in the implementation of the Tackling Alcohol-Fuelled Violence policies or other local factors.

Key words: trading hours, assault, emergency department, time-series

Introduction

A series of systematic reviews have found that restrictions on late night trading hours for licensed premises are generally associated with reductions in rates of alcohol-related harm, especially violence [1-4]. Within these reviews there are some studies that find little or no impact from changes to late trading hours [e.g. 5], but in general the evidence has been relatively consistent. In Australia, recent studies of restrictions in Sydney and Newcastle have shown substantial (e.g. >30%) reductions in police records of violence following reductions in late-night trading hours [6-8], while earlier studies from Western Australia found that a range of harms were associated with extending hotel trading hours [9, 10]. Similar effects have been shown in European studies looking at how trading hours changes affect police records of harm (e.g. [11, 12]).

Most studies looking at the impact of trading hours policies in entertainment precincts have focussed on police records of events (e.g. assaults or drink driving arrests), with few examining the broader impact on health service utilisation [13]. The use of hospital and emergency department (ED) data provides a means of assessing the impact of policy changes without the potential confounding of changes to policing practices that often occur alongside policy interventions in entertainment precincts. Alcohol is involved in a substantial proportion of injuries that result in presentation to EDs or admission to hospital [14-16]. Some previous analyses have found evidence that interventions in late night entertainment precincts can reduce rates of harms in these settings. For example, the introduction of 1:30am lockouts (after which no new customers may enter venues, but they can otherwise trade as

normal) and 3:30am last drinks in Newcastle, Australia has been estimated to have reduced ED attendances by over 300 per year [17]. Similarly, a study from St Vincent's Hospital in Sydney found a reduction in presentations to their ED (the main ED servicing the Kings Cross and Sydney central business entertainment district) for orbital fractures – fractures to a bone or bones surrounding the eye – following the introduction of lockouts and last drink policies in those precincts [18].

As described in detail elsewhere [19, 20] the Queensland government introduced the "Tackling Alcohol-Fuelled Violence" Policy (TAFV) in 2016. The policy aimed to: (i) change the drinking culture to include more responsible drinking practices; (ii) increase safety in the night-time environment; and (iii) implement a regulatory framework that maintains the interests of local business while reducing alcohol-fuelled violence. The major policy levers implemented as part of this process were: (i) the imposition of mandatory 3am last drinks in designated late-night entertainment precincts (i.e. Safe Night Precincts) across Queensland (2am outside of these precincts) in July 2016; (ii) the February 2017 restriction of the use of extended trading permits (reduced from 12 per calendar year to six), which initially provided a loophole to the last drinks restrictions; and (iii) the introduction of mandatory patron ID scanners at high risk venues from July 2017 onwards. While this policy was implemented across the state, a particular focus of the intervention was Fortitude Valley – the major entertainment precinct in Brisbane, the capital city. Fortitude Valley is the busiest entertainment precinct in Queensland, having at least three times the volume of visitors to

other precincts in the state. It was also the site of key incidents, including the death of Cole Miller, that in part prompted the TAFV intervention [19].

Based on previous studies [e.g. 4], the likely impact of these policies was a reduction in violence and potentially other alcohol-related harms. Measuring these outcomes using health systems data is inherently difficult [21]. Alcohol-specific measures are often limited to intoxication-related harms, while cause of injury is not always well recorded. One approach is to use a variety of proxy measures including alcohol-specific measures, broad measures of injury and measures related to specific injuries likely related to assault. For example, maxillofacial injuries have been shown previously to be commonly linked to violence and especially alcohol-related violence [22, 23].

Using time series analyses, we aim to examine the impact of these policy measures individually and as a package on five proxy measures of alcohol-related harm: late night ED presentations for alcohol intoxication, any injury and maxillofacial fractures, as well as hospital admissions for maxillofacial fractures or for any injury where the cause of injury was coded as assault. We include models examining the impact across the whole of Queensland, as well as sub-analyses looking only at hospitals likely to be affected by changes within Brisbane's key entertainment precincts.

Methods

Data sources

We use two main types of health service utilisation here – ED presentations and hospital admissions. In Australia, EDs deal with medical issues requiring immediate attention. Many people presenting to an ED will be treated there relatively quickly and never formally admitted to the hospital. In this way they capture a broader range of problems than hospital admissions, which are generally more serious. Only around 30% of ED presentations result in a hospital admission [24]. De-identified unit record health data for state-wide ED presentations and hospital admissions was sought from Queensland Health from 1 January 2009 onwards. As hospital records provide no indication of the location of the event that resulted in the presentation/admission (e.g. the assault or fall that led to the injury), specific analyses for incidents within entertainment precincts could not be conducted. Instead, we initially examine the impact of the package of reforms on key measures across the whole state. Given much the emphasis of the intervention has been on the Fortitude Valley precinct in Brisbane, we also conduct secondary analyses using data from the two major hospitals servicing inner-city Brisbane.

Emergency department presentations. De-identified ED unit records covering 26 major emergency departments in Queensland were extracted for the time period 1 July 2009 – 30 June 2019. Inconsistent data recording practices for some small rural and regional EDs meant that they were excluded from the study (3.4% of weekend night-time injury cases). The only major change to the EDs covered by the study came in 2017, with the opening of the

Sunshine Coast University Hospital. Sensitivity analyses excluding this new ED (and two nearby EDs: Caloundra and Nambour) produced similar results to our overall models, so data from the Sunshine Coast was included. The Brisbane sub-analyses used data from The Royal Brisbane and Women's Hospital and the Princess Alexandra Hospital – the two public hospitals closest to Fortitude Valley and Brisbane central business district.

To focus on the kinds of presentations most likely to have been impacted by the restrictions, we limited our cases to those presenting between 20:00 and 5:59 on Friday and Saturday (high-alcohol hours [25]) nights where the presenting patient was aged between 16 and 65 years. We allowed the lower age to be 16 years, as ID scanner data (see paper in this series) had people 16 years or younger attempting to enter Safe Night Precincts even though 18 is the minimum legal purchase age in Australia. Presentations were given a primary diagnosis code using the International Classification of Diseases (ICD) version 10 and three sets of presentations were extracted as our outcome variables: (i) presentations related to any injury or poisoning (ICD-10 S00-T98); (ii) presentations related to alcohol intoxication or harmful use (ICD-10 F10.0-F10.1); and (iii) presentations related to maxillofacial fractures, commonly associated with assault [23] (ICD-10 S02.2-S02.7).

Hospital admissions. Hospital admissions data were also analysed to investigate the changes in more serious incidents that resulted in hospitalisation. State-wide population hospital admission rates for 16-65 year olds were examined for 1 July 2009 to 31 December 2018. Because of the delays between injury and hospital admission, we did not rely on time-based

proxy measures for these indicators. Instead, we focussed on admission types most likely to be linked to assaults and used two types of admissions as separate outcome series – maxillofacial fractures (ICD-10 S02.2-S02.7) and admissions where an assault-related external cause was identified (ICD-10 X85-Y09). We kept these series separate to ensure any biases in measurement in a particular outcome (e.g. in the external cause coding) did not unnecessarily affect all results. As above, admissions at two major Brisbane hospitals (Royal Brisbane and Princess Alexandra) servicing Fortitude Valley Safe Night Precincts were examined.

Interventions

For the purposes of analyses, we identified three separate intervention points: (i) 1 July 2016 when the initial trading hours restrictions were implemented; (ii) 1 February 2017 when the use of extended trading permits was halved from 12 to 6 per year; and (iii) 1 July 2017 when mandatory ID scanners were introduced. We initially estimated models for each of these policies separately (where the intervention variables were coded as '1' from implementation date onwards and '0' beforehand). Due to the implementation of three interventions in such a short period of time, we also estimated the cumulative impact of the interventions by setting the intervention variable to 0 before July 2016, 0.333 between July 2016 and January 2017, 0.666 between February 2017 and June 2017, and 1 from July 2017 until June 2019/December 2018. Scaling the full intervention in this way makes comparisons with the other intervention effects more straightforward.

Analytic strategy

Data were modelled using per-capita rates (incidents per 10,000 people). We used age-specific Queensland population data for the state-wide models [26] and populations for the greater Brisbane area for the Brisbane-specific models [27]. We also conducted sensitivity analyses by running the same set of models on incident count data rather than per-capita rates (see Supplementary Tables S1-S4).

Using monthly data, seasonal auto-regressive integrated moving average time series models were estimated for each of the five outcome variables. These models are widely used for interrupted time-series analyses and allow for the incorporation of auto-regressive and moving average parameters to deal with the lack of independence in most time-series data (i.e. data near each other in time are often correlated). Unit root tests of stationarity and Box-Ljung Q tests were used to ensure the time series resembled white-noise – in other words, to ensure that long-term trends or correlations between time-points did not influence our estimates of policy impact. Seasonal adjustments were also made as all series exhibited significant seasonality, with peaks in the summer months and troughs in the winter months [28]. Similarly the specific values for the auto-regression and moving average parameters were selected based on autocorrelation plots with final models chosen where the Portmanteau test for white noise was satisfied [29]. In order to identify the best-fitting transfer function for the intervention variable cross-correlograms were examined (specified as lag; [28]). In previous models of ED data we incorporated daytime presentations as a control variable to account for any system changes [19], but for consistency with the hospital data we did not

include that series here. The results of these previous models were consistent with those presented here. All models were estimated using Stata v14 [30].

Ethics

Ethics approval was obtained from The University of Queensland (2017000012) and Deakin University (HEAG-H 183_2016) Human Research Ethics Committee.

Results

Emergency department presentations

Figure 1 show the per-capita rate of our three ED presentation outcomes between 2009 and 2019, with the three intervention points marked.

INSERT FIGURE 1

Results of the time series models for the ED data are presented in Table 1. There were no significant associations between the policy implementation and alcohol-specific ED presentations. Similarly, for maxillofacial injuries, there were no significant policy impacts. For total injury presentations, the implementation of the ID scanners in July 2017 was associated with a significant reduction. Taking the best estimates of the effect sizes for the policy (-0.21; 95% confidence interval -0.39, -0.04), we can estimate reductions in monthly high-alcohol hours attendances of 4.1% following the July 2017 implementation of the ID scanners, based on the overall monthly average rate of injury presentations across the study

period. There were no significant impacts on any outcomes for the combination of all three policy interventions or for either the initial or February 2017 update of the trading hours and extended trading hours policies.

INSERT TABLE 1

Table 2 provides the results of similar models estimated using only the data from the two major Brisbane EDs servicing Fortitude Valley. None of the policy measures had any association with any of the three types of ED presentation examined for this subset of presentations.

INSERT TABLE 2

Hospital admissions

Figure 2 shows the rate of hospital admissions for maxillofacial injuries and for any admission where an external cause of assault was recorded.

INSERT FIGURE 2

The results of the time series models for the two types of admissions across all of Queensland are presented in Table 3. There were no significant associations between any of the policy interventions and either category of hospital admission.

INSERT TABLE 3

Table 4 provides the model estimates for the same indicators focussed just on the major hospitals servicing Fortitude Valley. Again, there were no significant associations between the three policy interventions and either of the admission categories.

INSERT TABLE 4

The sensitivity analyses (Tables S1-S4) told a broadly similar story, although there were significant *increases* in the raw count of hospital admissions for maxillofacial fractures in the state-wide models for the first two intervention points and the full policy.

Discussion

This study examined the impact of the Queensland policy measures on health service utilisation by examined trends in alcohol-related injuries, intoxication and assault. Our results provide little evidence that the specific changes to policies explored here around late-night entertainment precincts in Queensland had a measurable impact on the incidence of injuries and intoxication as detected in the hospital systems. Across most outcome measures and intervention points, we found no significant effects on either ED presentations or hospital admissions. We did find one significant association, with the introduction of mandatory ID scanners in July 2017 associated with a reduction in all late-night injury presentations state-wide. However, this association was not replicated in the Brisbane-specific analyses and there

were non-significant effects for the whole suite of policies on injury presentations, raising concerns that this effect is spurious. Still, to our knowledge there have been no previous evaluations of the use of ID-scanners in night-time entertainment precincts and these findings raise at least the possibility that they had an impact on late-night injuries.

The association between the ID-scanner policy and ED injury presentations should be treated with some caution, given the potential lags in policy impact and the broad similarity of our parameter estimates across all intervention points for all injuries. Future research is necessary to assess the impact of ID-scanners without the confounding of the broader policy changes seen in this study. We found no evidence of impacts of the ID scanners on alcohol-specific ED attendances or on maxillofacial fractures, both likely to be more specifically linked to alcohol than our overall injury indicator. This may be due to inconsistencies in the recording of alcohol diagnoses within EDs [16] , it may indicate a potentially spurious association for our overall injury measure or it may relate to a lack of power for these less frequent outcomes. Thus, while we have suggestive evidence that the implementation of ID-scanners in Queensland may have led to small reductions (~4%) in late-night injury-related presentations to EDs, the broader pattern of results suggest this relationship should be treated very cautiously. Earlier analyses focussing specifically on young men, the most likely demographic to be affected by these measures [19], also found null results, casting further doubt on this small significant effect.

Our broad finding that there were no impacts of the trading hours restrictions on any measure are largely in contrast to previous evaluations of local-level restrictions in Newcastle and Sydney [17, 18, 31], where significant reductions in injury presentations followed trading hours restrictions. These inconsistent findings may be partially attributed to key differences in the implementation of trading hour measures. While in Newcastle and Sydney there were clear venue closing times of 3am and 3.30am, late-night alcohol access continued in Queensland entertainment precincts through extended trading permits – ensuring the continuation of late-night trading despite the TAFV policy's aim to cease alcohol service at 3am. Further, it is worth noting that previous international studies of trading hours policy changes have found mixed evidence of effects on ED-related harms [32] and the majority of well-designed studies that show impacts rely on police data [3]. These differences might suggest that ED attendance is a less sensitive indicator of change as it reflects only the most serious of incidents and may therefore often miss statistical significance, even if there is a decline. The lack of geographical specificity in health data systems mean that any impacts of the policy changes on health outcomes may be drowned out by noise – previous research in Queensland have shown that the majority of alcohol-related injury presentations to EDs stem from incidents in private settings rather than entertainment precincts [33]. ED data systems that record the location of the injury would allow for more specific analyses. Our findings also suggest no detectable impact of Queensland's policy changes on key measures of hospital admissions. This is relatively unsurprising given the lack of alcohol specificity in hospital data and the inability to even construct a time-based proxy measure given the delays between incidents and eventual hospital admission. Analyses of a range of other outcomes

(reported in this issue), suggest more that the policies implemented had positive impacts on some other measures with more geographical specificity (e.g. harms measures in police and ambulance data [34, 35], although in general the impacts on harms were still not as marked as those reported in previous Australian studies.

Limitations

This study has a number of limitations. Our focus on health system data meant that our outcome variables were generally less specific than ideal. For example, we analysed all high alcohol hours emergency department visits, although previous research has demonstrated that many of these presentations come from private settings and are unlikely to be affected by the policies implemented in Queensland [33]. Further, our measures relied on coding conducted as part of administrative processes within hospitals not designed for research. Previous analyses have highlighted the weaknesses of alcohol measures in hospital systems [16, 36] and we have relied on time and condition-based proxy measures to attempt to capture key trends [37,38]. These challenges exist to varying degrees for all our outcome variables, biasing all of our estimates of policy impact towards the null by increasing the noise in the data and making it harder to detect any specific impact on injuries and other outcomes stemming from licensed premises and entertainment precincts.

The complex interplay of the three separate intervention points also raises challenges for our analyses. The lack of time between intervention points and the likelihood of significant lags (e.g. Newcastle, where impacts took six months to become clear [8]) make it difficult to confidently attribute any effects to particular intervention points. Finally, the fact these

policies were implemented across the entire state of Queensland at the same time means that no reasonable control site could be used. Our findings are thus susceptible to the impacts of uncontrolled factors that coincided with the interventions and should be treated with some caution.

Conclusions

This paper provides little evidence that the introduction of restrictions on late night alcohol service and mandatory ID-scanners in Queensland entertainment precincts between 2016 and 2017 had an impact on outcomes measurable in the health system. We do find very tentative evidence that the introduction of ID scanners in late night entertainment precincts in Queensland between 2016 and 2017 reduced the incidence of injuries requiring ED-based treatment during weekending nights, but this effect should be treated with caution. These findings suggest that the late-night interventions in Queensland have had, at most, a small impact on alcohol-related harms measured in hospital systems. More geographically and temporally precise measures of harm are needed to more accurately measure policy impacts.

Acknowledgements

This study is funded by an ARC Linkage grant (LP160100067), Foundation for Alcohol Research and Education, Australian Rechabites Foundation, and Lives Lived Well. We would like to thank Queensland Police Service, Queensland Health, and Queensland Ambulance Service for the provision of data. ML is funded by an NHMRC Career Development Fellowship (GNT1123840).

Declarations of interest

This study is funded by an ARC Linkage grant (LP160100067), the Queensland Government, Foundation for Alcohol Research and Education, Australian Rechabites Foundation, and Lives Lived Well. ML is funded by an NHMRC Career Development Fellowship (GNT1123840) and receives research funding from the Foundation for Alcohol Research and Education, the Australian Research Council and the Victorian Health Promotion Foundation. KC receives funding from Australian Research Council, Queensland Government, and Northern Territory Government. PM receives funding from Australian Research Council and Australian National Health and Medical Research Council, grants from NSW Government, National Drug Law Enforcement Research Fund, Foundation for Alcohol Research and Education, Cancer Council Victoria, Central Australian Aboriginal Congress, Northern Territory government, Australian Rechabites Foundation, Northern Territory Primary Health Network, Lives Lived Well, Queensland government and Australian Drug Foundation, travel and related costs from Queensland Police Service, Queensland Office of Liquor Gaming and Racing and the Australasian Drug Strategy Conference. He has acted as a paid expert witness on behalf of a licensed venue and a security firm. JF receives funding from Australian Research Council and Australian National Health and Medical Research Council, funding from QLD Government, Department of Health, Tasmanian Department of Health, Foundation for Alcohol Research and Education, Criminology Research Council, VicHealth, travel and related costs from Queensland Police Service.

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Table 1. ARIMA models for high alcohol hours emergency department presentations per 10,000 residents, Queensland.

Model	July 2016			February 2017			July 2017			Full policy		
	Coef.	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***
Alcohol intoxication etc[a]	-0.02	-0.12, 0.07	0.63	0.01	-0.07, 0.09	0.78	0.01	-0.08, 0.08	0.99	-0.01	-0.04, 0.03	0.90
Any injury[b]	-0.12	-0.30, 0.07	0.22	-0.18	-0.41, 0.05	0.13	-0.21	-0.39, -0.04	0.02	-0.22	-0.46, 0.02	0.07
Maxillofacial fractures[c]	-0.01	-0.03, 0.03	0.91	-0.01	-0.04, 0.02	0.58	-0.02	-0.05, 0.01	0.35	-0.02	-0.07, 0.03	0.40

[a] SARIMA (3,0,0)(1,0,0,12) – interventions specified as lag 1. [b] SARIMA (2,0,2)(1,0,0,12) – interventions specified as lag 1. [c] SARIMA (1,0,0)(1,0,0,12) – interventions specified as lag 1. All models had a non-significant Q-test, indicating appropriate model specifications. ARIMA, auto regressive integrated moving average; CI, confidence interval; SARIMA, seasonal auto-regressive integrated moving average

Table 2. ARIMA models for high alcohol hours emergency department presentations per 10,000 residents, Brisbane.

Model	July 2016			February 2017			July 2017			Full policy		
	Coef.	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***
Alcohol intoxication etc[a]	-0.04	-0.10, 0.02	0.16	-0.02	-0.07, 0.03	0.46	0.01	-0.06, 0.08	0.82	-0.01	-0.03, 0.01	0.48
Any injury[b]	-0.03	-0.37, 0.31	0.86	0.05	-0.31, 0.41	0.79	-0.12	-0.48, 0.24	0.52	-0.10	-0.71, 0.51	0.76
Maxillofacial fractures[c]	-0.03	-0.07, 0.02	0.25	-0.02	-0.09, 0.05	0.57	-0.03	-0.10, 0.04	0.45	-0.04	-0.11, 0.03	0.28

[a] SARIMA (3,0,0)(1,0,0,12) – interventions specified as lag 1. [b] SARIMA (2,1,2)(1,0,0,12) – interventions specified as lag 1. [c] SARIMA (1,0,1)(1,0,0,12) – interventions specified as lag 1. All models had a non-significant Q-test, indicating appropriate model specifications. ARIMA, auto regressive integrated moving average; CI, confidence interval; SARIMA, seasonal auto-regressive integrated moving average.

Table 3. ARIMA models for maxillofacial fracture and assault hospital admissions per 10,000 people, Queensland

Model	July 2016			February 2017			July 2017			Full policy		
	Coef.	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***
Maxillofacial fractures[a]	0.01	-0.04, 0.06	0.711	0.02	-0.03, 0.07	0.457	-0.02	-0.08, 0.05	0.660	-0.01	-0.02, 0.02	0.826
Assault[b]	0.06	-0.26, 0.38	0.728	0.10	-0.17, 0.37	0.477	-0.18	-0.46, 0.11	0.224	-0.01	-0.09, 0.09	0.999

[a] ARIMA (1,0,0) – interventions specified as lag 1. [b] SARIMA (0,1,1)(0,1,1,12) – interventions specified as lag 1. All models had a non-significant Q-test, indicating good model fit. ARIMA, auto regressive integrated moving average; CI, confidence interval; SARIMA, seasonal auto-regressive integrated moving average.

Table 4. ARIMA models for maxillofacial fracture and assault hospital admissions per 10,000 people, Brisbane

Model	July 2016			February 2017			July 2017			Full policy		
	Coef.	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***	**Coef.**	**95% CI**	***P***
Maxillofacial fractures[a]	-0.05	-0.31, 0.20	0.70	0.07	-0.07, 0.21	0.31	-0.15	-0.65, 0.35	0.56	-0.12	-0.47, 0.23	0.51
Assault[b]	0.11	-0.34, 0.55	0.63	0.08	-0.71, 0.87	0.85	-0.18	-0.60, 0.25	0.42	0.03	-0.86, 0.92	0.95

[a] ARIMA (0,1,1) – interventions specified as lag 2. [b] ARIMA (1,1,0) SARIMA (1,1,0,12) – interventions specified as lag 1. All models had a non-significant Q-test, indicating good model fit. ARIMA, auto regressive integrated moving average; CI, confidence interval; SARIMA, seasonal auto-regressive integrated moving average.

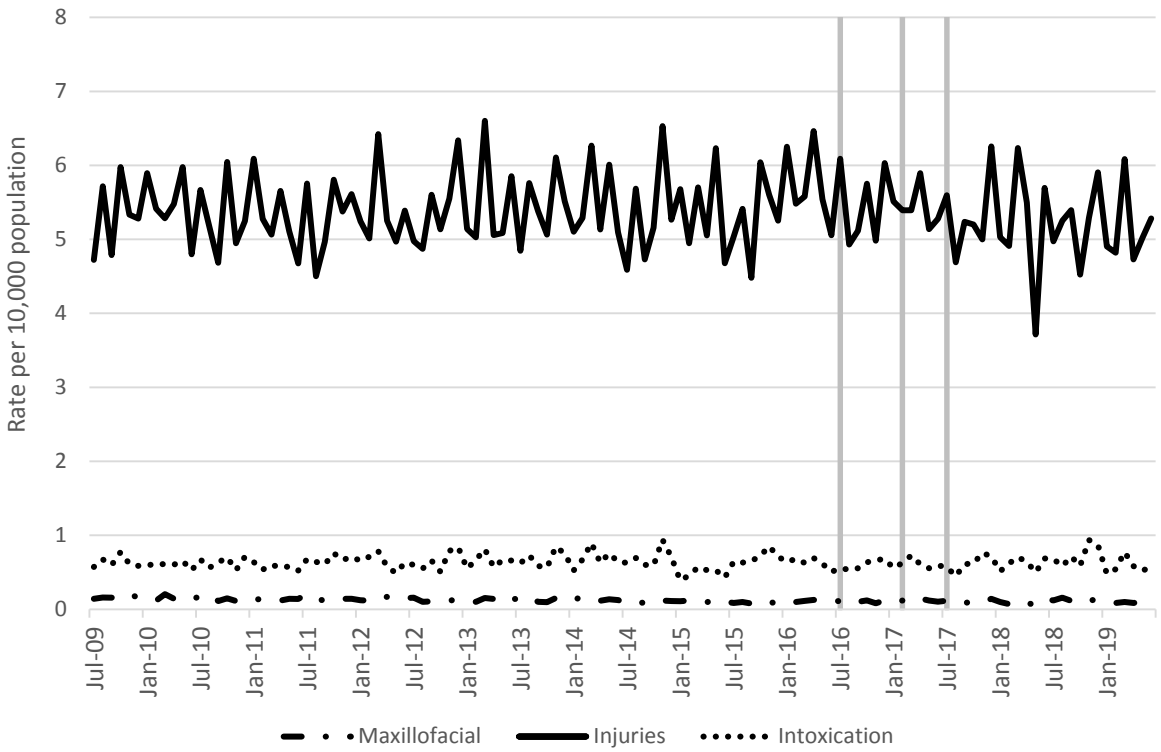

Figure 1. Monthly rate of presentations to Queensland emergency departments between 8pm-6am on Friday and Saturday nights, with an external cause (ICD-10 S00-T98), a maxillofacial fracture (ICD-10 S02.2-S02.7) or an alcohol intoxication/abuse (ICD-10 F10.0-F10.1) diagnosis, with intervention points marked.

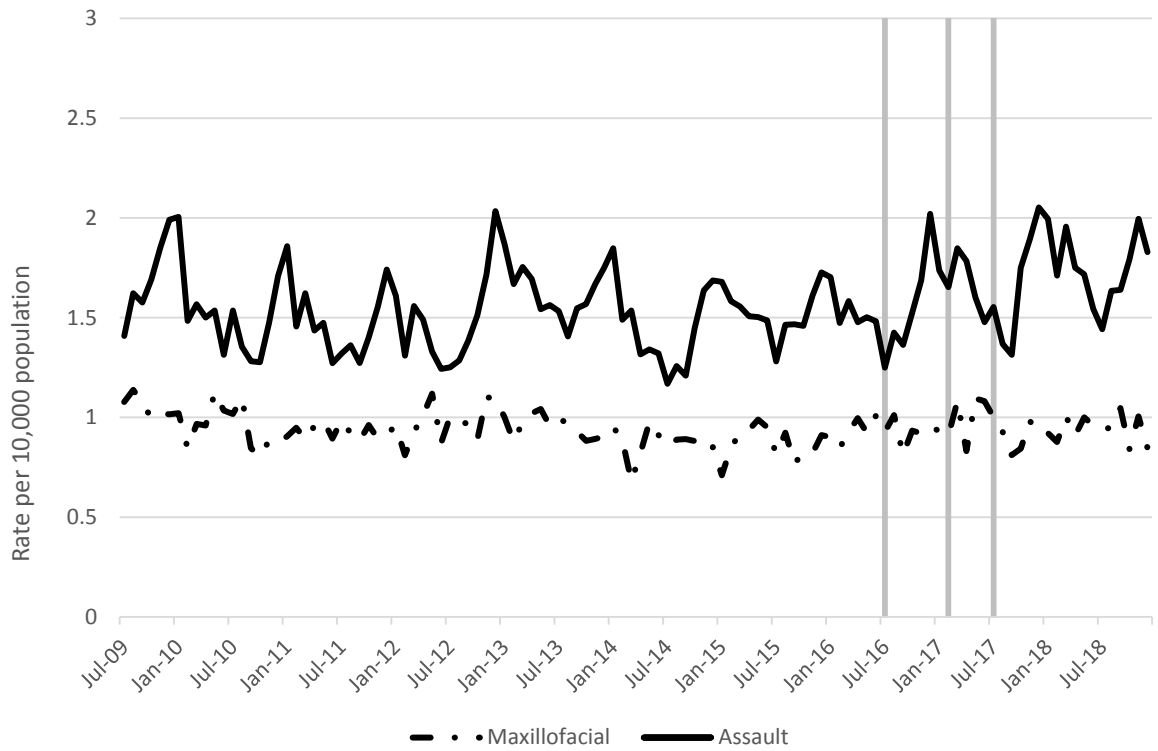

Figure 2. Monthly rate of admissions to Queensland hospitals with a primary diagnosis of maxillofacial fracture (ICD-10 S02.2-S02.7) or an external cause of assault (ICD-10 X85-Y09) were recorded, with intervention points marked.