

Young people with prior health service contacts have increased risk of repeated alcohol-related harm hospitalisations

SCOTT A. SIMS^{1,2} , GAVIN PEREIRA^{3,4,5} , DAVID PREEN¹, DANIEL FATOVICH^{6,7}  & MELISSA O'DONNELL^{1,2,8} 

¹School of Population and Global Health, University of Western Australia, Perth, Australia, ²Developmental Pathways and Social Policy, Telethon Kids Institute, Perth, Australia, ³Curtin School of Population Health, Curtin University, Perth, Australia, ⁴enAble Institute, Curtin University, Perth, Australia, ⁵Centre for Fertility and Health, Norwegian Institute of Public Health, Oslo, Norway, ⁶Department of Emergency Medicine, Royal Perth Hospital, Perth, Australia, ⁷Emergency Medicine, University of Western Australia, Perth, Australia, and ⁸Australian Centre for Child Protection, University of South Australia, Adelaide, Australia

Abstract

Introduction. After a first alcohol-related hospitalisation in youth, subsequent hospitalisations may demonstrate an increased risk of further alcohol-related hospitalisations, but there is no existing data on this. **Methods.** A retrospective longitudinal study between July 1992 and June 2017 using linked hospital administrative data identified 23 464 Western Australian young people [9009 (38.4%) females and 14 455 (61.6%) males], aged 12–24 years hospitalised for at least one alcohol-related harm (ARH) episode of care. Cox regression was used to estimate hazard ratios (HR) between risk factors and repeated alcohol-related hospitalisation after the first discharge for ARH. **Results.** Of those admitted for an alcohol-related hospitalisation ($n = 23\,464$), 21% ($n = 4996$) were readmitted for ARH. This high-risk sub-group comprised 46% ($n = 16\,017$) of the total alcohol-related admissions ($n = 34\,485$). After the first discharge for ARH, 16% (804) of people who experienced an alcohol-related readmission were readmitted within 1 month, and 51.8% (2589) were readmitted within 12 months. At increased risk of readmission were Aboriginal people and those with prior health service contacts occurring before their first alcohol-related hospitalisation, including illicit drug hospitalisations, mental health contacts and, in a sub-analysis, emergency department presentations. **Discussion and Conclusions.** The probability of a repeated ARH hospitalisation was highest in the first month after initial discharge. There is a high-risk sub-group of young people more likely to have a repeat ARH hospitalisation. This represents an opportunity to provide interventions to those most at risk of repeated ARH. [Sims SA, Pereira G, Preen D, Fatovich D, O'Donnell M. Young people with prior health service contacts have increased risk of repeated alcohol-related harm hospitalisations. *Drug Alcohol Rev* 2022;41:1226–1235]

Key words: hospital readmission, youth alcohol consumption, International Classification of Disease, data linkage, health service.

Introduction

Alcohol-related harm (ARH) remains one of the leading causes of preventable hospitalisations that continue to place a large burden on hospital resources [1]. The reduction of preventable visits is an opportunity to improve quality of care and reduce health-care spending [2], but little research has been conducted on repeat ARH. Most studies looking at predictors of readmissions are either focused on adults or the elderly [3,4], admissions other than ARH [5,6], utilise data from single hospital settings [7] or cross-sectional in design [8].

Knowing more about the characteristics of young people that re-admit for ARH could help provide an evidence base to aid in the tailoring of prevention services to these high-risk individuals. In addition, a comprehensive profiling of the most common types of diagnoses associated with these repeat admissions may help with the management and allocation of hospital resources.

In a hospital setting, patients presenting with ARH are typically resource intensive and can be disruptive, violent and aggressive towards staff and other patients [9]. Comorbidity of ARH with other major health issues also exists for young people. In addition, drugs

Scott A. Sims MBIostat, Biostatistician, Gavin Pereira PhD, Epidemiologist, David Preen PhD, Chair in Public Health, Daniel Fatovich MBBS, Senior Emergency Physician, Melissa O'Donnell PhD, Deputy Director. Correspondence to: Mr Scott A. Sims, School of Population and Global Health, University of Western Australia, Clifton Street Building, Clifton St, Nedlands, WA 6009, Australia. Tel: +(08) 6488 1312; E-mail: scott.sims@uwa.edu.au

Received 30 November 2021; accepted for publication 10 March 2022.

other than alcohol also have a strong association with problematic alcohol use. Survey findings showed that people who reported high levels of psychological distress were at least twice as likely to report recent illicit drug use, and more likely to report drinking more than four standard drinks on one occasion, compared to those with low levels of psychological distress [10].

Young people experiencing adverse health outcomes are likely to have comorbid issues and therefore more likely to be in contact with multiple health services, such as mental health, child protection services and emergency departments (ED) [11]. Young people exposed to ARH are particularly at high risk of mental illness, and vice versa. In Australia, those aged 13–17 years with mental health issues were four times more likely to have been drinking at harmful levels in the last 30 days [11]. Despite recent collective declines in adolescent drinking trends in Australia [12], it does not appear to have corresponded in a shift towards healthier behaviours [13]. In addition, the number of young people aged 15–24 years abstaining from alcohol has increased (26.1% in 2013 to 32.5% in 2019), while little has changed in the proportion of risky drinking. In 2019, 1 in 3 people aged 15–24 years had more than four standard drinks on one occasion at least once a month [10]. Aboriginal people are also less likely to drink alcohol, compared to non-Aboriginal people, but those who do are more likely to drink at risky levels. Aboriginal people aged 15 and over exceeded the single occasion alcohol risk guidelines at 1.2 times the rate of non-Aboriginal people (49% and 42%, respectively) [14]. Such risky drinking behaviour can lead to acute ARHs with injuries being experienced disproportionately by younger people [10].

This study aims to identify the risk of repeated alcohol-related hospitalisations and the length of time at which they re-occur, types of hospitalisation and characteristics of young people who experience them. Using Cox regression modelling, we have examined known risk factors for ARH and examined their association with repeat ARH using linked health administrative data. We include models examining the impact across all available hospital records for 12- to 24-year-olds for the whole of Western Australia (WA), as well as sub-analyses accounting for previous contact with ED prior to their first episode of ARH. There are opportunities for intervention in physical and mental health services if we know more about the types of young people frequently being hospitalised for ARH.

Methods

Design and participants

This was a retrospective longitudinal study of all children and young adults aged 12–24 years who were born between 1980 and 2005 and had an alcohol-

related hospitalisation in WA between July 1992 and June 2017.

Data sources

De-identified data for this study were collected from the Hospital Morbidity Data Collection (HMDC) and merged with the Mental Health Information System (MHIS), Emergency Department Data Collection, death registrations and child protection datasets. Data linkage was performed using probabilistic matching with clerical review by the Data Linkage Branch of the WA Department of Health which has been shown to be 99.89% accurate [15]. The HMDC comprises all episodes of care for patients discharged from all public and private hospitals in WA and were examined for the time period July 1992–June 2017. The MHIS collects data on use of mental health services in WA and contains clinical information from public outpatient clinics and all hospital (public and private) visits. Data from the MHIS were extracted for those born between 1980 and 2005 which resulted in records spanning between January 1996 and June 2017. Child protection notification and out of home care information were extracted from the Western Australian Child Protection Data collection for the time period January 1990–June 2017. The Emergency Department Data Collection contains data on ED activity in WA's public hospitals, as well ED activity from private hospitals under contract with the WA Government. The ED sub-analyses used Emergency Department Data Collection unit records for the time period January 2002–June 2017. Data for this study coded as ARH relate to the drinker, as opposed to the perpetrator, as patients hospitalised for injuries when the perpetrator had been affected by alcohol would not be captured.

Outcome

Hospitalisations were classified as alcohol-related using the International Statistical Classification of Diseases and Related Health Problems, Ninth Revision, Clinical Modification (ICD-9-CM) before July 1999 and the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) from July 1999 to June 2017 [16]. An episode of ARH serious enough to require hospitalisation was identified from the HMDC data set using alcohol-related international classification of diseases (ICD) codes to scan the principal diagnosis and up to 20 additional diagnoses (see Tables A1 and A2, Appendix, for ICD codes). Up to four external cause

code fields describing the cause of injury were then scanned for matching codes. ED presentations were not used as an outcome due to limitations in identifying presentations as alcohol-related [17].

All hospitalisations refer to inpatient admissions. A patient was deemed as having a single alcohol-related hospitalisation (the single group) if no further alcohol-related hospitalisations were recorded in the HMDC after their initial alcohol-related admission. A patient was deemed as having repeated alcohol-related hospitalisations (the repeated group) if one or more alcohol-related hospitalisations were recorded in the HMDC after their initial hospitalisation during the follow-up period. Repeated hospitalisations excluded inter-hospital transfers as these were regarded as part of the same episode of care.

Risk factors

Risk factors included demographic characteristics, such as age, sex, Aboriginality and area of residence. Aboriginality was derived by the WA Data Linkage Branch using a validated algorithm for any individual with at least one record in several WA government administrative datasets where Aboriginal status was recorded [18]. Socio-Economic Indexes for Areas (SEIFA) and remoteness area (RA) were derived by the WA Data Linkage Branch using mapping and concordance tables created by the Australian Bureau of Statistics [19]. SEIFA scores were categorised as either in the 80% least disadvantaged or 20% most disadvantaged. A hospitalisation was classified as having been admitted through ED if the 'Source of Referral' was an ED clinician or the mode of transport to hospital was by emergency ambulance.

Prior health service contacts include any mental health contact, child protection notification, period of care, illicit drug hospitalisation, or ED presentation recorded before the patients first alcohol-related hospitalisation. A prior child protection notification consists of any previous notification report made to the CPFS. A prior period of care consists of any previous period when a child was brought into care. A prior mental health contact was any admission (HMDC) or service contact that was mental health related (MHIS), but excluding alcohol, substance and self-poisoning deliberate self-harm related ICD codes. Illicit drug and mental illness categories were identified using ICD-9-CM codes and the equivalent ICD-10-AM codes. Prior ED presentations were included in the sub-analysis as an additional risk factor to assess whether having a prior ED presentation within 12 months of the first ARH admission was associated with repeated ARH.

Statistical analysis

Descriptive statistics were performed for all demographic characteristics of the cohort obtained from the HMDC to quantify the proportion of alcohol-related hospitalisations admitted through ED. Cox proportional hazards modelling was used to estimate the association of known risk factors with repeated ARH. A counting process approach was utilised where start time was age in months at first alcohol-related hospital discharge (separation date) and stop time was age in months at second alcohol-related hospital admission (admission date). Patients were censored at their date of death or if there was no repeat alcohol-related hospital admission before the end of follow up or when they turned 25 years of age. Inter-hospital transfers were identified to avoid counting transfers as readmissions and to adjust the time-zero for commencement of risk of repeated alcohol hospitalisations from the correct specified separation date. Estimates are presented as adjusted and unadjusted hazard ratios (HR) with Wald 95% confidence intervals (CI). Kaplan–Meier survivor function estimates together with log-rank tests confirmed the proportional hazards assumption held for all categorical covariates. SEIFA and RA were both recategorised to meet this assumption. Models were adjusted for prior health service contact types and known demographic risk factors, sex, Aboriginality, SEIFA and RA. All patients entered the study at their first alcohol-related hospital discharge (separation date). Age of the patient in months was used as the time scale so that time was measured as age at follow up and to account for age truncation. A sub-analysis was performed on hospitalisation data from 2003 to 2017 to examine prior ED presentations using the Cox regression modelling approach outlined above. Presentations within two calendar days of a first ARH admission were excluded to avoid treating the presentation as the same episode of care. Analyses were performed using SAS statistical software (v9.4).

Ethics

Ethics approval for this study was obtained from the WA Aboriginal Health Ethics Committee, the University of WA Human Research Ethics Committee and the Department of Health WA Human Research Ethics Committee [no. 2016/55]. During the linkage process, the best practice 'separation principle' [20] was adhered to by the WA Data Linkage Branch to safeguard privacy [21].

Results

Over the period July 1992–June 2017, a total of 442 494 people aged 12–24 years were hospitalised, of which 23 464 (5.3%) were hospitalised for at least one ARH episode. Table 1 compares young people who only have one episode against those with more than one to identify factors that may warrant an intervention. Of those

hospitalised for ARH, 18 468 (78.7%) had only one alcohol-related hospitalisation, while 4996 (21.3%) were hospitalised for two or more ARH episodes. The mode duration before a repeat episode was within 1 month of the initial discharge for ARH, where 804 people (16%) had a repeat episode. About half (51.8%) of people who had a repeat alcohol-related hospitalisation did so within 12 months of the first discharge for ARH. The most

Table 1. Characteristics based on hospitalisations experienced during follow up (born 1980–2005 having hospitalisation between ages 12 and 24), for single (only one admission) and repeated (2 or more admissions) groups

Characteristic	Single (N = 18 468 patients)			Repeat (N = 4996 patients)		
	Admissions		Admitted through ED, %	Admissions		Admitted through ED, %
	n	%		n	%	
Total	18 468	100.0	90.5	16 017	100.0	80.8
Sex						
Female	6926	37.5	89.9	6818	42.6	80.9
Male	11 542	62.5	90.8	9199	57.4	80.8
Aboriginality						
Non-Aboriginal	15 358	83.2	90.7	10 517	65.7	77.6
Aboriginal	3110	16.8	89.3	5500	34.3	87.0
Age at admission						
12–16 years	3239	17.5	92.7	1945	12.1	86.6
17–18 years	3922	21.2	91.6	2836	17.7	81.5
19–20 years	4249	23.0	90.0	3570	22.3	80.6
21–22 years	3705	20.1	89.6	3882	24.2	79.2
23–24 years	3353	18.2	88.6	3784	23.6	79.3
Socio-economic condition of person and household at time of admission						
Most disadvantaged (lower 20%)	4337	23.5	87.7	4571	28.5	83.2
Less disadvantaged (upper 80%)	13 610	73.7	91.1	11 347	70.8	79.8
Missing	521	2.8	96.5	99	0.6	84.8
Remoteness area						
Metro	11 980	64.9	90.7	10 061	62.8	78.3
Regional	3478	18.8	88.8	2683	16.8	80.5
Remote	2489	13.5	90.7	3174	19.8	89.1
Missing	521	2.8	96.5	99	0.6	84.8
Illicit drugs						
Total	2606	14.1	78.7	3747	23.4	68.4
Cannabis	1892	10.2	73.0	3069	19.2	65.8
Opioids	453	2.5	91.8	605	3.8	77.2
Methamphetamine	423	2.3	79.2	539	3.4	68.1
Hallucinogens (including LSD)	142	0.8	85.9	139	0.9	77.0
Cocaine	77	0.4	81.8	79	0.5	73.4
Non-alcohol/substance-related mental illness						
Any non-alcohol/substance mental disorder	4373	23.7	81.1	6949	43.4	71.9
Deliberate self-harm	2728	14.8	95.5	3012	18.8	93.6
Anxiety disorders	1978	10.7	83.3	2724	17.0	75.3
Psychotic disorders	1648	8.9	73.1	3051	19.1	62.8
Mood disorders	819	4.4	85.8	1190	7.4	81.8
Personality and behaviour disorders	557	3.0	74.7	1819	11.4	70.0
Disorders of psychological development	243	1.3	69.1	383	2.4	58.2
Organic mental disorder	113	0.6	89.4	138	0.9	65.9
Mental retardation	34	0.2	67.6	120	0.8	66.7
Other mental disorders	144	0.8	78.5	249	1.6	66.7

ED, emergency department; LSD, lysergic acid diethylamide.

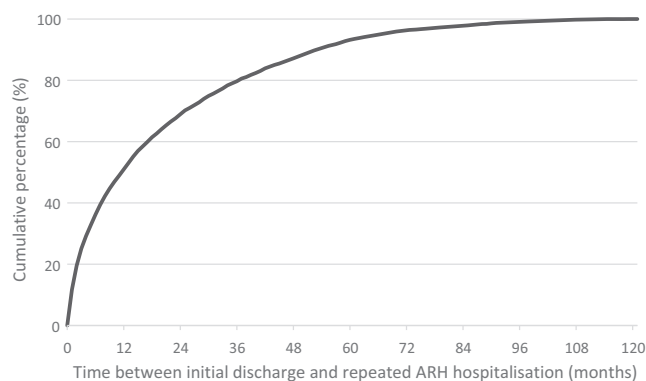


Figure 1. Cumulative distribution function of time in months between initial discharge and repeat alcohol-related hospitalisation (ARH).

common time of recurrence was within 1 month where 804 (16.1%) had a repeat alcohol-related hospitalisation (Figure 1). Overall, although only 21.3% (4996) of people had repeat alcohol harm hospitalisations, they comprised 46.4% (16 017) of the 34 485 alcohol-related admissions. Males accounted for 50.2% of repeated hospitalisations, with 11% of males and 8% of females admitted for ARH three or more times.

The comparison between those having a single alcohol hospitalisation (the single group) and those having two or more alcohol-related hospitalisations (the repeat group) varied across demographic characteristics and other types of comorbid admissions. In particular, the proportion of Aboriginal people in the repeat group was 34.3% compared to 16.8% in the single group. As expected, metropolitan areas had the highest proportion of alcohol-related hospitalisations; however, variation across RAs between the two groups was minimal, with people residing in remote areas having the greatest differential between repeat and single groups (19.8% vs. 13.5%, respectively). Overall, one out of three alcohol-related hospitalisations was also diagnosed with a non-alcohol and non-substance related mental illness (32.8%). This was especially apparent in the repeated group with 43.4% of all hospitalisations also indicating mental illness, increasing from 23.7% of hospitalisations for the single group. All types of mental illness were increased for the repeated group, with the most common types of mental illness for the repeated group being for psychotic disorders (19.1%), deliberate self-harm (18.8%) and anxiety disorders (17%). The proportion of hospitalisations admitted through ED was lower for the repeated group compared to the single group across all demographic characteristics. The highest proportion of hospitalisations admitted through ED for the repeat group was for Aboriginal patients (87% admitted through ED), from remote areas (89.1% admitted through ED) and deliberate self-harm (93.6% admitted through ED).

Table 2 ranks the leading types of injuries, external causes of morbidity and factors influencing health status and contact with health services for patients with repeat alcohol-harm hospitalisations, along with the proportion admitted from EDs for each diagnosis. ICD codes are only displayed for admissions that used ICD-10-AM as mapping to ICD-9-CM could not be matched 1:1 across the entire breakdown of categories. In addition, as only 2% of ICD codes were ICD-9-CM, this allowed the presentation of diagnosis information at a more specific and detailed level than possible using only ICD-9-CM.

Table 3 shows the risk factors associated with repeated alcohol-related hospitalisations after the first discharge for ARH while adjusting for other risk factors. Aboriginal young people had a 95% higher risk than non-Aboriginal young people of recurrence when adjusting for other factors (HR = 1.95; 95% CI 1.81, 2.10). Those residing in remote areas of WA at time of admission had a 51% increase in the recurrence risk compared to those living in the metropolitan areas (HR = 1.51; 95% CI 1.41, 1.62); however, the level of association reduced when adjusted for risk factors (HR = 1.10; 95% CI 1.01, 1.19). In the adjusted model, no significant associations were found between SEIFA, prior child maltreatment notifications or prior periods of care and the outcome of a repeat ARH hospitalisation.

Health service contacts prior to the initial ARH discharge were an important prognostic factor for repeated alcohol harm hospitalisations. People having a prior mental health contact were 2.4 times at more risk than those with no prior mental health contact (HR = 2.37; 95% CI 2.22, 2.53). The main types of prior health service contact associated with the risk of a repeated alcohol-related hospitalisation were for people with a prior illicit drug hospitalisation who were at 4.4 times higher risk than those without a prior illicit drug hospitalisation (HR = 4.40; 95% CI 4.11, 4.72). Our sub-analysis provided similar model estimates using additional data from linked ED presentations. Those with an ED presentation within 12 months of their first alcohol admission were 1.3 times more likely to be associated with having a repeat ARH admission than those who did not have a prior ED presentation (Table S1, Supporting Information). A prior presentation period of 24 months was analysed and made no significant difference to the model estimates.

Discussion

Recurrence of ARH in young people contributed to a disproportionate number of alcohol-related hospitalisations, as almost a half of these admissions (46.4%) were from the 21.3% of people who were readmitted for ARH. The highest risk of having a repeated hospitalisation for ARH

Table 2. Leading International Classification of Diseases diagnoses for injuries, external causes of morbidity and mortality, and factors influencing health status and contact with health services for patients with repeat alcohol-harm hospitalisations

ICD-10-AM category/code	Repeat alcohol harm (N = 4996 patients)		Admitted through ED (%)
	Admissions		
	n	%	
<i>Top 10 types of injuries related to single body regions</i>			
Injuries to the head (S00–S09)	2213	13.8	95.2
Injuries to the wrist and hand (S60–S69)	1117	7.0	91.3
Injuries to the elbow and forearm (S50–S59)	1010	6.3	92.4
Injuries to the knee and lower leg (S80–S89)	541	3.4	95.2
Injuries to the abdomen, lower back, lumbar spine and pelvis (S30–S39)	411	2.6	96.4
Injuries to the shoulder and upper arm (S40–S49)	402	2.5	94.5
Injuries to the thorax (S20–S29)	384	2.4	94.8
Injuries to the neck (S10–S19)	344	2.2	96.2
Injuries to the ankle and foot (S90–S99)	293	1.8	91.1
Injuries to the hip and thigh (S70–S79)	278	1.7	93.9
Total injuries related to single body regions (S00–S99)	4665	29.1	92.8
Total injuries to multiple or unspecified body regions and other consequences of external causes (T00–T98)	2830	17.7	92.9
Total injury admissions (S00–T98)	6714	41.9	92.9
<i>Top 10 external causes of morbidity and mortality</i>			
Intentional self-poisoning by and exposure to antiepileptic, sedative-hypnotic, antiparkinsonian and psychotropic drugs, nec (X61)	1146	7.2	95.9
Assault by bodily force (Y04)	967	6.0	94.1
Intentional self-harm by sharp object (X78)	938	5.9	91.0
Intentional self-poisoning by and exposure to alcohol (X65)	857	5.4	96.8
Intentional self-poisoning by and exposure to nonopioid analgesics, antipyretics and antirheumatics (X60)	545	3.4	96.5
Contact with sharp glass (W25)	297	1.9	90.6
Assault by blunt object (Y00)	294	1.8	94.6
Intentional self-poisoning by and exposure to other and unspecified drugs, medicaments and biological substances (X64)	262	1.6	95.8
Accidental exposure to unspecified factor (X59)	246	1.5	91.5
Intentional self-poisoning by and exposure to narcotics and hallucinogens, nec (X62)	237	1.5	95.4
Total external causes of morbidity and mortality (V01–Y98)	7322	45.7	92.1
<i>Top 10 factors influencing health status and contact with health services</i>			
Tobacco use (Z72.0)	5850	36.5	73.5
Alcohol use (Z72.1)	1826	11.4	79.1
Personal history of self-harm (Z91.5)	1742	10.9	72.6
Personal history of noncompliance with medical treatment and regimen (Z91.1)	1238	7.7	64.7
Drug use (Z72.2)	1120	7.0	83.0
Problems in relationship with spouse or partner (Z63.0)	635	4.0	78.1
Homelessness (Z59.0)	548	3.4	80.1
Other specified problems related to primary support group (Z63.8)	511	3.2	75.3
Other problems related to housing and economic circumstances (Z59.8)	483	3.0	80.3
Problems in relationship with parents and in-laws (Z63.1)	403	2.5	69.2
Total factors influencing health status and contact with health services (Z00–Z99)	9781	61.1	76.7
Total admissions	16 017	100.0	80.8

ED, emergency department; ICD-10-AM, International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification.

were Aboriginal people and those with a previous mental health service contact or illicit drug (non-alcohol) related hospitalisation. Similar research in this area also showed no significant association for either sex, socioeconomic status or RA with having a repeat admission [5]. The prevalence of comorbid illicit drug use and mental illness is widely known, with the prognosis for both conditions being poorer together than for either condition alone [22]. The prevalence of mental disorders in our study was more pronounced among those with repeated hospitalisations, with 43.4% of repeated ARH also having a mental disorder diagnosis, compared to 23.7% of single only hospitalisations. Most Aboriginal people do not use illicit drugs, but the proportion of drug use is higher among Aboriginal people than among non-Aboriginal people [23]. This is reflected in the characteristics of the repeated group where over 34% of readmissions for ARH were for Aboriginal people, two times higher than the proportion in the single admission only group. Illicit drug use is a society-wide issue that is associated with several health impacts and social harms that disproportionately affect Aboriginal people. Illicit drug use is also linked with social issues, such as harms to children and family, violence, crime and incarceration [24].

The most common period for repeat harm was within 1 month of discharge from a first alcohol-related hospitalisation, with other similar studies also showing within 30 days the most common readmission period [3,8,25]. It is therefore important to focus on this early period for prevention and early intervention for young people who need it. This could provide an opportune time for short-term support and appropriate referral to mental health services for longer-term follow up and support. Previous studies have shown that patients with alcohol misuse at risk of readmission are less likely to receive preventive health care and may benefit from targeted interventions to increase rates of outpatient follow up after hospital discharge [7]. In practice, interventions may consist of providing high-risk repeat ARH patients with information, support and the opportunity to seek further assistance if required. This may lead to an opportunity to be assessed and referred to community-based alcohol and other drug (AOD) services, and ongoing treatment planning where appropriate. However, as our study shows, there is a disproportionate number of Aboriginal people with repeat ARH who may require a culturally appropriate approach than most mainstream AOD strategies and services provide. The literature on AOD services for Aboriginal people shows the importance of designing services specifically for Aboriginal people, providing adequate resourcing and funding of services, and the need to collect better data to enable best practice for Aboriginal people [26]. Together with mental illness and comorbid drug use, it could be these

reasons that are behind the risk factors highlighted in our study that are increasing the risk of repeated ARH.

A comprehensive listing of leading diagnosis types for repeat alcohol hospitalisations enables further profiling of the extent of the issue so we can better tailor interventions for hospitalised young people. Utilising ICD diagnoses to profile the high-risk repeated ARH group helps build an understanding of the characteristics of people with a history of self-harm, noncompliance with medical treatment and other comorbid conditions. These circumstances suggest that a history of AOD use, together with any prior mental health and substance use issues are important in determining at-risk young people. The high proportion of hospitalisations for this repeat group also represents a large financial and resource burden on the health system, contributing to the estimated \$55.2 billion per year of AOD cost to the Australian community [27]. Being able to identify the characteristics of this group allows for a more tailored and precise identification of those most at risk and who we should be most concerned about.

The advantage of using linked data for our study is that it provides a cross-sectoral picture of this high-risk sub-group of young people. It shows a range of issues influence repeat alcohol harm that involves mental health, AODs across different health services that encompass the social determinants of health. Together our findings support existing evidence-based approaches to inform service delivery that are relevant to young people exposed to ARH [28]. It is essential that interventions for ARH in young people be tailored differently compared to adults, such as focusing on engagement, including family in treatment if possible, and addressing co-occurring mental health and social problems [28]. Therefore, an approach that encompasses government health agencies and health service providers working together with non-government organisations, carers and families, and agencies across government is required to manage these issues.

Limitations

Acute harm such as hospitalisation for AODs is typically under-reported [17,29–31]. This is predominantly due to limitations in accurately identifying and recording ARH within hospital administration systems [32–34]. As such our findings are likely an underrepresentation of the true proportion of alcohol-related hospitalisations and associated diagnostic information. There are some limitations related to geographical residence, such as potential alcohol admissions outside of WA if not a resident during follow up, and hence possible admissions during this period. In addition, we could not account for emigration in censoring; however, only approximately 4% of the population are

Table 3. Risk factors influencing the probability of 12- to 24-year-olds having a repeated alcohol-related hospitalisation after the first discharge for alcohol-related harm, 1992–2017

Characteristic	Unadjusted HR (95% CI)	Adjusted HR (95% CI) ^a
<i>Sex</i>		
Female	1.02 (0.97, 1.08)	0.93 (0.88, 0.98)*
Male	REF	REF
<i>Aboriginality</i>		
Aboriginal	2.18 (2.06, 2.32)**	1.95 (1.81, 2.10)**
Non-Aboriginal	REF	REF
<i>SEIFA</i>		
Most disadvantaged (lower 20%)	1.25 (1.18, 1.33)**	1.00 (0.94, 1.07)
Less disadvantaged (upper 80%)	REF	REF
<i>Remoteness area</i>		
Remote	1.51 (1.41, 1.62)**	1.10 (1.01, 1.19)
Regional	0.88 (0.82, 0.95)*	0.87 (0.80, 0.94)*
Metro	REF	REF
<i>Prior child protection notification</i>		
Yes	1.70 (1.59, 1.81)**	1.02 (0.95, 1.10)
No	REF	REF
<i>Prior period of out of home care</i>		
Yes	1.98 (1.80, 2.18)**	1.06 (0.95, 1.18)
No	REF	REF
<i>Prior illicit drug hospitalisation</i>		
Yes	7.25 (6.83, 7.70)**	4.40 (4.11, 4.72)**
No	REF	REF
<i>Prior MH contact^b</i>		
Yes	3.90 (3.68, 4.12)**	2.37 (2.22, 2.53)**
No	REF	REF

P* value <0.05; *P* value <0.0001. ^aMultivariate model is adjusted for sex, Aboriginality, SEIFA, remoteness area, prior child protection notification, prior period of care, prior illicit drug hospitalisation and prior mental health contact. ^bRelates to any prior mental health contact with MHIS, or HMDC that is non-alcohol and non-substance related. CI, confidence interval; HR, hazard ratio; MH, mental health; SEIFA, Socio-Economic Indexes for Areas.

estimated to have left WA during the study period [35]. We could not differentiate between planned or unplanned readmissions.

Conclusions

Young people most at risk of having a repeat alcohol hospitalisation after their first discharge for ARH include those with severe mental illness and challenging behaviours, Aboriginal people, males, people with prior ED presentations, prior mental health contacts and prior illicit drug hospitalisations. Although one-fifth (21.3%) of young people discharged from their initial alcohol-related hospitalisation were readmitted for ARH, they comprised almost half of the total alcohol-related admissions (46.4%). The largest increase in the chance of a repeated episode was observed in the first month after initial discharge, providing an opportune time to provide support and interventions to those at risk of repeated harm.

Acknowledgements

This research was supported by a Stewart Brightspark Raine Medical Research Foundation Priming Grant and we thank Jon and Caro Stewart, the Brightspark Foundation and the Raine Medical Research Foundation for their generous support. The authors wish to thank the staff at the Western Australian Data Linkage Branch and the data custodians of Emergency Department data, Hospital Morbidity data, Mental Health contact data, Death Registrations and Child Protection data. The authors also acknowledge the people of Western Australia, whose data are being used for this project. GP was supported with funding from the National Health and Medical Research Council Project and Investigator Grants #1099655 and #1173991, institutional funding for the WA Health and Artificial Intelligence Consortium, and the Research Council of Norway through its Centres of Excellence funding scheme #262700. The views expressed are not necessarily those of the Government Department that have provided data for this project.

Open access publishing facilitated by The University of Western Australia, as part of the Wiley – The

University of Western Australia agreement via the Council of Australian University Librarians.

Conflict of Interest

The authors have no conflicts of interest.

References

- [1] Lingamanaicker K, Geelhoed E, Fatovich DM *et al.* Direct cost of alcohol-related presentations to Royal Perth Hospital emergency department. *Emerg Med Australas* 2019;31:1045–52.
- [2] Kristensen SR, Bech M, Quentin W. A roadmap for comparing readmission policies with application to Denmark, England, Germany and the United States. *Health Policy* 2014;119:264–73.
- [3] Wadhwa RK, Joynt Maddox KE, Kazi DS, Shen C, Yeh RW. Hospital revisits within 30 days after discharge for medical conditions targeted by the hospital readmissions reduction program in the United States: national retrospective analysis. *BMJ* 2019;366:14563.
- [4] Chavez LJ, Liu C-F, Tefft N *et al.* Unhealthy alcohol use in older adults: association with readmissions and emergency department use in the 30 days after hospital discharge. *Drug Alcohol Depend* 2015;158:94–101.
- [5] Serafino S, Somerford P, Codde J. Hospitalisation as a consequence of deliberate self-harm in Western Australia, 1981–1998. Perth, WA: Health Department of Western Australia, 2000. (Epidemiology occasional paper, 11).
- [6] Nordeck CD, Welsh C, Schwartz RP *et al.* Rehospitalization and substance use disorder (SUD) treatment entry among patients seen by a hospital SUD consultation-liaison service. *Drug Alcohol Depend* 2018;186:23–8.
- [7] Borg B, Douglas IS, Hull M, Keniston A, Moss M, Clark BJ. Alcohol misuse and outpatient follow-up after hospital discharge: a retrospective cohort study. *Addict Sci Clin Pract* 2018;13:24.
- [8] Yedlapati SH, Stewart SH. Predictors of alcohol withdrawal readmissions. *Alcohol Alcohol* 2018;53:448–52.
- [9] Egerton-Warburton D, Gosbell A, Wadsworth A, Fatovich DM, Richardson DB. Survey of alcohol-related presentations to Australasian emergency departments. *Med J Aust* 2014;201:584–7.
- [10] Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2019. Canberra: Australian Institute of Health and Welfare, 2020.
- [11] Lima F, Sims S, O'Donnell M. Harmful drinking is associated with mental health conditions and other risk behaviours in Australian young people. *Aust N Z J Public Health* 2020;44:201–7.
- [12] Mojica-Perez Y, Callinan S, Livingston M. Declines in alcohol consumption in Australia: some challenges to the theory of collectivity. *Addiction* 2021 [Epub ahead of print].
- [13] Vashishtha R, Pennay A, Dietze PM, Livingston M. Trends in adolescent alcohol and other risky health- and school-related behaviours and outcomes in Australia. *Drug Alcohol Rev* 2021;40:1071–82.
- [14] Australian Bureau of Statistics. National Aboriginal and Torres Strait Islander Health Survey, 2018–19. Canberra: Australian Bureau of Statistics, 2019.
- [15] Holman CDAJ, Bass AJ, Rouse IL, Hobbs MST. Population-based linkage of health records in Western Australia: development of a health services research linked database. *Aust N Z J Public Health* 1999;23:453–9.
- [16] World Health Organization. ICD-10 international statistical classification of diseases and related health problems. In: International statistical classification of diseases and related health problems, 10th rev edn. Geneva: World Health Organization, 2005.
- [17] Sims S, Preen D, Pereira G, Fatovich D, Livingston M, O'Donnell M. Alcohol-related harm in emergency departments: linking to subsequent hospitalizations to quantify under-reporting of presentations. *Addiction* 2020;116:1371–80.
- [18] Christensen D, Davis G, Draper G *et al.* Evidence for the use of an algorithm in resolving inconsistent and missing indigenous status in administrative data collections. *Aust J Soc Issues* 2014;49:423–43.
- [19] Australian Bureau of Statistics. Census of population and housing: Socio-Economic Indexes for Areas (SEIFA) [Internet]. 2033.0.55.001. 2016. Available at: <https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/2033.0.55.001main+features12016> (accessed 27 March 2021).
- [20] Kelman CW, Bass AJ, Holman CDJ. Research use of linked health data – a best practice protocol. *Aust N Z J Public Health* 2002;26:251–5.
- [21] Government of Western Australia Department of Health. Data Linkage Western Australia [Internet]. 2021. Available at: <https://www.data-linkage-wa.org.au/> (accessed 27 March 2021).
- [22] Teesson M, Hall W, Lynskey M, Degenhardt L. Alcohol- and drug-use disorders in Australia: implications of the National Survey of Mental Health and Wellbeing. *Aust N Z J Psychiatry* 2000;34:206–13.
- [23] Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2019. Drug Statistics series no. 32. PHE 270. Canberra: Australian Institute of Health and Welfare, 2020.
- [24] Australian Health Ministers' Advisory Council. Aboriginal and Torres Strait Islander Health Performance Framework 2014 Report. Canberra: Australian Health Ministers' Advisory Council, 2015.
- [25] Lee S, Herrin J, Bobo WV, Johnson R, Sangaralingham LR, Campbell RL. Predictors of return visits among insured emergency department mental health and substance abuse patients, 2005–2013. *West J Emerg Med* 2017;18:884–93.
- [26] MacRae A, Hoareau J. Review of illicit drug use among Aboriginal and Torres Strait Islander people. Perth: Australian Indigenous HealthInfoNet, 2016.
- [27] Collins D, Lapsley HM (Helen M). The costs of tobacco, alcohol and illicit drug abuse to Australian society in 2004/05. Canberra: Department of Health and Ageing, 2008.
- [28] Christie GIG, Cheetham A, Lubman DI. Interventions for alcohol and drug use disorders in young people: 10 key evidence-based approaches to inform service delivery. *Curr Addict Rep* 2020;7:464–74.
- [29] O'Donnell M, Sims S, MacLean MJ, Gonzalez-Izquierdo A, Gilbert R, Stanley FJ. Trends in alcohol-related injury admissions in adolescents in Western Australia and England: population-based cohort study. *BMJ Open* 2017;7:e014913.
- [30] Egerton-Warburton D, Gosbell A, Moore K, Wadsworth A, Richardson D, Fatovich DM. Alcohol-related harm in emergency departments: a prospective, multi-centre study. *Addiction* 2018;113:623–32.
- [31] Laslett A, Catalano P, Chikritzhs T *et al.* The range and magnitude of alcohol's harm to others. Victoria: AER Centre for Alcohol Policy Research, 2010:1–236.
- [32] Pascal R, Liang W, Gilmore W, Chikritzhs T. Risks of alcohol-attributable hospitalisation and death in Australia over time: evidence of divergence by region, age and sex. *Australas Med J* 2013;6:134–51.
- [33] Gray D, Cartwright K, Stearne A, Saggars S, Wilkes E, Wilson M. Review of the harmful use of alcohol among Aboriginal and Torres Strait Islander people. Mount Lawley, WA: Australian Indigenous HealthInfoNet, 2018. (Australian Indigenous Healthreviews; vol. 18, no. 11 [2018]).
- [34] Saunders JB, Room R. Enhancing the ICD system in recording alcohol's involvement in disease and injury. *Alcohol Alcohol* 2012;47:216–8.
- [35] ABS. Migration, Australia [Internet]. 2020. Available at: <https://www.abs.gov.au/statistics/people/population/migration-australia/latest-release> (accessed 2 February 2022).

APPENDIX

Table A1. Alcohol-related harm ICD-9-CM code categories and descriptions

ICD-9-CM	Description of alcohol-related hospitalisations
255.0	Alcoholic pseudo-Cushing's syndrome
291	Alcoholic psychosis
303	Acute alcohol intoxication
305.0	Alcohol abuse
331.7	Alcoholic nervous system degeneration
357.5	Alcoholic polyneuropathy
359.4	Alcoholic myopathy
425.5	Alcoholic cardiomyopathy
535.3	Alcoholic gastritis
571.0	Alcoholic fatty liver
571.1	Acute alcoholic hepatitis
571.2	Alcoholic cirrhosis of liver
571.3	Alcoholic liver damage, unspecified
577.1	Alcoholic pancreatitis
790.3	Excessive blood level of alcohol
980	Toxic effect of alcohol (alcohol poisoning)
E860.0	Alcoholic beverages poisoning
E950.9	Suicide and self-inflicted poisoning by other and unspecified solid and liquid substances

ICD-9-CM, International Statistical Classification of Diseases and Related Health Problems, Ninth Revision, Clinical Modification.

Table A2. Alcohol-related harm ICD-10-AM code categories and descriptions

ICD-10-AM	Description of alcohol-related hospitalisations
E24.4	Alcohol-induced pseudo-Cushing's syndrome
E52	Alcoholic pellagra [if assigned with a code F10.x]
F10	Mental and behavioural disorders due to use of alcohol
G31.2	Degeneration of nervous system due to alcohol
G40.5	Epileptic seizures related to alcohol
G62.1	Alcoholic polyneuropathy
G72.1	Alcoholic myopathy
I42.6	Alcoholic cardiomyopathy
K29.2	Alcoholic gastritis
K70	Alcoholic liver disease
K85	Alcohol pancreatitis [if assigned with a code F10.x] [1999-Jul-01 to 2006-Jun-30]
K85.2	Alcohol-induced acute pancreatitis [2006-Jul-01 onwards]
K86.0	Alcohol-induced chronic pancreatitis
O35.4	Maternal care for (suspected) damage to foetus from alcohol
R78.0	Finding of alcohol in blood
T51.0	Toxic effect: ethanol
T51.1	Toxic effect: methanol

(Continues)

Table A2. (Continued)

ICD-10-AM	Description of alcohol-related hospitalisations
T51.9	Toxic effect: alcohol, unspecified
X45	Accidental poisoning by and exposure to alcohol
X65	Intentional self-poisoning by and exposure to alcohol
Y15	Poisoning by and exposure to alcohol, undetermined intent
Y90	Evidence of alcohol involvement determined by blood alcohol level [excl. Y90.9]
Z71.4	Alcohol abuse counselling and surveillance
Z72.1	Problems related to lifestyle—alcohol use

Codes selected as being appropriate for harm due to consumption of alcohol were based on clinical coding advice received from the Western Australian Clinical Coding Authority (WACCA). Z codes related to historic conditions were excluded. ICD-10-AM, International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Table S1. Prior ED presentation and other risk factors influencing the probability of 12- to 24-year-olds having a repeated alcohol-related hospitalisation after the first discharge for alcohol-related harm, 2003–2017.