BMJ Open

BMJ Open is committed to open peer review. As part of this commitment we make the peer review history of every article we publish publicly available.

When an article is published we post the peer reviewers' comments and the authors' responses online. We also post the versions of the paper that were used during peer review. These are the versions that the peer review comments apply to.

The versions of the paper that follow are the versions that were submitted during the peer review process. They are not the versions of record or the final published versions. They should not be cited or distributed as the published version of this manuscript.

BMJ Open is an open access journal and the full, final, typeset and author-corrected version of record of the manuscript is available on our site with no access controls, subscription charges or pay-per-view fees (http://bmjopen.bmj.com).

If you have any questions on BMJ Open's open peer review process please email info.bmjopen@bmj.com

BMJ Open

The Data-linkage Alcohol Cohort Study (DACS): Investigating mortality, morbidity, offending and incarceration among people with an alcohol-related problem using linked administrative data

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-030605
Article Type:	Protocol
Date Submitted by the Author:	22-Mar-2019
Complete List of Authors:	Peacock, Amy; University of New South Wales, National Drug and Alcohol Research Centre; Chiu, Vivian; University of Queensland, School of Psychology Leung, Janni; University of Queensland, School of Medicine Dobbins, Timothy Larney, Sarah; University of NSW, National Drug and Alcohol Research Centre Gisev, Natasa; University of New South Wales, National Drug and Alcohol Research Centre Pearson, Sallie-Anne; University of New South Wales, Medicines Policy Research Unit Degenhardt, Louisa; University of New SouthWales, National Drug and Alcohol Research Centre
Keywords:	alcohol, data linkage, mortality, morbidity, incarceration, offending

SCHOLARONE™
Manuscripts

The Data-linkage Alcohol Cohort Study (DACS): Investigating mortality, morbidity, offending and incarceration among people with an alcohol-related problem using linked administrative data

Amy Peacock[1,2], Vivian Chiu[1,3,4], Janni Leung[1,3,4,5], Timothy Dobbins[1], Sarah Larney[1], Natasa Gisev[1], Sallie-Anne Pearson[6], & Louisa Degenhardt[1]

[1]National Drug and Alcohol Research Centre, University of New South Wales Sydney, Australia

[2]School of Medicine (Psychology), University of Tasmania, Australia

[3]School of Psychology, Brisbane, The University of Queensland, Australia

[4]Centre for Youth Substance Abuse Research, Brisbane, The University of Queensland, Australia

[5]Institute for Health Metrics and Evaluation, University of Washington, United States

[6]Centre for Big Data Research in Health, University of New South Wales Sydney, Australia

For peer review only

Word Count: 2146

Corresponding author: Amy Peacock, Research Fellow, National Drug and Alcohol Research Centre, University of New South Wales, e: amy.peacock@unsw.edu.au, t: +61 2 9385 0333, f: +61 2 9385 0222.

Abstract

Introduction: Alcohol consumption is a leading cause of death and disability globally. The aim of this program of research is to use linked health and law enforcement data to establish and describe individuals presenting to emergency and inpatient health care services with an acute alcohol harm or problematic alcohol use; measure their health service utilisation and law enforcement engagement; and quantify morbidity, mortality, offending and incarceration among this cohort.

Methods and analysis: We will assemble a retrospective cohort of people presenting to emergency departments and hospitals between January 1st, 2005 and December 31st, 2014 in New South Wales, Australia with a diagnosis denoting an acute alcohol harm or problematic alcohol use. We will link their hospital data with records from other healthcare services (e.g., community-based mental health care provision, cancer registry), mortality, offending, and incarceration data sets. The four overarching areas for analysis comprise: i) describing at first point of contact the characteristics of those presenting to emergency and inpatient hospital services with a diagnosis indicating an acute alcohol harm and/or problematic alcohol use; ii) quantifying health service utilisation and law enforcement engagement; iii) quantifying rates of mortality, morbidity, offending and incarceration; and iii) assessing predictors (e.g., age, sex) of mortality, morbidity, offending, and incarceration amongst this cohort.

Ethics and dissemination: We will report our findings in accordance with the Reporting of studies Conducted using Observational Routinely-collected health Data statement (RECORD) and Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) where appropriate. We will publish data in tabular, aggregate forms only. We will not disclose individual results. We will disseminate project findings at scientific conferences and in peer-review journals. We will aim to present findings to relevant stakeholders (e.g., addiction medicine, emergency medicine, policy makers) to maximise translational impact of research findings.

Keywords: alcohol; data linkage; mortality; morbidity; incarceration; offending; harm

For peer review only

STRENGTHS AND LIMITATIONS OF THIS STUDY

Strengths:

- This study comprises a population-based cohort of people with a diagnosis indicating an acute alcohol problem and/or problematic alcohol use (as identified through emergency department attendances and hospital separations) over an extended period (2005-2014).
- There is a wealth of information on these participants through linkage to various routinely-collected administrative data sets (i.e., emergency department presentations, hospital separations, cancer notifications, mental health ambulatory care, mortality, offending, and incarceration).

Limitations:

- Routinely-collected administrative data contain limited contextual information and represent an underestimate of total health and offending outcomes for these individuals (e.g., where not brought to the attention of, and recorded by, these services).
- Intervention and treatment for alcohol-related problems are not wholly captured across these data sources, and may impact experiences of morbidity, mortality, offending and incarceration.
- The study period represents a snapshot for each individual; some individuals may have an extensive history of engagement with healthcare and law enforcement prior to entry to the cohort but this cannot necessarily be identified with the data used here.

For peer review only

Introduction

Reducing the health, social, and economic burden of alcohol use is a priority in Australia and globally[1] [2]. Alcohol consumption is estimated to play a causal role in over 200 disease and injury conditions[2]. Approximately 3.9% of deaths and 1.8% of hospitalisations in Australia are alcohol-related[3]. Alcohol use negatively impacts on the community through reduced workplace productivity, traffic accidents, family problems, crime, and public disorder, with an estimated economic cost of $14 billion annually[4].

Recent evidence suggests increasing rates of alcohol-related problems in Australia over the past two decades despite evidence of declining population levels of consumption (particularly among young people)[5-9]. This increase in harms represents a significant burden on healthcare and law enforcement services. Indeed, recent estimates suggest that approximately one in ten emergency department presentations in Australia are alcohol-related[10], with more than 144,000 alcohol-attributable hospitalisations in Australia in 2012/13[11].

The aforementioned data are based on modeled estimates or on aggregated number of presentations to services. It is important to understand these events at the individual level: a significant proportion of people who experience alcohol-related problems will have recurrent problems, experience substantial morbidity and higher risk of mortality, and place significant burden on healthcare and law enforcement services. In Australia, there has been no attempt at the population level to longitudinally track people with alcohol-related problems to measure overall mortality, morbidity and other problems (e.g., offending and incarceration), despite such work for other substances (e.g., opioids[12]).

This project, named the Data linkage Alcohol Cohort Study (DACS), will use data linkage to identify individuals presenting to emergency department or inpatient hospital services with a diagnosis indicating an acute alcohol harm or problematic use. This cohort of people will be linked to additional health and law enforcement service data for robust measurement of alcohol-related harms and burden. The overarching objectives of this program of research are to:

1. Describe the cohort at their first point of contact with emergency department or inpatient hospital services within the study period for an acute alcohol harm and/or problematic alcohol use;
2. Quantify healthcare service utilisation and law enforcement engagement among the cohort (and associated economic costs) and assess individual and situational characteristics as predictors of frequency of engagement;
3. Quantify the rate of mortality, morbidity, offending and incarceration amongst the cohort, looking at overall rates and cause-specific outcomes where possible; and

For peer review only

4. Assess individual and situational characteristics as predictors of mortality, morbidity, offending and incarceration.

Methods and Analysis

Study Design

This study will link two routinely collected administrative datasets from New South Wales (NSW), Australia, to assemble a retrospective observational cohort of people presenting to emergency department and hospital inpatient services with an acute alcohol harm and/or problematic alcohol use. Once the cohort has been identified, their linked data from various other routinely-collected administrative data sets will be extracted, providing information on emergency department presentations, hospital separations, cancer notifications, mental health ambulatory care, mortality, offending, and incarceration. Data linkage will be undertaken by the Centre for Health Record Linkage (CheReL).

Formation of Base Cohort

The base cohort will consist of individuals with a diagnosis indicating an acute alcohol harm or problematic alcohol use presenting to inpatient services (NSW Admitted Patient Data Collection; NSW APDC) and acute services (NSW Emergency Department Data Collection; NSW EDDC) in NSW between January 1st, 2005 and December 31st, 2014. Diagnostic classification systems used by NSW APDC and NSW EDDC in this period comprise the International Classification of Diseases and Health Related Problems 9th and 10th edition Australian Modification (ICD-9-CM or ICD-10-AM; APDC and EDDC) or the Systematized Nomenclature of Medicine--Clinical Terms Australian Modification (SNOMED-CT-AU; EDDC only). Diagnostic codes used for cohort inclusion were identified through a review of various sources on alcohol-related health burden and mortality (e.g., Chikritzhs, et al. [13]) and in consultation with specialists in the field (see **Table 1** for ICD-10 codes; see **Appendix 1** for all the diagnosis codes used for data extraction). A flowchart of how the base cohort will be formed and the administrative datasets to be linked (described in the next section) is presented in **Figure 1**. Inclusion in the cohort may be modified depending on the specific research question being addressed.

Table 1 approximately here

Figure 1 approximately here

Datasets and Linkage

On identifying the base cohort, the CheReL will extract linked data for these individuals from a range of routinely-collected administrative data sets using probabilistic record linkage methods and

For peer review only

ChoiceMaker software[14]. Variables used for linkage will include full name, sex and date of birth. Descriptions of the data sets are presented in **Table 2**.

Table 2 approximately here

Patient and public involvement

Patients were not involved in the design of the study. As described in our dissemination activities, we will aim to present findings to relevant stakeholders (e.g., addiction medicine, emergency medicine, policy makers) to maximise translational impact of research findings. We will prepare one-page summaries of key findings for distribution to drug treatment services and harm-reduction services.

Planned statistical analyses

Below, we outline the core analyses to address the overarching research questions. In all analyses, multiple confounding variables will be controlled for as appropriate. We will also undertake the below analyses for the total cohort and focused specifically on those aged 15-24 years old. This younger age demographic has demonstrated significant recent shifts in alcohol consumption alongside increasing harms[7 8], and also represents a portion of the sample likely to have no or limited engagement with healthcare and law enforcement services prior to the study period.

Aim 1. Describe the cohort at their first point of contact with emergency department or inpatient hospital services within the study period for an acute alcohol harm and/or problematic alcohol use.

We will describe the characteristics of the cohort at their index event (i.e., first emergency department presentation or hospital separation with an alcohol-related diagnosis, as listed in **Appendix 1**). Our description will include their individual characteristics (e.g., age, sex, socio-economic status) and situational characteristics of their presentation (e.g., hospital type (public/private), diagnosis). We will analyse the 12-month period prior to each person's index presentation to quantify existing health comorbidities (using an established comorbidity score, e.g., Charlson Comorbidity Index[15] or Elixhauser Comorbidity Index[16]), as well as offending and incarceration within that period. For these analyses, we will exclude individuals who had an index event within the first 12 months of the cohort commencement (i.e., between January 1st and December 31st, 2005) to ensure we have a complete 12-month period prior to index presentation.

Aim 2. Quantify healthcare service utilisation and law enforcement engagement among the cohort (and associated economic costs) and assess individual and situational characteristics as predictors of frequency of engagement.

For peer review only

We will calculate total number of emergency department presentations and hospital separations each year, and number of unique people each year with an emergency department presentation/hospital separation. We will estimate the number of hospital separations in two ways, as a count of: i) *episode-of-care*, defined as the period between a formal or statistical admission and a formal or statistical discharge, whereby the individual leaves hospital (discharge or death) or receives a different type of care, and ii) *a period-of-stay*, defined as the period between a formal admission and discharge/death, in which there might be multiple episodes of care (for example, transferring from acute care to rehabilitation) [17]. We will identify people who re-present to these services within 30 days of discharge (re-admission), as well as those individuals who attend at high-frequency ($\geq$ 4 presentations/separations in a year) and high-intensity (average $\geq$4 presentations/separations in a year across period of follow-up or until death). We will use regression analyses to assess individual and situational characteristics of re-admission, high-frequency attendance, and high-intensity attendance. We will quantify engagement with law enforcement (offending and incarceration). We will also estimate costs associated with health service utilisation and law enforcement engagement using standard reference material for costs (e.g. Australian Refined Diagnosis Related Group (AR-DRG) codes for quantification of economic cost of hospital services[18]).

Aim 3. Quantify the rate of mortality, morbidity, offending and incarceration amongst the cohort, looking at overall rates and cause-specific outcomes where possible. Aim 4. Assess individual and situational characteristics as predictors of mortality, morbidity, offending and incarceration.

Mortality analyses. We will calculate all-cause and cause-specific crude mortality rates as number of deaths in the cohort divided by person-years of observation. We will estimate all-cause and cause-specific standardised mortality ratios by comparing the observed number of deaths and expected number of deaths. We will stratify crude mortality rates and standardised mortality ratios by other demographic and situational characteristics where possible based on population data (e.g., age, geography, sex, comorbidity). We will conduct survival analyses to determine time from the index presentation to the outcome of interest (mortality or, if mortality does not occur, the censoring date) and use Cox proportional hazards regression to calculate hazard ratios for all-cause and cause-specific mortality based on time-independent (e.g., gender) and time-dependent variables (e.g., age, calendar year, geographic region, comorbidity score).

Morbidity analyses. The main outcome of interest will be time (measured by the number of days) between presentations. Individuals will be censored at the end of the study period or date of death, whichever occurred first. We will use survival analysis methods that incorporate multiple observations per person [19] to examine the relationship between the risk factors (individual and situational

For peer review only

characteristics at index) and the time interval distributions of recurrent presentations with multiple causes for each individual. We will examine any re-admission and alcohol-related re-admission as well as time to specific type of alcohol-related re-admission (as defined in Table 1). Risk factors will be identified for the entire cohort, adjusting for diagnostic groups. We will assess heterogeneity between diagnostic groups in the effect of risk factors descriptively. We will use the community-based mental health treatment data (MH-AMB) to undertake a sub-group analysis of people with comorbid mental health issues.

Offending and incarceration analyses. To assess the frequencies of engagement with the criminal justice system among individuals with problematic use of alcohol, we will calculate rates of all offences and alcohol-related offences (as per BOCSAR classification in standard crime statistics reporting [20]) per 1,000 person-years, as well as rates of incarceration episodes and time between offences (or death or end of follow-up, whichever comes first) distinguished by the characteristics of individuals (e.g. gender).

We will use survival analysis methods to examine the relationship between engagement with health services (characterised by number of alcohol-related presentations) and time to a subsequent arrests (days to any offence/ days to alcohol-related offence). The hazard ratios for subsequent arrests will be adjusted for time-independent (e.g., gender, country of birth) and time-dependent variables (e.g., age, comorbidity score, calendar year, length of hospital stay, geographic region, private/public hospital, types of procedures undergone, remoteness, socio-economic status).

Methodological considerations

There are several key methodological considerations to be noted with the use of these data sets. The number of participating emergency departments has intermittently increased over time from around 46 EDs in 1996 to around 90 in 2010[21]. There are around 150 EDs in NSW, and those servicing larger proportions of the NSW population are included, but possible under-ascertainment of total alcohol burden should be noted. Variation in computer programs and management practices at emergency departments and hospitals may lead to variation in diagnosis coding practices (i.e. ICD-9, ICD-10 and SNOMED codes entered by physicians) and in the screening and capture of alcohol involvement in healthcare presentations. Hence, the specificity of some disease categories may vary, and under-ascertainment of alcohol-related presentations is likely[22]. Finally, data on alcohol consumption, as well as intervention and treatment for problematic alcohol use, cannot be systematically ascertained from the included data sources.

Ethics and Dissemination

For peer review only

Data storage, retention, and access

To protect privacy and confidentiality, approval for the linkage of health data in NSW is provided under strict conditions for the storage, retention and use of the data. The current approval permits storage of the data at three sites, the University of New South Wales, University of Queensland, and University of Tasmania, for up to 5 years following the date of publication of results.

Dissemination

Patients were not involved in the design of the study. We will report our findings in accordance with the Reporting of studies Conducted using Observational Routinely-collected health Data statement (RECORD)[23] and Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER)[24] where appropriate. We will publish data in tabular, aggregate forms only and cells containing data from less than 10 participants will be suppressed. We will not disclose individual results.

We will disseminate project findings at scientific conferences and in peer-review journals. We will aim to present findings to relevant stakeholders (e.g., addiction medicine, emergency medicine, policy makers) to maximise translational impact of research findings.

Discussion

This program of research will provide a comprehensive population-level understanding of the burden of problematic alcohol use on individuals and on healthcare and law enforcement services. It will extend knowledge of individual and situational factors that predict adverse alcohol-related outcomes, with the capacity to inform personalised intervention. The patterns of healthcare utilisation will also improve our knowledge of patient needs to enhance healthcare delivery for targeted populations. The multi-dimensional measurement of diverse events produced by this project can better reflect the scale and impact of alcohol-related problems which may be under-ascertained in the study of a single dataset.

For peer review only

Authors' contributions: AP and LD conceived the study idea. AP, LD, TD, NG, SL, SAP, and AD provided input to the study design and research questions. AP, TD, VC, and JL developed the statistical analysis plan. AP, VC, and JL completed the first draft of the manuscript. All authors reviewed the manuscript and provided input to the final draft.

Funding statement: This work was funded by research support funds awarded by UNSW Sydney to AP. AP, SL and LD are supported by NHMRC research fellowships (#1109366, #1140938 and #1041472/#1135991). SL and NG are supported by UNSW Scientia Fellowships. SL and LD are supported by NIH grant NIDA R01DA1104470. The National Drug and Alcohol Research Centre is supported by funding from the Australian Government Department of Health under the Drug and Alcohol Program.

Patient consent: Not required.

Competing interests: None relevant to declare.

Ethics approval: New South Wales Population and Health Services Research Ethics Committee, approved in August 2016 (2016/08/650), valid for 5 years.

Acknowledgements: The authors wish to thank Professor Jürgen Rehm for his input on the diagnostic codes chosen. We wish to thank the Clinical Terminology Team at the National E-Health Transition Authority (now the Australian Digital Health Agency) for assisting with mapping ICD-10-AM codes to SCT-AU. We also wish to thank the NSW Ministry of Health, the Centre for Health Record Linkage (CHeReL), the Cancer Institute NSW and other data custodians for reviewing the project protocol, approving the project, and providing requested data. The Cause of Death Unit Record File (COD URF) is provided by the Australian Coordinating Registry for the COD URF on behalf of the NSW Registry of Births, Deaths and Marriages, NSW Coroner and the National Coronial Information System.

For peer review only

References

1. Australian Government Department of Health. National Drug Strategy 2017-2016. In: Health Do, ed. Canberra: Commonwealth of Australia 2017.
2. World Health Organization. Global status report on alcohol and health. Geneva: World Health Organization, 2018.
3. Gao C, Ogeil RP, Lloyd B. Alcohol's burden of disease in Australia. Canberra: Foundation for Alcohol Research and Education and VicHealth in collaboration with Turning Point, 2014.
4. Manning M, Smith C, Mazerolle P. The societal costs of alcohol misuse in Australia. Trends & issues in crime and criminal justice No. 454. Canberra: Australian Institute of Criminology, 2013.
5. Livingston M. Understanding recent trends in Australian alcohol consumption. Canberra: Foundation for Alcohol Research and Education, 2015.
6. Livingston M, Matthews S, Barratt MJ, et al. Diverging trends in alcohol consumption and alcohol-related harm in Victoria. *Australian and New Zealand Journal of Public Health* 2010;34(4):368-73.
7. Livingston M. Recent trends in risky alcohol consumption and related harm among young people in Victoria, Australia. *Australian and New Zealand Journal of Public Health* 2008;32(3):266-71.
8. Callinan S, Pennay A, Livingston M, et al. Patterns in Reduction or Cessation of Drinking in Australia (2001–2013) and Motivation for Change. *Alcohol and Alcoholism* 2018;54(1):79-86. doi: 10.1093/alcalc/agy072
9. Livingston M, Callinan S, Raninen J, et al. Alcohol consumption trends in Australia: Comparing surveys and sales-based measures. *Drug and Alcohol Review* 2018;37:S9-S14.
10. Egerton-Warburton D, Gosbell A, Moore K, et al. Alcohol-related harm in emergency departments: a prospective, multi-centre study. *Addiction* 2018;113(4):623-32. doi: 10.1111/add.14109
11. Lensvelt E, Gilmore W, Liang W, et al. Estimated alcohol-attributable deaths and hospitalisations in Australia 2004 to 2015. National Alcohol Indicators, Bulletin 16. Perth: National Drug Research Institute, Curtin University. , 2018.
12. Degenhardt L, Larney S, Kimber J, et al. The impact of opioid substitution therapy on mortality post-release from prison: retrospective data linkage study. *Addiction* 2014;109(8):1306-17. doi: 10.1111/add.12536
13. Chikritzhs T, Catalano P, Stockwell T, et al. Australian alcohol indicators, 1990-2001: Patterns of alcohol use and related harms for Australian states and territories. Perth: National Drug Research Institute, Curtin University, 2003.
14. Key Concepts of the ChoiceMaker 2 Record Matching System [program]. Washington, DC, 2003.
15. Charlson M, Szatrowski TP, Peterson J, et al. Validation of a combined comorbidity index. *J Clin Epidemiol* 1994;47(11):1245-51. [published Online First: 1994/11/01]
16. Elixhauser A, Steiner C, Harris DR, et al. Comorbidity measures for use with administrative data. *Medical Care* 1998:8-27.
17. AIHW. Australian Institute of Health and Welfare - Hospitals Glossary 2018 [Available from: https://www.aihw.gov.au/reports-data/health-welfare-services/hospitals/glossary.
18. Australian Refined Diagnosis Related Groups (AR-DRG) Classification Version 8.0 Australian Consortium for Classification Development.
19. Amorim LD, Cai J. Modelling recurrent events: a tutorial for analysis in epidemiology. *Int J Epidemiol* 2015;44(1):324-33. doi: 10.1093/ije/dyu222 [published Online First: 2014/12/17]
20. AIHW. Australian and New Zealand Standard Offence Classification (ANZSOC). Cat. no. 1234.0., 2011.
21. NSW Ministry of Health. NSW Emergency Department Data Collection: Data Dictionary. Sydney: NSW Ministry of Health, 2017.
22. McKenzie K, Harrison JE, McClure RJ. Identification of alcohol involvement in injury - related hospitalisations using routine data compared to medical record review. *Australian and New Zealand Journal of Public Health* 2010;34(2):146-52.

For peer review only

23. Benchimol EI, Smeeth L, Guttmann A, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. *PLoS Medicine* 2015;12(10):e1001885. doi: 10.1371/journal.pmed.1001885

24. Stevens GA, Alkema L, Black RE, et al. Guidelines for Accurate and Transparent Health Estimates Reporting: the GATHER statement. *Lancet* 2016;388(10062):e19-e23. doi: 10.1016/S0140-6736(16)30388-9

For peer review only

Table 1. Alcohol-related diagnosis codes used from the International Classification of Diseases and Health Related Problems, 10th edition Australian Modification (ICD-10-AM)

Alcohol-related diagnosis	ICD-10-AM codes
Alcohol-induced pseudo-Cushing's syndrome	E24.4
Wernicke encephalopathy	E51.2
Mental and behavioural disorders due to use of alcohol	F10
Degeneration of nervous system due to alcohol	G31.2
Alcoholic polyneuropathy	G62.1
Alcoholic myopathy	G72.1
Alcoholic cardiomyopathy	I42.6
Alcoholic gastritis	K29.2
Alcohol-induced liver diseases	K70.0, K70.1, K70.2, K70.3, K70.4, K70.9
Alcohol-induced pancreatitis	K85.2, K86.0
Maternal care for (suspected) damage to foetus from alcohol	O35.4
Foetal alcohol syndrome (dysmorphic)	Q86.0
Detection of alcohol in blood	R78.0, T51, X45, X65, Y15, Y90, Y91

Note. Diagnostic classification systems used by NSW APDC and NSW EDDC in this period comprise the International Classification of Diseases and Health Related Problems 9th and 10th edition Australian Modification (ICD-9-CM or ICD-10-AM; APDC and EDDC) or the Systematized Nomenclature of Medicine--Clinical Terms Australian Modification (SNOMED-CT-AU; EDDC only). Diagnostic codes used for cohort inclusion were identified through a review of various sources on alcohol-related health burden and mortality and in consultation with specialists in the field (see **Appendix 1** for all the diagnosis codes used for data extraction).

For peer review only

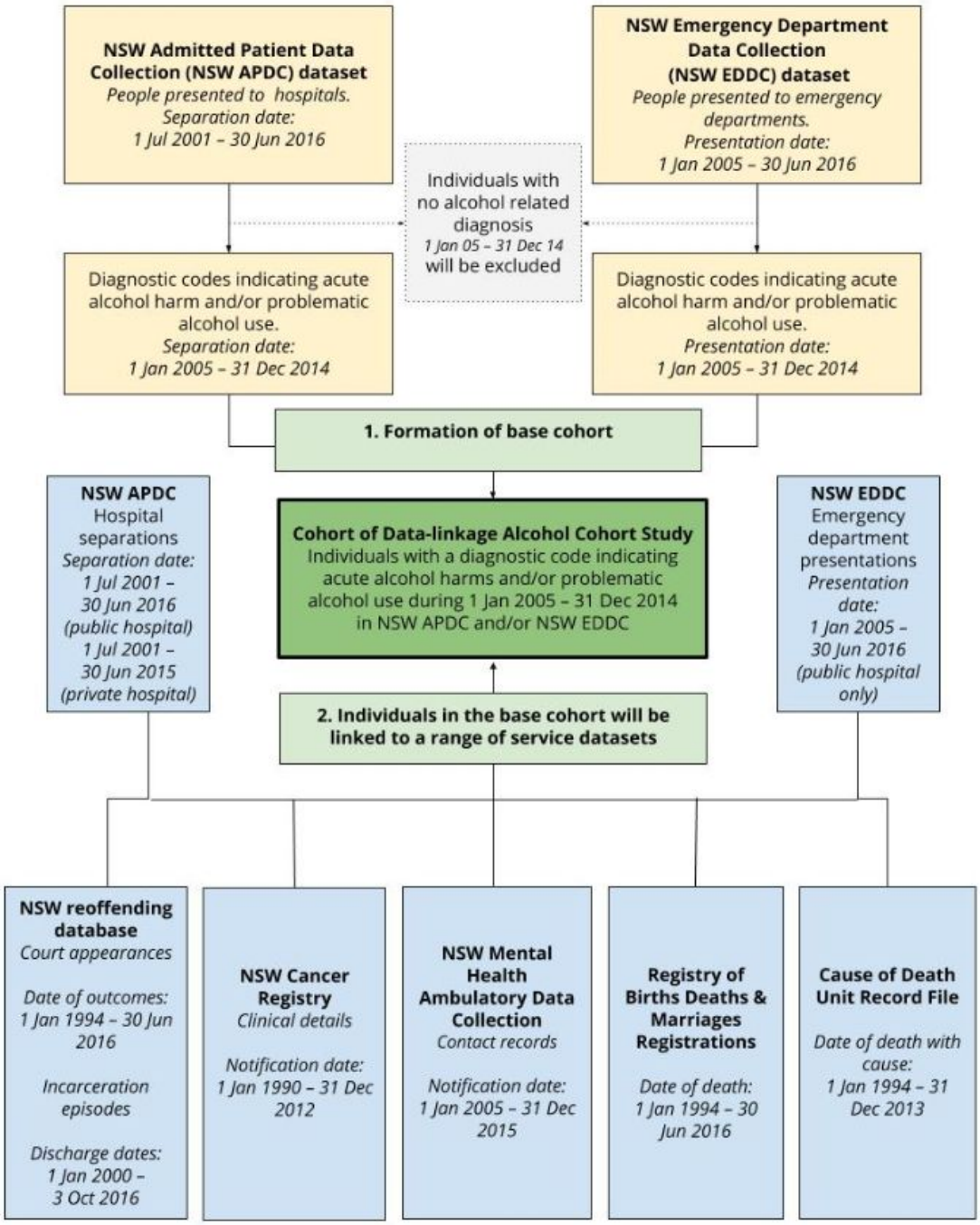


Figure 1. Formation of the Data-linkage Cohort Study (DACS)

Table 2. Datasets for Linkage

Database	Description	Key variables
NSW Admitted Patients Data Collection (NSW APDC)	Records of all hospital separations (including discharges, transfers and deaths) from all public and private hospitals, public multi-purpose services, and day procedure centres in NSW.	Records for each episode of care include date of admission and separation, emergency status, principal and additional diagnoses, treatment procedures, mode of separation and facility identifier.
NSW Emergency Department Data Collection (NSW EDDC)	Records of all presentations to Emergency Departments in major metropolitan and major non-metropolitan public hospitals in NSW.	Records for each episode of care include date of admission and separation, emergency status, diagnosis, mode of arrival and separation and facility identifier.
NSW Mental Health Ambulatory Data Collection (MH-AMB)	Records of episodes of care delivered by NSW ambulatory mental health service units to non-admitted individuals, including day programmes, psychiatric outpatients and outreach services.	Records for each contact include date of contact, diagnosis and services delivered. Facility information includes provider group, provider role and service category and facility location.
NSW Central Cancer Registry	Records of all new cases of cancer (defined as an occurrence of a primary malignant neoplasm in an organ of a particular person; excluding occurrence of skin cancers other than melanoma) diagnosed in NSW residents.	Data includes clinical details of individuals e.g. cancer group, degree of spread, date and age of diagnosis. If applicable, information regarding date and age of death, and cause of death is also included.

For peer review only

NSW Re-offending Database (ROD)	Court records, with all finalised court appearances in NSW Children's, Local, District and Supreme Courts, and juvenile detention and adult incarceration in NSW.	Records include date and type of offence, outcome of court appearance, conviction date and penalty. Incarceration information includes commencement and conclusion date of incarceration, conviction date.
NSW Registry of Births, Deaths and Marriages (RBDM) and the Australian Coordinating Registry (ACR) Cause of Death Unit Record File (COD URF)	The two datasets contain mortality information for deaths occurring in NSW, which also includes Australian Bureau of Statistics (ABS) death registration data. The Cause of Death Unit Record File is held by the NSW Ministry of Health Secure Analytics for Population Health Research and Intelligence	Data includes date of death and contributing or multiple cause of death codes (where relevant).

For peer review only

Appendix 1: Diagnostic codes used for data extraction

A) ICD codes

The codes on the following sheet will be used to identify people in the Admitted Patients Data Collection and Emergency Department Data Collection (cases). Codes were selected based on identification by NSW Health as reflective of an acute alcohol problem[1] or, where indicated (*) from Turning Point Alcohol and Drug Centre guidance for calculating alcohol and other drug statistics [2]. Where indicated (~), additional codes are included on the basis of discussion between investigators and specialists in the field. ICD-9-CM and ICD-10-AM codes were mapped using the Australian Consortium for Classification Development mapping tables, with backwards mapping from ICD-10-AM to ICD-9-CM[3], and alcohol-specific code mapping developed by Chikritzhs et al.[4].

ICD-10-AM	Conditions	ICD-9-CM	Conditions
E24.4	*Alcohol-induced pseudo-Cushing's syndrome	*No alcohol-specific code available*	
E51.2	~Wernicke encephalopathy	291.1	Alcohol-induced persisting amnestic disorder
F10	Mental and behavioural disorders due to use of alcohol	291	Alcohol-induced mental disorders
		303	Alcohol dependence syndrome
		305.0	Nondependent alcohol abuse
G31.2	*Degeneration of nervous system due to alcohol	303	Alcohol dependence syndrome
G62.1	*Alcoholic polyneuropathy	357.5	*Alcoholic polyneuropathy
G72.1	*Alcoholic myopathy	*No alcohol-specific code available*	
I42.6	*Alcoholic cardiomyopathy	425.5	*Alcoholic cardiomyopathy
K29.2	*Alcoholic gastritis	535.3	*Alcoholic gastritis
K70.0	Alcoholic fatty liver	571.0	*Alcoholic fatty liver
K70.1	Alcoholic hepatitis	571.1	Acute alcoholic hepatitis
K70.2	Alcoholic fibrosis and sclerosis of liver		
K70.3	Alcoholic cirrhosis of liver	571.2	Alcoholic cirrhosis of liver
K70.4	Alcoholic hepatic failure		
K70.9	Alcoholic liver disease, unspecified	571.3	Alcoholic liver damage, unspecified
K85.2	*Alcohol-induced acute pancreatitis	*No alcohol-specific code available*	
K86.0	*Alcohol-induced chronic pancreatitis	*No alcohol-specific code available*	
O35.4	*Maternal care for suspected damage to foetus from alcohol	*No alcohol-specific code available*	
P04.3	*Foetus and newborn affected by maternal use of alcohol	760.71	Alcohol affecting fetus or newborn via placenta or breast milk

For peer review only

Q86.0	*Foetal alcohol syndrome (dysmorphic)		
R78.0	Finding of alcohol in blood	790.3	Excessive blood level of alcohol
T51	Toxic effect of alcohol	980	Toxic effect of alcohol
X45	Accidental poisoning by and exposure to alcohol	E860	Accidental poisoning by alcohol not elsewhere classified
X65^	Intentional self-poisoning by and exposure to alcohol	*No alcohol-specific code available*	
Y15	Poisoning by and exposure to alcohol, undetermined intent	E860	Accidental poisoning by alcohol not elsewhere classified
		980	Toxic effect of alcohol
Y90^^	Evidence of alcohol involvement determined by blood alcohol level	*No alcohol-specific code available*	
Y91^^^	Evidence of alcohol involvement determined by level of intoxication	*No alcohol-specific code available*	

^note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the above codes

^^note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the 'Finding of alcohol in blood' code

^^^note that generalised mapping matches were only available for Y91.1 and Y91.9 with SNO-MED although lexical matching suggest use of 'Alcohol intoxication' code∞

For peer review only

B) SNOMED codes

The following codes will be used to identify people in the Emergency Department Data Collection (cases). Emergency departments may use either or a combination of ICD-9, ICD-10 (see above) or SNOMED. Codes were mapped in consultation with the Clinical Terminology Team at the National E-Health Transition Authority (now Australian Digital Health Agency) to approximate ICD-10-AM codes using lexical and generalised mapping (the latter comprising the International SCT-ICD map) for SCT-AU (v20160430 April 2016). A number of codes were only found in ICD-10 and not ICD-10-CM (F10 K29.20 K29.21 T51 X45 X65 Y90 Y91), and thus these codes were searched with a wildcard for the last character, yielding hits for the following codes (F10.0 F10.1 F10.2 F10.3 F10.4 F10.5 F10.6 F10.7 F10.8 F10.9 K29.2 T51.0 T51.1 T51.2 T51.3 T51.9 X45 X45.99 Y91.1 Y91.9). Lexical mapping (i.e., synonym with a lexical match) was used for those codes where a hit was not identified with the International SCT-ICD map. Note that those variables flagged with a # were added following review of NSW Health codes for acute emergency department presentation data; the same applies where flagged with a ^, with the exception that these terms are now deprecated.

ICD-10-AM	ICD-9-CM	SNOMED-CT-AU	CONDITIONS
E24.4	*No alcohol-specific code available*	237738005	Pseudo-Cushing's syndrome due to alcohol
E51.2	291.1	21007002	Wernicke's disease
F10	291	191477001	Pathological alcohol intoxication
	303	42344001	Alcohol-induced psychosis
	305.0	25702006	Alcohol intoxication
		228315001	Binge drinker
		18653004	Alcohol intoxication delirium
		21000000	Idiosyncratic intoxication
		228341007	Unable to abstain from drinking
		32553006	Hangover
		228357007	Persistent effect of alcohol
		228316000	Alcoholic binges exceeding sensible amounts
		268645007	Nondependent alcohol abuse
		228354000	Drink driving
		228317009	Alcoholic binges exceeding safe amounts
		191883007	Nondependent alcohol abuse, episodic
		169942003	Maternal alcohol abuse
		304605000	Methanol abuse
		288021000119107	Disorder due to alcohol abuse
		191882002	Nondependent alcohol abuse, continuous
		15167005	Alcohol abuse
		284591009	Persistent alcohol abuse

		228310006	Drinks in morning to get rid of hangover
		41083005	Alcohol-induced sleep disorder
		191884001	Nondependent alcohol abuse in remission
		86325007	Non megaloblastic anaemia due to alcoholism
		191805002	Episodic acute alcoholic intoxication in alcoholism
		191802004	Acute alcoholic intoxication in alcoholism
		7200002	Alcoholism
		235955000	Drug-induced chronic pancreatitis
		66590003	Alcohol dependence
		713583005	Mild alcohol dependence
		2403008	Psychoactive substance dependence
		25702006	Alcohol intoxication
		7200002	Alcoholism
		308742005	Alcohol withdrawal-induced convulsion
		713862009	Severe alcohol dependence
		10755041000119100	Alcohol dependence in childbirth
		191812006	Episodic chronic alcoholism
		2403008	Psychoactive substance dependence
		154211000119108	Chronic pancreatitis due to chronic alcoholism
		191804003	Continuous acute alcoholic intoxication in alcoholism
		191813001	Chronic alcoholism in remission
		7200002	Alcoholism
		87810006	Megaloblastic anaemia due to alcoholism
		66590003	Alcohol dependence
		231467000	Absinthe addiction
		300939009	Abstinent alcoholic
		191811004	Continuous chronic alcoholism
		714829008	Moderate alcohol dependence
		235952002	Chronic pancreatitis due to acute alcohol intoxication
		97571000119109	Thrombocytopenia co-occurrent and due to alcoholism
		66590003	Alcohol dependence
		10741871000119101	Alcohol dependence in pregnancy
		288041000119101	Perceptual disturbance due to alcohol withdrawal

		191480000	Alcohol withdrawal syndrome
		85561006	Uncomplicated alcohol withdrawal
		191480000	Alcohol withdrawal syndrome
		8635005	Alcohol withdrawal delirium
		79578000	Alcohol paranoia
		61144001	Alcohol-induced psychotic disorder with delusions
		191476005	Alcohol withdrawal hallucinosis
		7052005	Alcohol hallucinosis
		42344001	Alcohol-induced psychosis
		191480000	Alcohol withdrawal syndrome
		191478006	Alcoholic paranoia
		191471000	Korsakov's alcoholic psychosis with peripheral neuritis
		73097000	Alcohol amnestic disorder
		192811002	Alcoholic encephalopathy
		69482004	Korsakoff's psychosis
		42344001	Alcohol-induced psychosis
		281004	Dementia associated with alcoholism
		231463001	^Alcoholic dementia NOS (disorder)
		191475009	Chronic alcoholic brain syndrome
		78524005	Alcohol-induced sexual dysfunction
		34938008	Alcohol-induced anxiety disorder
		228353006	Reverse tolerance to alcohol
		228351008	Physical tolerance to alcohol
		228350009	Behavioural tolerance to alcohol
		53936005	Alcohol-induced mood disorder
		228323004	Drinking bout
		29212009	Alcohol-induced organic mental disorder
		228322009	Drinking episode
		192206005	^Mental and behavioral disorders due to use of alcohol (disorder)
		192207001	^Mental and behavioral disorders due to use of alcohol: acute intoxication (disorder)
		192208006	^Mental and behavioral disorders due to use of alcohol: harmful use (disorder)
		192209003	^Mental and behavioural disorders due to use of alcohol: dependence syndrome) or (chronic alcoholism [& (addiction) or (dipsomania)]) (disorder)

		192210008	^Mental and behavioral disorders due to use of alcohol: withdrawal state (disorder)
		192211007	^Mental and behavioral disorders due to use of alcohol: withdrawal state with delirium (disorder)
		192212000	^Mental and behavioural disorders due to use of alcohol: psychotic disorder (& [hallucinosis] or [jealousy] or [paranoia] or [psychosis NOS]
		192213005	^Mental and behavioral disorders due to use of alcohol: amnesic syndrome (disorder)
		192214004	^Mental and behavioural disorders due to use of alcohol: residual and late-onset psychotic disorder) or (chronic alcoholic brain syndrome [& dementia NOS]
		192215003	^Mental and behavioral disorders due to use of alcohol: other mental and behavioral disorders (disorder)
		268639004	^Chronic alcoholism (disorder)
		268683008	^Mental and behavioral disorders due to use of alcohol: dependence syndrome (disorder)
		268684002	^Mental and behavioral disorders due to use of alcohol: psychotic disorder (disorder)
		304606004	^Ethanol abuse (finding)
		268685001	^Mental and behavioral disorders due to use of alcohol: residual and late-onset psychotic disorder (disorder)
		192216002	^Mental and behavioral disorders due to use of alcohol: unspecified mental and behavioral disorder (disorder)
G31.2	303	192811002	Alcoholic encephalopathy
		133301000119102	Degenerative brain disorder due to alcohol
		300992002	Alcohol-induced cerebellar ataxia
		361272001	Cerebellar ataxia due to alcoholism
		135761000119101	Cerebral degeneration due to alcoholism
		230353003	Morel laminar sclerosis
		361273006	Alcoholic cerebellar degeneration
G62.1	357.5	192811002	Alcoholic encephalopathy

		69482004	Korsakoff's psychosis
		191471000	Korsakov's alcoholic psychosis with peripheral neuritis
		7916009	Alcoholic polyneuropathy
		191472007	#Wernicke-Korsakov syndrome (disorder)
G72.1	*No alcohol-specific code available*	19303008	Alcohol myopathy
I42.6	425.5	83521008	Dilated cardiomyopathy caused by alcohol
K29.2	535.3	2043009	Alcoholic gastritis
		40241000119109	Gastric haemorrhage due to alcoholic gastritis
K70.0	571.0	41309000	Alcoholic liver damage
K70.1	571.1	50325005	Alcoholic fatty liver
K70.2	571.2	235875008	Alcoholic hepatitis
K70.3	571.3	9953008	Acute alcoholic liver disease
K70.4		1085021000119106	Hepatic ascites due to chronic alcoholic hepatitis
K70.9		1082611000119101	Ascites due to alcoholic hepatitis
		41309000	Alcoholic liver damage
		307757001	Chronic alcoholic hepatitis
		235880004	Alcoholic fibrosis and sclerosis of liver
		420054005	Alcoholic cirrhosis
		309783001	Oesophageal varices in alcoholic cirrhosis of the liver
		1082601000119104	Ascites due to alcoholic cirrhosis
		235881000	Alcoholic hepatic failure
		1082621000119108	Hepatic coma due to alcoholic liver failure
		713370005	Acute on chronic alcoholic liver disease
		713181003	Chronic alcoholic liver disease
K85.2	*No alcohol-specific code available*	235942001	Alcohol-induced acute pancreatitis
		445507008	Alcohol-induced pancreatitis
K86.0	*No alcohol-specific code available*	235952002	Chronic pancreatitis due to acute alcohol intoxication
		154211000119108	Chronic pancreatitis due to chronic alcoholism
O35.4	*No alcohol-specific code available*	199551008	Maternal care for (suspected) damage to fetus from alcohol

P04.3	760.71	36558000	Fetal or neonatal effect of alcohol transmitted via placenta and/or breast milk
		268796000	Fetal or neonatal effect of placental or breast transfer of alcohol
		698321001	Neonatal effect of alcohol transmitted via breast milk
		205791004	Fetal or neonatal effect of maternal use of alcohol
		609438005	Fetal or neonatal effect of maternal alcohol addiction
Q86.0	Alcohol affecting fetus or newborn via placenta or breast milk	609437000	Fetal Alcohol Spectrum Disorder
		205788004	Fetal alcohol syndrome
		205791004	Fetal or neonatal effect of maternal use of alcohol
		36558000	Fetal or neonatal effect of alcohol transmitted via placenta and/or breast milk
R78.0	790.3	442766007	Alcohol in blood specimen above reference range
		442669008	Ethanol in blood specimen above legal threshold for operating vehicle
		441685000	Ethanol in blood specimen above reference range
		274776000	Finding of alcohol in blood
		207273009	^Alcohol blood level excessive (situation)
		160592001	Alcohol intake above recommended sensible limits
T51	980	216633005	Accidental poisoning by alcoholic beverage
		216635003	Accidental poisoning by denatured alcohol
		95906008	Drug interaction with alcohol
		287166006	Accidental poisoning with ethyl alcohol
		442764005	Poisoning by benzene
		82782008	Alcohol poisoning
		212807002	Grain alcohol causing toxic effect
		216636002	Accidental poisoning by methylated spirit
		315226008	Pain in lymph nodes after alcohol consumption
		89507002	Toxic effect of denatured alcohol
		25966003	Metabolic acidosis due to methanol
		212809004	Methyl alcohol causing toxic effect

For peer review only

		216640006	Accidental poisoning by methanol
		212813006	Toxic effect of isopropyl alcohol
		6749002	Toxic effect of propyl alcohol
		216645001	Accidental poisoning by isopropyl alcohol
		216648004	Accidental poisoning by rubbing alcohol substitute
		4953006	Toxic effect of butyl alcohol
		6749002	Toxic effect of propyl alcohol
		57346004	Toxic effect of fusel oil
		216651006	Accidental poisoning by fusel oil
		87460008	Toxic effect of amyl alcohol
		67426006	Toxic effect of alcohol
		82047000	Diarrhoea due to alcohol intake
		314539001	Alcohol related optic neuropathy
		269765000	Accidental poisoning by alcohol
		212816003	^Rubbing alcohol causing toxic effect (disorder)
		212817007	^Isopropyl alcohol causing toxic effect NOS (disorder)
		212818002	^Fusel oil causing toxic effect NOS (disorder)
		212819005	^Other alcohol causing toxic effect (disorder)
		212820004	^Alcohol causing toxic effect NOS (disorder)
		213687005	^Toxic effect of other alcohols (disorder)
		212815004	^Isopropanol causing toxic effect (disorder)
		212814000	^Dimethyl carbinol causing toxic effect (disorder)
		212811008	^Wood alcohol causing toxic effect (disorder)
		212808007	^Ethyl alcohol causing toxic effect NOS (disorder)
		212806006	^Ethyl alcohol causing toxic effect (disorder)
		699208000	Thrombocytopenia due to alcohol
X45	E860	212813006	Toxic effect of isopropyl alcohol
		216640006	Accidental poisoning by methanol
		82782008	Alcohol poisoning
		216635003	Accidental poisoning by denatured alcohol
		6749002	Toxic effect of propyl alcohol
		212809004	Methyl alcohol causing toxic effect
		242263000	Accidental exposure to alcohol

For peer review only

		216633005	Accidental poisoning by alcoholic beverage
		212813006	Toxic effect of isopropyl alcohol
		242265007	Accidental exposure to ethanol
		278363000	Alcoholic macrocytosis
		442764005	Poisoning by benzene
		4953006	Toxic effect of butyl alcohol
		287166006	Accidental poisoning with ethyl alcohol
		699208000	Thrombocytopenia due to alcohol
		212809004	Methyl alcohol causing toxic effect
		67426006	Toxic effect of alcohol
		6749002	Toxic effect of propyl alcohol
		216645001	Accidental poisoning by isopropyl alcohol
		89507002	Toxic effect of denatured alcohol
		212807002	Grain alcohol causing toxic effect
		216648004	Accidental poisoning by rubbing alcohol substitute
		216651006	Accidental poisoning by fusel oil
		216636002	Accidental poisoning by methylated spirit
		89507002	Toxic effect of denatured alcohol
		442764005	Poisoning by benzene
		87460008	Toxic effect of amyl alcohol
		269765000	Accidental poisoning by alcohol
		57346004	Toxic effect of fusel oil
		221843007	^Accidental poisoning by and exposure to alcohol, occurrence at home (event)
		221844001	^Accidental poisoning by and exposure to alcohol, occurrence in residential institution (event)
		221845000	^Accidental poisoning by and exposure to alcohol, occurrence at school, other institution and public administrative area (event)
		221846004	^Accidental poisoning by and exposure to alcohol, occurrence at sports and athletics area (event)
		221847008	^Accidental poisoning by and exposure to alcohol, occurrence on street and highway (event)
		221848003	^Accidental poisoning by and exposure to alcohol, occurrence at trade and service area (event)

		221849006	^Accidental poisoning by and exposure to alcohol, occurrence at industrial and construction area (event)
		221850006	^Accidental poisoning by and exposure to alcohol, occurrence on farm (event)
		221851005	^Accidental poisoning by and exposure to alcohol, occurrence at other specified place (event)
		221852003	^Accidental poisoning by and exposure to alcohol, occurrence at unspecified place (event)
		57346004	Toxic effect of fusel oil
X65 (*note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the above codes*)	*No alcohol-specific code available*	222103001	^Intentional self-poisoning by and exposure to alcohol (event)
		222104007	^Intentional self-poisoning by and exposure to alcohol, occurrence at home (event)
		222105008	^Intentional self-poisoning by and exposure to alcohol, occurrence in residential institution (event)
		222106009	^Intentional self-poisoning by and exposure to alcohol, occurrence at school, other institution and public administrative area (event)
		222107000	^Intentional self-poisoning by and exposure to alcohol, occurrence at sports and athletics area (event)
		222108005	^Intentional self-poisoning by and exposure to alcohol, occurrence on street and highway (event)
		222110007	^Intentional self-poisoning by and exposure to alcohol, occurrence at trade and service area (event)
		222111006	^Intentional self-poisoning by and exposure to alcohol, occurrence at industrial and construction area (event)

For peer review only

		222112004	^Intentional self-poisoning by and exposure to alcohol, occurrence on farm (event)
		222113009	^Intentional self-poisoning by and exposure to alcohol, occurrence at other specified place (event)
		222114003	^Intentional self-poisoning by and exposure to alcohol, occurrence at unspecified place (event)
		312963001	Methanol retinopathy
Y15	E860	222702003	^Poisoning by and exposure to alcohol, undetermined intent (event)
	980	222703008	^Poisoning by and exposure to alcohol, occurrence at home, undetermined intent (event)
		222704002	^Poisoning by and exposure to alcohol, occurrence in residential institution, undetermined intent (event)
		222705001	^Poisoning by and exposure to alcohol, occurrence at school, other institution and public administrative area, undetermined intent (event)
		222706000	^Poisoning by and exposure to alcohol, occurrence at sports and athletics area, undetermined intent (event)
		222707009	^Poisoning by and exposure to alcohol, occurrence on street and highway, undetermined intent (event)
		222708004	^Poisoning by and exposure to alcohol, occurrence at trade and service area, undetermined intent (event)
		222709007	^Poisoning by and exposure to alcohol, occurrence at industrial and construction area, undetermined intent (event)
		222710002	^Poisoning by and exposure to alcohol, occurrence on farm, undetermined intent (event)
		222711003	^Poisoning by and exposure to alcohol, occurrence at other specified place, undetermined intent (event)

		222713000	^Poisoning by and exposure to alcohol, occurrence at unspecified place, undetermined intent (event)
		274776000	Finding of alcohol in blood
Y90 (*note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the 'Finding of alcohol in blood' code*)	*No alcohol-specific code available*	223333005	^Evidence of alcohol involvement determined by blood alcohol level (navigational concept)
		223334004	^Evidence of alcohol involvement determined by blood alcohol level of less than 20 mg/100 ml (navigational concept)
		223335003	^Evidence of alcohol involvement determined by blood alcohol level of 20-39 mg/100 ml (navigational concept)
		223336002	^Evidence of alcohol involvement determined by blood alcohol level of 40-59 mg/100 ml (navigational concept)
		223337006	^Evidence of alcohol involvement determined by blood alcohol level of 60-79 mg/100 ml (navigational concept)
		223338001	^Evidence of alcohol involvement determined by blood alcohol level of 80-99 mg/100 ml (navigational concept)
		223339009	^Evidence of alcohol involvement determined by blood alcohol level of 100-119 mg/100 ml (navigational concept)
		223340006	^Evidence of alcohol involvement determined by blood alcohol level of 120-199 mg/100 ml (navigational concept)
		223341005	^Evidence of alcohol involvement determined by blood alcohol level

For peer review only

			of 200-239 mg/100 ml (navigational concept)
		223342003	^Evidence of alcohol involvement determined by blood alcohol level of 240 mg/100 ml or more (navigational concept)
		223343008	^Evidence of alcohol involvement determined by presence of alcohol in blood, level not specified (navigational concept)
		25702006	Alcohol intoxication
Y91 (*note that generalised mapping matches were only available for Y91.1 and Y91.9 with SNO-MED although lexical matching suggest use of 'Alcohol intoxication' code*)	*No alcohol-specific code available*	230800004	Alcoholic coma
		82047000	Diarrhoea due to alcohol intake
		361267005	Alcohol-related fit
		223344002	^Evidence of alcohol involvement determined by level of intoxication (navigational concept)
		223345001	^Evidence of alcohol involvement determined by level of intoxication, mild alcohol intoxication (navigational concept)
		223346000	^Evidence of alcohol involvement determined by level of intoxication, moderate alcohol intoxication (navigational concept)
		223347009	^Evidence of alcohol involvement determined by level of intoxication, severe alcohol intoxication (navigational concept)
		223348004	^Evidence of alcohol involvement determined by level of intoxication, very severe alcohol intoxication (navigational concept)

		223349007	^Evidence of alcohol involvement determined by level of intoxication, alcohol involvement, not otherwise specified (navigational concept)

For peer review only

References

1. Toson B, Harvey LA, Close JC. New ICD-10 version of the Multipurpose Australian Comorbidity Scoring System outperformed Charlson and Elixhauser comorbidities in an older population. *J Clin Epidemiol* 2016;79:62-69. doi: 10.1016/j.jclinepi.2016.04.004 [published Online First: 2016/04/23]
2. Preen DB, Holman CD, Spilsbury K, et al. Length of comorbidity lookback period affected regression model performance of administrative health data. *J Clin Epidemiol* 2006;59(9):940-6. doi: 10.1016/j.jclinepi.2005.12.013 [published Online First: 2006/08/10]
3. NSW. IaPC. Statutory Guidelines on Research: Health Records and Information Privacy Act 2002 (NSW). 2002
4. Chikritzhs TC, P.; Stockwell, T.; Donath, S.; Ngo, H.; Young, D. and Mathews, S. Australian alcohol indicators, 1990-2001: Patterns of alcohol use and related harms for Australian states and territories. : Curtin University of Technology: National Drug Research Institute, 2003.

For peer review only

BMJ Open

Protocol for the Data-linkage Alcohol Cohort Study (DACS): Investigating mortality, morbidity, and offending among people with an alcohol-related problem using linked administrative data

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2019-030605.R1
Article Type:	Protocol
Date Submitted by the Author:	05-Jun-2019
Complete List of Authors:	Peacock, Amy; University of New South Wales, National Drug and Alcohol Research Centre; Chiu, Vivian; University of Queensland, School of Psychology Leung, Janni; University of Queensland, School of Medicine Dobbins, Timothy Larney, Sarah; University of NSW, National Drug and Alcohol Research Centre Gisev, Natasa; University of New South Wales, National Drug and Alcohol Research Centre Pearson, Sallie-Anne; University of New South Wales, Medicines Policy Research Unit Degenhardt, Louisa; University of New SouthWales, National Drug and Alcohol Research Centre
Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Mental health, Epidemiology
Keywords:	alcohol, data linkage, mortality, morbidity, incarceration, offending

SCHOLARONE™
Manuscripts

Protocol for the Data-linkage Alcohol Cohort Study (DACS): Investigating mortality, morbidity, and offending among people with an alcohol-related problem using linked administrative data

Amy Peacock[1,2], Vivian Chiu[1,3,4], Janni Leung[1,3,4,5], Timothy Dobbins[1], Sarah Larney[1], Natasa Gisev[1], Sallie-Anne Pearson[6], & Louisa Degenhardt[1]

[1]National Drug and Alcohol Research Centre, University of New South Wales Sydney, Australia

[2]Division of Psychology, School of Medicine, University of Tasmania, Australia

[3]School of Psychology, Brisbane, The University of Queensland, Australia

[4]Centre for Youth Substance Abuse Research, Brisbane, The University of Queensland, Australia

[5]Institute for Health Metrics and Evaluation, University of Washington, United States

[6]Centre for Big Data Research in Health, University of New South Wales Sydney, Australia

For peer review only

Word Count: 2469

Corresponding author: Amy Peacock, Research Fellow, National Drug and Alcohol Research Centre, University of New South Wales, e: amy.peacock@unsw.edu.au, t: +61 2 9385 0333, f: +61 2 9385 0222.

Abstract

Introduction: The aims of this program of research are to use linked health and law enforcement data to describe individuals presenting to emergency and inpatient health care services with an acute alcohol harm or problematic alcohol use; measure their health service utilisation and law enforcement engagement; and quantify morbidity, mortality, offending and incarceration.

Methods and analysis: We will assemble a retrospective cohort of people presenting to emergency departments and/or admitted to hospitals between January 1st, 2005 and December 31st, 2014 in New South Wales, Australia with a diagnosis denoting an acute alcohol harm or problematic alcohol use. We will link their hospital data with records from other healthcare services (e.g., community-based mental health care provision, cancer registry), mortality, offending, and incarceration data sets. The four overarching areas for analysis comprise: i) describing the characteristics of those presenting to emergency and inpatient hospital services with a diagnosis indicating an acute alcohol harm and/or problematic alcohol use at first point of contact within the cohort period; ii) quantifying health service utilisation and law enforcement engagement; iii) quantifying rates of mortality, morbidity, offending and incarceration; and iii) assessing predictors (e.g., age, sex) of mortality, morbidity, offending, and incarceration amongst this cohort.

Ethics and dissemination: Ethics approval has been provided by the New South Wales Population and Health Services Research Ethics Committee. We will report our findings in accordance with the Reporting of studies Conducted using Observational Routinely-collected health Data statement (RECORD) and Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER) where appropriate. We will publish data in tabular, aggregate forms only. We will not disclose individual results. We will disseminate project findings at scientific conferences and in peer-review journals. We will aim to present findings to relevant stakeholders (e.g., addiction medicine, emergency medicine, policy makers) to maximise translational impact of research findings.

Keywords: alcohol; data linkage; mortality; morbidity; incarceration; offending; harm

For peer review only

STRENGTHS AND LIMITATIONS OF THIS STUDY

Strengths:

- This study comprises a population-based cohort of people with a diagnosis indicating an acute alcohol problem and/or problematic alcohol use (as identified through emergency department attendances and hospital separations) over an extended period (2005-2014).
- There is a wealth of information on these participants through linkage to various routinely-collected administrative data sets (i.e., emergency department presentations, hospital separations, cancer notifications, mental health ambulatory care, mortality, offending, and incarceration).

Limitations:

- Routinely-collected administrative data contain limited contextual information and represent an underestimate of total health and offending outcomes for these individuals (e.g., where not brought to the attention of, and recorded by, these services).
- Intervention and treatment for alcohol-related problems are not wholly captured across these data sources, and may impact experiences of morbidity, mortality, offending and incarceration.
- The study period represents a snapshot for each individual; some individuals may have an extensive history of engagement with healthcare and law enforcement prior to entry to the cohort but this cannot necessarily be identified with the data used here.

For peer review only

Introduction

Reducing the health, social, and economic burden of alcohol use is a priority in Australia and globally[1,2]. Alcohol consumption is estimated to play a causal role in over 200 disease and injury conditions[2]. Approximately 3.9% of deaths and 1.8% of hospitalisations in Australia are alcohol-related[3]. Alcohol use negatively impacts on the community through reduced workplace productivity, traffic accidents, family problems, crime, and public disorder, with an estimated economic cost of $14 billion annually[4].

Recent evidence suggests declining population levels of consumption in Australia over the past two decades without clear evidence of a corresponding decrease in harms[5-9]. Alcohol-related harms represent a significant burden on healthcare and law enforcement services. Indeed, recent estimates suggest that approximately one in ten emergency department presentations in Australia are alcohol-related[10], with more than 144,000 alcohol-attributable hospitalisations in Australia in 2012/13[11].

The aforementioned data are based on modeled estimates or on aggregated number of presentations to services. It is important to understand these events at the individual level: a significant proportion of people will have recurrent alcohol-related problems and experience substantial morbidity and higher risk of mortality as a consequence, placing a significant burden on healthcare and law enforcement services. In Australia, there has been no recent attempt at the population level to longitudinally track people with alcohol-related problems to measure overall mortality, morbidity and other problems (e.g., offending and incarceration), despite such work for other substances (e.g., opioids[12]).

This project, named the Data linkage Alcohol Cohort Study (DACS), will use data linkage to identify individuals presenting to emergency department or inpatient hospital services in New South Wales (NSW), Australia, with a diagnosis indicating an acute alcohol harm or problematic use. Records for this cohort of people will be linked to additional health and law enforcement service data for robust measurement of alcohol-related harms and burden. The overarching objectives of this program of research are to:

1. Describe the cohort at their first point of contact with emergency department or inpatient hospital services within the study period for an acute alcohol harm and/or problematic alcohol use;
2. Quantify healthcare service utilisation and law enforcement engagement among the cohort (and associated economic costs) and assess individual and situational characteristics as predictors of frequency of engagement;

For peer review only

3. Quantify the rate of mortality, morbidity, offending and incarceration amongst the cohort, looking at overall rates and cause-specific outcomes where possible; and
4. Assess individual and situational characteristics as predictors of mortality, morbidity, offending and incarceration.

Methods and Analysis

Study Design

This study will link two routinely collected administrative datasets from NSW, Australia, to assemble a retrospective observational cohort of people presenting to emergency department and hospital inpatient services with an acute alcohol harm and/or problematic alcohol use. Once the cohort has been identified, their linked data from other routinely-collected administrative data sets will be extracted, providing information on emergency department presentations, hospital separations, cancer notifications, mental health ambulatory care, mortality, offending, and incarceration. Data linkage will be undertaken by the Centre for Health Record Linkage (CHeReL).

Formation of Base Cohort

The base cohort will consist of individuals with a diagnosis indicating an acute alcohol harm or problematic alcohol use presenting to inpatient services (NSW Admitted Patient Data Collection; NSW APDC) and acute services (NSW Emergency Department Data Collection; NSW EDDC) in NSW between January 1st, 2005 and December 31st, 2014. Diagnostic classification systems used by NSW APDC and NSW EDDC in this period comprise the International Classification of Diseases and Health Related Problems 9th and 10th edition Australian Modification (ICD-9-CM or ICD-10-AM; APDC and EDDC) and the Systematized Nomenclature of Medicine--Clinical Terms Australian Modification (SNOMED-CT-AU; EDDC only). Diagnostic codes used for cohort inclusion were identified through a review of various sources on alcohol-related health burden and mortality (e.g., Chikritzhs, et al. [13]) and in consultation with specialists in the field (see **Table 1** for ICD-10 codes; see **Appendix 1** for all the diagnosis codes used for cohort identification). A flowchart of how the base cohort will be formed and the administrative datasets to be linked (described in the next section) is presented in **Figure 1**. Inclusion in the cohort may be modified depending on the specific research question being addressed.

Table 1 approximately here

Figure 1 approximately here

Datasets and Linkage

For peer review only

On identifying the base cohort, the CHeReL will extract linked data for these individuals from a range of routinely-collected administrative data sets using the probabilistic record linkage software ChoiceMaker[14,15]. Identifying information (i.e., name, address, date of birth and gender) for each dataset is included in the Master Linkage Key (MLK) constructed by the CHeReL. The ChoiceMaker software uses an exact 'blocking' algorithm to search for valid matches in the MLK to identify all matching records. A combination of two techniques is used to determine whether each potential match denotes (or possibly denotes) the same person, comprising: i) a probabilistic decision, which is computed using a machine learning technique, and ii) absolute rules, which include upper and lower probability cut-offs which initially start at 0.75 and 0.25 for a linkage and are adjusted for each individual linkage to ensure false links are minimised. The parameters for the extract from the MLK are set such that no true matches are missed if full identifiers are available. Extensive quality assurance measures ensure the false positive rate for linkage is less than 0.5% and the false negative rate for linkage is less than 0.1%[15]. All datasets except the NSW Re-offending Database (ROD) are routinely contained within the MLK. The internal matching process of the NSW Re-offending Database (ROD) has been validated (specificity of 99.9 percent and a sensitivity of 93.8 percent[16]), and linkage of records within the MLK to those within ROD will follow the same process as above. Descriptions of the data sets for linkage are presented in **Table 2**.

Table 2 approximately here

Patient and public involvement

Patients and the public were not involved in the design of the study. As described in our dissemination activities (outlined below), we will aim to present findings to relevant stakeholders (e.g., addiction medicine, emergency medicine, policy makers) to maximise translational impact of research findings. We will prepare one-page summaries of key findings for distribution to drug treatment services and harm-reduction services.

Planned statistical analyses

Below, we outline the core analyses to address the overarching research questions. In all analyses, multiple confounding variables will be controlled as appropriate. We will also undertake the below analyses for the total cohort and focused specifically on young people (e.g., aged 15-24 years old). This younger age demographic has demonstrated significant recent shifts in alcohol consumption alongside increasing harms[7,8], and also represents a portion of the sample likely to have no or limited engagement with healthcare and law enforcement services prior to the study period.

For peer review only

Aim 1. Describe the cohort at their first point of contact with emergency department or inpatient hospital services within the study period for an acute alcohol harm and/or problematic alcohol use.

We will describe the characteristics of the cohort at their index event (i.e., first emergency department presentation or hospital separation with an alcohol-related diagnosis within the cohort period; diagnosis codes identified in **Appendix 1**). Our description will include the individual characteristics (e.g., age, sex, socio-economic status) and situational characteristics (e.g., public or private hospital, diagnosis) of their presentation. We will analyse the 12-month period prior to each person's index presentation to quantify existing health comorbidities (using an established comorbidity score, e.g., Charlson Comorbidity Index[17] or Elixhauser Comorbidity Index[18]), as well as offending and incarceration within that period. For these analyses, we will exclude individuals who had an index event within the first 12 months of the cohort commencement (i.e., between January 1st and December 31st, 2005) to provide capacity for analyses of the 12-month period prior to index presentation.

Aim 2. Quantify healthcare service utilisation and law enforcement engagement among the cohort (and associated economic costs) and assess individual and situational characteristics as predictors of frequency of engagement.

We will calculate total number of emergency department presentations and hospital separations each year, and number of unique people each year with an emergency department presentation/hospital separation with an alcohol-related diagnosis. We will estimate the number of hospital separations in two ways, as a count of episodes of care and of periods of stay[19]. A period of stay will be defined as the complete period of care from admission to hospital until separation. A period of stay may consist of multiple episodes of care, the latter defined as a period of a specific care type (e.g., receipt of acute care and rehabiliation may be coded as two episodes-of-care within one period-of-stay).

We will identify people who re-present to these services within 30 days of discharge (re-admission), as well as those individuals who attend at high-frequency ($\geq$4 presentations/separations in a year) and high-intensity (average $\geq$4 presentations/separations in a year across period of follow-up or until death). We will use regression analyses to assess individual and situational characteristics of re-admission, high-frequency attendance, and high-intensity attendance. We will quantify engagement with law enforcement (offending and incarceration). We will also estimate costs associated with health service utilisation and law enforcement engagement using standard reference material for costs (e.g. Australian Refined Diagnosis Related Group (AR-DRG) codes for quantification of economic cost of hospital services[20]).

For peer review only

Aim 3. Quantify the rate of mortality, morbidity, offending and incarceration amongst the cohort, looking at overall rates and cause-specific outcomes where possible. Aim 4. Assess individual and situational characteristics as predictors of mortality, morbidity, offending and incarceration.

Mortality analyses. We will calculate all-cause and cause-specific crude mortality rates as the number of deaths in the cohort divided by person-years of observation. We will estimate all-cause and cause-specific standardised mortality ratios by comparing the observed number of deaths and expected number of deaths. We will classify deaths in accordance with guidance for clustering major causes of mortality[21], with a focus on causes of death wholly or partly attributable to alcohol consumption[22]. We will stratify crude mortality rates and standardised mortality ratios by other demographic and situational characteristics where possible based on population data (e.g., age, geography, sex, comorbidity). We will conduct survival analyses to determine time from the index presentation to the outcome of interest (mortality or, if mortality does not occur, the censoring date) and use Cox proportional hazards regression to calculate hazard ratios for all-cause and cause-specific mortality based on time-independent (e.g., gender) and time-dependent (e.g., age, calendar year, geographic region, comorbidity score) variables.

Morbidity analyses. The main outcome of interest will be time (measured by the number of days) between presentations. Individuals will be censored at the end of the study period or date of death, whichever occurred first. We will use survival analysis methods that incorporate multiple observations per person[23] to examine the relationship between risk factors (individual and situational characteristics at index) and the time interval distributions of recurrent presentations with multiple causes for each individual. We will examine any re-admission and alcohol-related re-admission, as well as time to specific type of alcohol-related re-admission (as defined in Table 1). Risk factors will be identified for the entire cohort, adjusting for diagnostic groups. We will assess heterogeneity between diagnostic groups in the effect of risk factors descriptively. We will use the community-based mental health treatment data (MH-AMB) to undertake a sub-group analysis of people with comorbid mental health issues.

Offending and incarceration analyses. To assess frequency of engagement with the criminal justice system among individuals with problematic use of alcohol, we will calculate rates of all offences and alcohol-related offences per 1,000 person-years, as well as rates of incarceration episodes and time between offences (or death or end of follow-up, whichever comes first) distinguished by the characteristics of individuals (e.g. gender). Offences will be classified in accordance with the Australian and New Zealand Standard Offence Classification (ANZSOC) system[24] (as per the NSW Bureau of Crime Statistics and Research (BOCSAR) standard crime statistics reporting[25]).

For peer review only

We will use survival analysis methods to examine the relationship between engagement with health services (characterised by number of alcohol-related presentations) and time to a subsequent arrest (days to any offence/ days to alcohol-related offence). The hazard ratios for subsequent arrest will be adjusted for time-independent (e.g., gender, country of birth) and time-dependent (e.g., age, comorbidity score, calendar year, length of hospital stay, geographic region, private/public hospital, types of procedures undergone, remoteness, socio-economic status) variables.

Methodological considerations

There are several key methodological considerations to be noted with the use of these data sets. Firstly, the number of participating emergency departments has intermittently increased over time, from around 46 emergency departments in 1996 to around 90 in 2010[26]. There are around 150 emergency departments in NSW. Those servicing larger proportions of the NSW population are included but possible under-ascertainment of total engagement with emergency departments for alcohol-related problems should be noted. Where necessary, we will run analyses with and without the EDs that were added later in the series to establish if this has changed the study outcomes to account for variable data quality from inclusion of new participating emergency departments in the EDDC. Secondly, variation in computer programs and management practices at emergency departments and hospitals may lead to variation in diagnosis coding practices (i.e. ICD-9, ICD-10 and SNOMED codes entered by physicians) and in the screening and capture of alcohol involvement in healthcare presentations. Hence, the specificity of some disease categories may vary, and under-ascertainment of alcohol-related presentations is likely[27]. Thirdly, data on alcohol consumption, as well as intervention and treatment for problematic alcohol use, cannot be systematically ascertained from the included data sources. The MH-AMB captures ambulatory mental health service provided to non-admitted individuals. To the authors' knowledge, this data set has not been used to quantify engagement in prevention and intervention for alcohol-related problems in previous linkage studies. Until we have the capacity to study the data, we cannot know the quality of information provided however, there may be the capacity to explore use of this data set to capture such engagement, and take this into consideration in analyses. Fourthly, the false positive rate for linkage is less than 0.5% and the false negative rate for linkage is less than 0.1%[15]. We will compare time-independent information (e.g., date of birth, date of death) across datasets to identify inconsistencies that may be indicative of false positive linkages. These participants will be excluded from the cohort and identified in all reporting on final cohort composition. Finally, the study period represents a snapshot for each individual. Some individuals may have an extensive history of engagement with healthcare and law enforcement prior to entry to the cohort; this will be considered when drawing inferences from findings.

For peer review only

Ethics and Dissemination

Data storage, retention, and access

To protect privacy and confidentiality, approval for the linkage of health data in NSW is provided under strict conditions for the storage, retention and use of the data. The current approval permits storage of the data at three sites: the University of New South Wales, University of Queensland, and University of Tasmania.

Ethics and Dissemination

Ethical approval for this project has been provided by the New South Wales Population and Health Services Research Ethics Committee (2016/08/650). Data custodian approval has been granted and linkage and data cleaning have nearly been completed, with data analyses being performed and reporting occurring whilst the project retains ethical approval (currently until 2021). We will report our findings in accordance with the Reporting of studies Conducted using Observational Routinely-collected health Data statement (RECORD)[28] and Guidelines for Accurate and Transparent Health Estimates Reporting (GATHER)[29] where appropriate. We will publish data in tabular, aggregate forms only and cells containing data from less than 10 participants will be suppressed. We will not disclose individual results.

We will disseminate project findings at scientific conferences and in peer-review journals. We will aim to present findings to relevant stakeholders (e.g., addiction medicine, emergency medicine, policy makers) to maximise translational impact of research findings.

Discussion

This program of research will provide a comprehensive population-level understanding of the burden of problematic alcohol use on individuals and on healthcare and law enforcement services. It will extend knowledge of individual and situational factors that predict adverse alcohol-related outcomes, with the capacity to inform personalised intervention. The patterns of healthcare utilisation will also improve our knowledge of patient needs to enhance healthcare delivery for targeted populations. The multi-dimensional measurement of diverse events produced by this project can better reflect the scale and impact of alcohol-related problems which may be under-ascertained in the study of a single dataset.

For peer review only

Authors' contributions: AP and LD conceived the study idea. AP, LD, TD, NG, SL, SAP, and AD provided input to the study design and research questions. AP, TD, VC, and JL developed the statistical analysis plan. AP, VC, and JL completed the first draft of the manuscript. All authors reviewed the manuscript and provided input to the final draft.

Funding statement: This work was funded by research support funds awarded by UNSW Sydney to AP. AP, SL and LD are supported by NHMRC research fellowships (#1109366, #1140938 and #1041472/#1135991). SL and NG are supported by UNSW Scientia Fellowships. SL and LD are supported by NIH grant NIDA R01DA1104470. The National Drug and Alcohol Research Centre is supported by funding from the Australian Government Department of Health under the Drug and Alcohol Program.

Patient consent: Not required.

Competing interests: None relevant to declare.

Ethics approval: New South Wales Population and Health Services Research Ethics Committee, approved in August 2016 (2016/08/650)

Data availability: Unpublished data are not available to be accessed.

Acknowledgements: The authors wish to thank Professor Jürgen Rehm for his input on the diagnostic codes chosen and Professor Adrian Dunlop for his input on study design. We wish to thank the Clinical Terminology Team at the National E-Health Transition Authority (now the Australian Digital Health Agency) for assisting with mapping ICD-10-AM codes to SCT-AU. We also wish to thank the NSW Ministry of Health, the Centre for Health Record Linkage (CHeReL), the Cancer Institute NSW and other data custodians for reviewing the project protocol, approving the project, and providing requested data. The Cause of Death Unit Record File (COD URF) is provided by the Australian Coordinating Registry for the COD URF on behalf of the NSW Registry of Births, Deaths and Marriages, NSW Coroner and the National Coronial Information System.

For peer review only

References

1. Australian Government Department of Health. National Drug Strategy 2017-2016. In: Health Do, ed. Canberra: Commonwealth of Australia 2017.
2. World Health Organization. Global status report on alcohol and health. Geneva: World Health Organization, 2018.
3. Gao C, Ogeil RP, Lloyd B. Alcohol's burden of disease in Australia. Canberra: Foundation for Alcohol Research and Education and VicHealth in collaboration with Turning Point, 2014.
4. Manning M, Smith C, Mazerolle P. The societal costs of alcohol misuse in Australia. Trends & issues in crime and criminal justice No. 454. Canberra: Australian Institute of Criminology, 2013.
5. Livingston M. Understanding recent trends in Australian alcohol consumption. Canberra: Foundation for Alcohol Research and Education, 2015.
6. Livingston M, Matthews S, Barratt MJ, et al. Diverging trends in alcohol consumption and alcohol-related harm in Victoria. *Australian and New Zealand Journal of Public Health* 2010;34(4):368-73.
7. Livingston M. Recent trends in risky alcohol consumption and related harm among young people in Victoria, Australia. *Australian and New Zealand Journal of Public Health* 2008;32(3):266-71.
8. Callinan S, Pennay A, Livingston M, et al. Patterns in Reduction or Cessation of Drinking in Australia (2001–2013) and Motivation for Change. *Alcohol and Alcoholism* 2018;54(1):79-86. doi: 10.1093/alcalc/agy072
9. Livingston M, Callinan S, Raninen J, et al. Alcohol consumption trends in Australia: Comparing surveys and sales-based measures. *Drug and Alcohol Review* 2018;37:S9-S14.
10. Egerton-Warburton D, Gosbell A, Moore K, et al. Alcohol-related harm in emergency departments: a prospective, multi-centre study. *Addiction* 2018;113(4):623-32. doi: 10.1111/add.14109
11. Lensvelt E, Gilmore W, Liang W, et al. Estimated alcohol-attributable deaths and hospitalisations in Australia 2004 to 2015. National Alcohol Indicators, Bulletin 16. Perth: National Drug Research Institute, Curtin University. , 2018.
12. Degenhardt L, Larney S, Kimber J, et al. The impact of opioid substitution therapy on mortality post-release from prison: retrospective data linkage study. *Addiction* 2014;109(8):1306-17. doi: 10.1111/add.12536
13. Chikritzhs T, Catalano P, Stockwell T, et al. Australian alcohol indicators, 1990-2001: Patterns of alcohol use and related harms for Australian states and territories. Perth: National Drug Research Institute, Curtin University, 2003.
14. Key Concepts of the ChoiceMaker 2 Record Matching System [program]. Washington, DC, 2003.
15. Lawrence G, Dinh I, Taylor L. The Centre for Health Record Linkage: a new resource for health services research and evaluation. *Health Information Management Journal* 2008;37(2):60-62.
16. Hua J, Fitzgerald J. Matching court records to measure reoffending. *BOCSAR NSW Crime and Justice Bulletins* 2006:12.
17. Charlson M, Szatrowski TP, Peterson J, et al. Validation of a combined comorbidity index. *J Clin Epidemiol* 1994;47(11):1245-51. [published Online First: 1994/11/01]
18. Elixhauser A, Steiner C, Harris DR, et al. Comorbidity measures for use with administrative data. *Medical Care* 1998:8-27.
19. AIHW. Australian Institute of Health and Welfare - Hospitals Glossary 2018 [Available from: https://www.aihw.gov.au/reports-data/health-welfare-services/hospitals/glossary.
20. Australian Refined Diagnosis Related Groups (AR-DRG) Classification Version 8.0 Australian Consortium for Classification Development.
21. Randall D, Roxburgh A, Gibson A, et al. Mortality among people who use illicit drugs: A toolkit for classifying major causes of death. Sydney: National Drug and Alcohol Research Centre, University of NSW, 2009.

For peer review only

22. Roerecke M, Rehm J. Cause-specific mortality risk in alcohol use disorder treatment patients: a systematic review and meta-analysis. *International Journal of Epidemiology* 2014;43(3):906-19. doi: 10.1093/ije/dyu018
23. Amorim LD, Cai J. Modelling recurrent events: a tutorial for analysis in epidemiology. *Int J Epidemiol* 2015;44(1):324-33. doi: 10.1093/ije/dyu222 [published Online First: 2014/12/17]
24. Pink B. Australian and New Zealand Standard Offence Classification (ANZSOC), 2011 (3rd edition): Australian Bureau of Statistics,.
25. AIHW. Australian and New Zealand Standard Offence Classification (ANZSOC). Cat. no. 1234.0., 2011.
26. NSW Ministry of Health. NSW Emergency Department Data Collection: Data Dictionary. Sydney: NSW Ministry of Health, 2017.
27. McKenzie K, Harrison JE, McClure RJ. Identification of alcohol involvement in injury - related hospitalisations using routine data compared to medical record review. *Australian and New Zealand Journal of Public Health* 2010;34(2):146-52.
28. Benchimol EI, Smeeth L, Guttmann A, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. *PLoS Medicine* 2015;12(10):e1001885. doi: 10.1371/journal.pmed.1001885
29. Stevens GA, Alkema L, Black RE, et al. Guidelines for Accurate and Transparent Health Estimates Reporting: the GATHER statement. *Lancet* 2016;388(10062):e19-e23. doi: 10.1016/S0140-6736(16)30388-9

For peer review only

Table 1. Alcohol-related diagnosis codes used from the International Classification of Diseases and Health Related Problems, 10th edition Australian Modification (ICD-10-AM)

Alcohol-related diagnosis	ICD-10-AM codes
Alcohol-induced pseudo-Cushing's syndrome	E24.4
Wernicke encephalopathy	E51.2
Mental and behavioural disorders due to use of alcohol	F10
Degeneration of nervous system due to alcohol	G31.2
Alcoholic polyneuropathy	G62.1
Alcoholic myopathy	G72.1
Alcoholic cardiomyopathy	I42.6
Alcoholic gastritis	K29.2
Alcohol-induced liver diseases	K70.0, K70.1, K70.2, K70.3, K70.4, K70.9
Alcohol-induced pancreatitis	K85.2, K86.0
Maternal care for (suspected) damage to foetus from alcohol	O35.4
Foetal alcohol syndrome (dysmorphic)	Q86.0
Detection of alcohol in blood	R78.0, T51, X45, X65, Y15, Y90, Y91

Note. Diagnostic classification systems used by NSW APDC and NSW EDDC in this period comprise the International Classification of Diseases and Health Related Problems 9th and 10th edition Australian Modification (ICD-9-CM or ICD-10-AM; APDC and EDDC) or the Systematized Nomenclature of Medicine--Clinical Terms Australian Modification (SNOMED-CT-AU; EDDC only). Diagnostic codes used for cohort inclusion were identified through a review of various sources on alcohol-related health burden and mortality and in consultation with specialists in the field (see **Appendix 1** for all the diagnosis codes used for data extraction).

For peer review only

Figure 1. Formation of the Data-linkage Cohort Study (DACS)

For peer review only

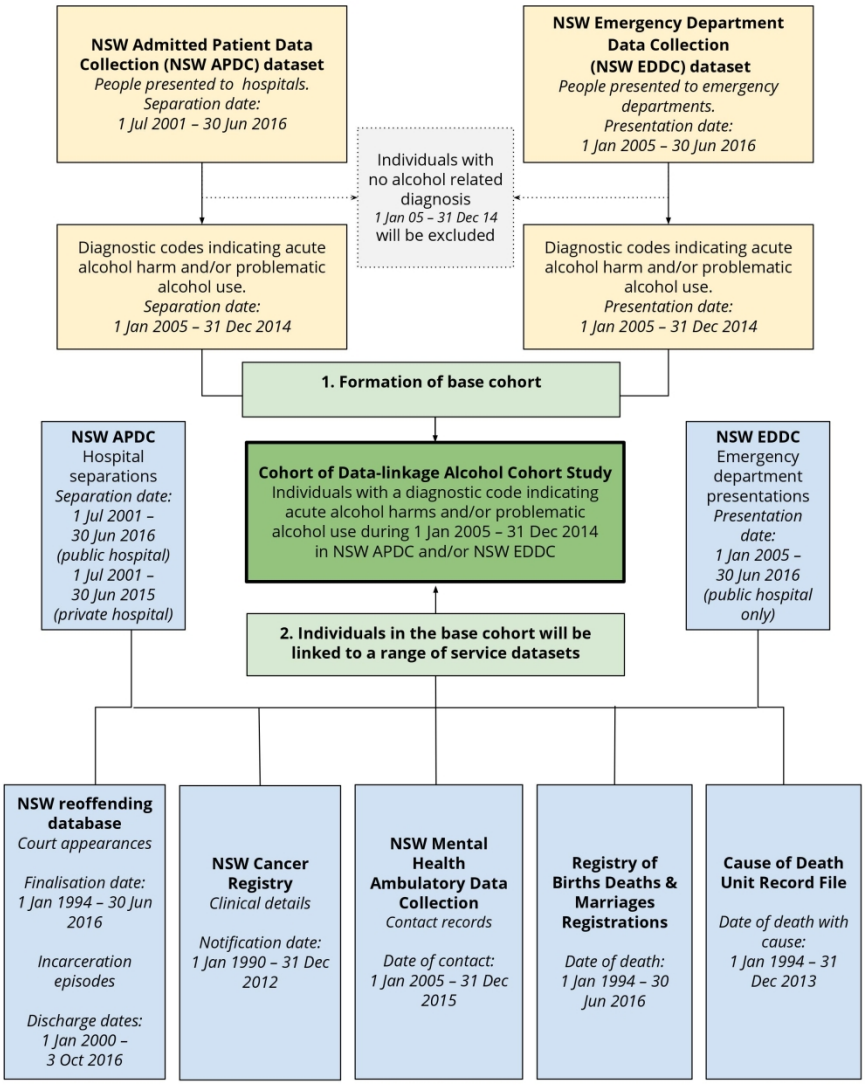
Table 2. Datasets for Linkage

Database	Description	Key variables
NSW Admitted Patients Data Collection (NSW APDC)	Records of all hospital separations (including discharges, transfers and deaths) from all public and private hospitals, public multi-purpose services, and day procedure centres in NSW.	Records for each episode of care include date of admission and separation, emergency status, principal and additional diagnoses, treatment procedures, mode of separation and facility identifier.
NSW Emergency Department Data Collection (NSW EDDC)	Records of all presentations to Emergency Departments in major metropolitan and major non-metropolitan public hospitals in NSW.	Records for each episode of care include date of admission and separation, emergency status, diagnosis, mode of arrival and separation and facility identifier.
NSW Mental Health Ambulatory Data Collection (MH-AMB)	Records of episodes of care delivered by NSW ambulatory mental health service units to non-admitted individuals, including day programmes, psychiatric outpatients and outreach services.	Records for each contact include date of contact, diagnosis and services delivered. Facility information includes provider group, provider role and service category and facility location.
NSW Central Cancer Registry	Records of all new cases of cancer (defined as an occurrence of a primary malignant neoplasm in an organ of a particular person; excluding occurrence of skin cancers other than melanoma) diagnosed in NSW residents.	Data includes clinical details of individuals e.g. cancer group, degree of spread, date and age of diagnosis. If applicable, information regarding date and age of death, and cause of death is also included.

For peer review only

NSW Re-offending Database (ROD)	Court records, with all finalised court appearances in NSW Children's, Local, District and Supreme Courts, and juvenile detention and adult incarceration in NSW.	Records include date and type of offence, outcome of court appearance, conviction date and penalty. Incarceration information includes commencement and conclusion date of incarceration, conviction date.
NSW Registry of Births, Deaths and Marriages (RBDM) and the Australian Coordinating Registry (ACR) Cause of Death Unit Record File (COD URF)	The two datasets contain mortality information for deaths occurring in NSW, which also includes Australian Bureau of Statistics (ABS) death registration data. The Cause of Death Unit Record File is held by the NSW Ministry of Health Secure Analytics for Population Health Research and Intelligence	Data includes date of death and contributing or multiple cause of death codes (where relevant).

For peer review only



209x289mm (300 x 300 DPI)

Appendix 1: Diagnostic codes used for data extraction

A) ICD codes

The codes on the following sheet will be used to identify people in the Admitted Patients Data Collection and Emergency Department Data Collection (cases). Codes were selected based on identification by NSW Health as reflective of an acute alcohol problem[1] or, where indicated (*) from Turning Point Alcohol and Drug Centre guidance for calculating alcohol and other drug statistics [2]. Where indicated (~), additional codes are included on the basis of discussion between investigators and specialists in the field. ICD-9-CM and ICD-10-AM codes were mapped using the Australian Consortium for Classification Development mapping tables, with backwards mapping from ICD-10-AM to ICD-9-CM[3], and alcohol-specific code mapping developed by Chikritzhs et al.[4].

ICD-10-AM	Conditions	ICD-9-CM	Conditions
E24.4	*Alcohol-induced pseudo-Cushing's syndrome	*No alcohol-specific code available*	
E51.2	~Wernicke encephalopathy	291.1	Alcohol-induced persisting amnestic disorder
F10	Mental and behavioural disorders due to use of alcohol	291	Alcohol-induced mental disorders
		303	Alcohol dependence syndrome
		305.0	Nondependent alcohol abuse
G31.2	*Degeneration of nervous system due to alcohol	303	Alcohol dependence syndrome
G62.1	*Alcoholic polyneuropathy	357.5	*Alcoholic polyneuropathy
G72.1	*Alcoholic myopathy	*No alcohol-specific code available*	
I42.6	*Alcoholic cardiomyopathy	425.5	*Alcoholic cardiomyopathy
K29.2	*Alcoholic gastritis	535.3	*Alcoholic gastritis
K70.0	Alcoholic fatty liver	571.0	*Alcoholic fatty liver
K70.1	Alcoholic hepatitis	571.1	Acute alcoholic hepatitis
K70.2	Alcoholic fibrosis and sclerosis of liver		
K70.3	Alcoholic cirrhosis of liver	571.2	Alcoholic cirrhosis of liver
K70.4	Alcoholic hepatic failure		
K70.9	Alcoholic liver disease, unspecified	571.3	Alcoholic liver damage, unspecified
K85.2	*Alcohol-induced acute pancreatitis	*No alcohol-specific code available*	
K86.0	*Alcohol-induced chronic pancreatitis	*No alcohol-specific code available*	
O35.4	*Maternal care for suspected damage to foetus from alcohol	*No alcohol-specific code available*	
P04.3	*Foetus and newborn affected by maternal use of alcohol	760.71	Alcohol affecting fetus or newborn via placenta or breast milk

For peer review only

Q86.0	*Foetal alcohol syndrome (dysmorphic)		
R78.0	Finding of alcohol in blood	790.3	Excessive blood level of alcohol
T51	Toxic effect of alcohol	980	Toxic effect of alcohol
X45	Accidental poisoning by and exposure to alcohol	E860	Accidental poisoning by alcohol not elsewhere classified
X65^	Intentional self-poisoning by and exposure to alcohol	*No alcohol-specific code available*	
Y15	Poisoning by and exposure to alcohol, undetermined intent	E860	Accidental poisoning by alcohol not elsewhere classified
		980	Toxic effect of alcohol
Y90^^	Evidence of alcohol involvement determined by blood alcohol level	*No alcohol-specific code available*	
Y91^^^	Evidence of alcohol involvement determined by level of intoxication	*No alcohol-specific code available*	

^note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the above codes

^^note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the 'Finding of alcohol in blood' code

^^^note that generalised mapping matches were only available for Y91.1 and Y91.9 with SNO-MED although lexical matching suggest use of 'Alcohol intoxication' code∞

For peer review only

B) SNOMED codes

The following codes will be used to identify people in the Emergency Department Data Collection (cases). Emergency departments may use either or a combination of ICD-9, ICD-10 (see above) or SNOMED. Codes were mapped in consultation with the Clinical Terminology Team at the National E-Health Transition Authority (now Australian Digital Health Agency) to approximate ICD-10-AM codes using lexical and generalised mapping (the latter comprising the International SCT-ICD map) for SCT-AU (v20160430 April 2016). A number of codes were only found in ICD-10 and not ICD-10-CM (F10 K29.20 K29.21 T51 X45 X65 Y90 Y91), and thus these codes were searched with a wildcard for the last character, yielding hits for the following codes (F10.0 F10.1 F10.2 F10.3 F10.4 F10.5 F10.6 F10.7 F10.8 F10.9 K29.2 T51.0 T51.1 T51.2 T51.3 T51.9 X45 X45.99 Y91.1 Y91.9). Lexical mapping (i.e., synonym with a lexical match) was used for those codes where a hit was not identified with the International SCT-ICD map. Note that those variables flagged with a # were added following review of NSW Health codes for acute emergency department presentation data; the same applies where flagged with a ^, with the exception that these terms are now deprecated.

ICD-10-AM	ICD-9-CM	SNOMED-CT-AU	CONDITIONS
E24.4	*No alcohol-specific code available*	237738005	Pseudo-Cushing's syndrome due to alcohol
E51.2	291.1	21007002	Wernicke's disease
F10	291	191477001	Pathological alcohol intoxication
	303	42344001	Alcohol-induced psychosis
	305.0	25702006	Alcohol intoxication
		228315001	Binge drinker
		18653004	Alcohol intoxication delirium
		21000000	Idiosyncratic intoxication
		228341007	Unable to abstain from drinking
		32553006	Hangover
		228357007	Persistent effect of alcohol
		228316000	Alcoholic binges exceeding sensible amounts
		268645007	Nondependent alcohol abuse
		228354000	Drink driving
		228317009	Alcoholic binges exceeding safe amounts
		191883007	Nondependent alcohol abuse, episodic
		169942003	Maternal alcohol abuse
		304605000	Methanol abuse
		288021000119107	Disorder due to alcohol abuse
		191882002	Nondependent alcohol abuse, continuous
		15167005	Alcohol abuse
		284591009	Persistent alcohol abuse

		228310006	Drinks in morning to get rid of hangover
		41083005	Alcohol-induced sleep disorder
		191884001	Nondependent alcohol abuse in remission
		86325007	Non megaloblastic anaemia due to alcoholism
		191805002	Episodic acute alcoholic intoxication in alcoholism
		191802004	Acute alcoholic intoxication in alcoholism
		7200002	Alcoholism
		235955000	Drug-induced chronic pancreatitis
		66590003	Alcohol dependence
		713583005	Mild alcohol dependence
		2403008	Psychoactive substance dependence
		25702006	Alcohol intoxication
		7200002	Alcoholism
		308742005	Alcohol withdrawal-induced convulsion
		713862009	Severe alcohol dependence
		10755041000119100	Alcohol dependence in childbirth
		191812006	Episodic chronic alcoholism
		2403008	Psychoactive substance dependence
		154211000119108	Chronic pancreatitis due to chronic alcoholism
		191804003	Continuous acute alcoholic intoxication in alcoholism
		191813001	Chronic alcoholism in remission
		7200002	Alcoholism
		87810006	Megaloblastic anaemia due to alcoholism
		66590003	Alcohol dependence
		231467000	Absinthe addiction
		300939009	Abstinent alcoholic
		191811004	Continuous chronic alcoholism
		714829008	Moderate alcohol dependence
		235952002	Chronic pancreatitis due to acute alcohol intoxication
		97571000119109	Thrombocytopenia co-occurrent and due to alcoholism
		66590003	Alcohol dependence
		10741871000119101	Alcohol dependence in pregnancy
		288041000119101	Perceptual disturbance due to alcohol withdrawal

		191480000	Alcohol withdrawal syndrome
		85561006	Uncomplicated alcohol withdrawal
		191480000	Alcohol withdrawal syndrome
		8635005	Alcohol withdrawal delirium
		79578000	Alcohol paranoia
		61144001	Alcohol-induced psychotic disorder with delusions
		191476005	Alcohol withdrawal hallucinosis
		7052005	Alcohol hallucinosis
		42344001	Alcohol-induced psychosis
		191480000	Alcohol withdrawal syndrome
		191478006	Alcoholic paranoia
		191471000	Korsakov's alcoholic psychosis with peripheral neuritis
		73097000	Alcohol amnestic disorder
		192811002	Alcoholic encephalopathy
		69482004	Korsakoff's psychosis
		42344001	Alcohol-induced psychosis
		281004	Dementia associated with alcoholism
		231463001	^Alcoholic dementia NOS (disorder)
		191475009	Chronic alcoholic brain syndrome
		78524005	Alcohol-induced sexual dysfunction
		34938008	Alcohol-induced anxiety disorder
		228353006	Reverse tolerance to alcohol
		228351008	Physical tolerance to alcohol
		228350009	Behavioural tolerance to alcohol
		53936005	Alcohol-induced mood disorder
		228323004	Drinking bout
		29212009	Alcohol-induced organic mental disorder
		228322009	Drinking episode
		192206005	^Mental and behavioral disorders due to use of alcohol (disorder)
		192207001	^Mental and behavioral disorders due to use of alcohol: acute intoxication (disorder)
		192208006	^Mental and behavioral disorders due to use of alcohol: harmful use (disorder)
		192209003	^Mental and behavioural disorders due to use of alcohol: dependence syndrome) or (chronic alcoholism [& (addiction) or (dipsomania)]) (disorder)

		192210008	^Mental and behavioral disorders due to use of alcohol: withdrawal state (disorder)
		192211007	^Mental and behavioral disorders due to use of alcohol: withdrawal state with delirium (disorder)
		192212000	^Mental and behavioural disorders due to use of alcohol: psychotic disorder (& [hallucinosis] or [jealousy] or [paranoia] or [psychosis NOS]
		192213005	^Mental and behavioral disorders due to use of alcohol: amnesic syndrome (disorder)
		192214004	^Mental and behavioural disorders due to use of alcohol: residual and late-onset psychotic disorder) or (chronic alcoholic brain syndrome [& dementia NOS]
		192215003	^Mental and behavioral disorders due to use of alcohol: other mental and behavioral disorders (disorder)
		268639004	^Chronic alcoholism (disorder)
		268683008	^Mental and behavioral disorders due to use of alcohol: dependence syndrome (disorder)
		268684002	^Mental and behavioral disorders due to use of alcohol: psychotic disorder (disorder)
		304606004	^Ethanol abuse (finding)
		268685001	^Mental and behavioral disorders due to use of alcohol: residual and late-onset psychotic disorder (disorder)
		192216002	^Mental and behavioral disorders due to use of alcohol: unspecified mental and behavioral disorder (disorder)
G31.2	303	192811002	Alcoholic encephalopathy
		133301000119102	Degenerative brain disorder due to alcohol
		300992002	Alcohol-induced cerebellar ataxia
		361272001	Cerebellar ataxia due to alcoholism
		135761000119101	Cerebral degeneration due to alcoholism
		230353003	Morel laminar sclerosis
		361273006	Alcoholic cerebellar degeneration
G62.1	357.5	192811002	Alcoholic encephalopathy

		69482004	Korsakoff's psychosis
		191471000	Korsakov's alcoholic psychosis with peripheral neuritis
		7916009	Alcoholic polyneuropathy
		191472007	#Wernicke-Korsakov syndrome (disorder)
G72.1	*No alcohol-specific code available*	19303008	Alcohol myopathy
I42.6	425.5	83521008	Dilated cardiomyopathy caused by alcohol
K29.2	535.3	2043009	Alcoholic gastritis
		40241000119109	Gastric haemorrhage due to alcoholic gastritis
K70.0	571.0	41309000	Alcoholic liver damage
K70.1	571.1	50325005	Alcoholic fatty liver
K70.2	571.2	235875008	Alcoholic hepatitis
K70.3	571.3	9953008	Acute alcoholic liver disease
K70.4		1085021000119106	Hepatic ascites due to chronic alcoholic hepatitis
K70.9		1082611000119101	Ascites due to alcoholic hepatitis
		41309000	Alcoholic liver damage
		307757001	Chronic alcoholic hepatitis
		235880004	Alcoholic fibrosis and sclerosis of liver
		420054005	Alcoholic cirrhosis
		309783001	Oesophageal varices in alcoholic cirrhosis of the liver
		1082601000119104	Ascites due to alcoholic cirrhosis
		235881000	Alcoholic hepatic failure
		1082621000119108	Hepatic coma due to alcoholic liver failure
		713370005	Acute on chronic alcoholic liver disease
		713181003	Chronic alcoholic liver disease
K85.2	*No alcohol-specific code available*	235942001	Alcohol-induced acute pancreatitis
		445507008	Alcohol-induced pancreatitis
K86.0	*No alcohol-specific code available*	235952002	Chronic pancreatitis due to acute alcohol intoxication
		154211000119108	Chronic pancreatitis due to chronic alcoholism
O35.4	*No alcohol-specific code available*	199551008	Maternal care for (suspected) damage to fetus from alcohol

P04.3	760.71	36558000	Fetal or neonatal effect of alcohol transmitted via placenta and/or breast milk
		268796000	Fetal or neonatal effect of placental or breast transfer of alcohol
		698321001	Neonatal effect of alcohol transmitted via breast milk
		205791004	Fetal or neonatal effect of maternal use of alcohol
		609438005	Fetal or neonatal effect of maternal alcohol addiction
Q86.0	Alcohol affecting fetus or newborn via placenta or breast milk	609437000	Fetal Alcohol Spectrum Disorder
		205788004	Fetal alcohol syndrome
		205791004	Fetal or neonatal effect of maternal use of alcohol
		36558000	Fetal or neonatal effect of alcohol transmitted via placenta and/or breast milk
R78.0	790.3	442766007	Alcohol in blood specimen above reference range
		442669008	Ethanol in blood specimen above legal threshold for operating vehicle
		441685000	Ethanol in blood specimen above reference range
		274776000	Finding of alcohol in blood
		207273009	^Alcohol blood level excessive (situation)
		160592001	Alcohol intake above recommended sensible limits
T51	980	216633005	Accidental poisoning by alcoholic beverage
		216635003	Accidental poisoning by denatured alcohol
		95906008	Drug interaction with alcohol
		287166006	Accidental poisoning with ethyl alcohol
		442764005	Poisoning by benzene
		82782008	Alcohol poisoning
		212807002	Grain alcohol causing toxic effect
		216636002	Accidental poisoning by methylated spirit
		315226008	Pain in lymph nodes after alcohol consumption
		89507002	Toxic effect of denatured alcohol
		25966003	Metabolic acidosis due to methanol
		212809004	Methyl alcohol causing toxic effect

For peer review only

		216640006	Accidental poisoning by methanol
		212813006	Toxic effect of isopropyl alcohol
		6749002	Toxic effect of propyl alcohol
		216645001	Accidental poisoning by isopropyl alcohol
		216648004	Accidental poisoning by rubbing alcohol substitute
		4953006	Toxic effect of butyl alcohol
		6749002	Toxic effect of propyl alcohol
		57346004	Toxic effect of fusel oil
		216651006	Accidental poisoning by fusel oil
		87460008	Toxic effect of amyl alcohol
		67426006	Toxic effect of alcohol
		82047000	Diarrhoea due to alcohol intake
		314539001	Alcohol related optic neuropathy
		269765000	Accidental poisoning by alcohol
		212816003	^Rubbing alcohol causing toxic effect (disorder)
		212817007	^Isopropyl alcohol causing toxic effect NOS (disorder)
		212818002	^Fusel oil causing toxic effect NOS (disorder)
		212819005	^Other alcohol causing toxic effect (disorder)
		212820004	^Alcohol causing toxic effect NOS (disorder)
		213687005	^Toxic effect of other alcohols (disorder)
		212815004	^Isopropanol causing toxic effect (disorder)
		212814000	^Dimethyl carbinol causing toxic effect (disorder)
		212811008	^Wood alcohol causing toxic effect (disorder)
		212808007	^Ethyl alcohol causing toxic effect NOS (disorder)
		212806006	^Ethyl alcohol causing toxic effect (disorder)
		699208000	Thrombocytopenia due to alcohol
X45	E860	212813006	Toxic effect of isopropyl alcohol
		216640006	Accidental poisoning by methanol
		82782008	Alcohol poisoning
		216635003	Accidental poisoning by denatured alcohol
		6749002	Toxic effect of propyl alcohol
		212809004	Methyl alcohol causing toxic effect
		242263000	Accidental exposure to alcohol

For peer review only

		216633005	Accidental poisoning by alcoholic beverage
		212813006	Toxic effect of isopropyl alcohol
		242265007	Accidental exposure to ethanol
		278363000	Alcoholic macrocytosis
		442764005	Poisoning by benzene
		4953006	Toxic effect of butyl alcohol
		287166006	Accidental poisoning with ethyl alcohol
		699208000	Thrombocytopenia due to alcohol
		212809004	Methyl alcohol causing toxic effect
		67426006	Toxic effect of alcohol
		6749002	Toxic effect of propyl alcohol
		216645001	Accidental poisoning by isopropyl alcohol
		89507002	Toxic effect of denatured alcohol
		212807002	Grain alcohol causing toxic effect
		216648004	Accidental poisoning by rubbing alcohol substitute
		216651006	Accidental poisoning by fusel oil
		216636002	Accidental poisoning by methylated spirit
		89507002	Toxic effect of denatured alcohol
		442764005	Poisoning by benzene
		87460008	Toxic effect of amyl alcohol
		269765000	Accidental poisoning by alcohol
		57346004	Toxic effect of fusel oil
		221843007	^Accidental poisoning by and exposure to alcohol, occurrence at home (event)
		221844001	^Accidental poisoning by and exposure to alcohol, occurrence in residential institution (event)
		221845000	^Accidental poisoning by and exposure to alcohol, occurrence at school, other institution and public administrative area (event)
		221846004	^Accidental poisoning by and exposure to alcohol, occurrence at sports and athletics area (event)
		221847008	^Accidental poisoning by and exposure to alcohol, occurrence on street and highway (event)
		221848003	^Accidental poisoning by and exposure to alcohol, occurrence at trade and service area (event)

		221849006	^Accidental poisoning by and exposure to alcohol, occurrence at industrial and construction area (event)
		221850006	^Accidental poisoning by and exposure to alcohol, occurrence on farm (event)
		221851005	^Accidental poisoning by and exposure to alcohol, occurrence at other specified place (event)
		221852003	^Accidental poisoning by and exposure to alcohol, occurrence at unspecified place (event)
		57346004	Toxic effect of fusel oil
X65 (*note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the above codes*)	*No alcohol-specific code available*	222103001	^Intentional self-poisoning by and exposure to alcohol (event)
		222104007	^Intentional self-poisoning by and exposure to alcohol, occurrence at home (event)
		222105008	^Intentional self-poisoning by and exposure to alcohol, occurrence in residential institution (event)
		222106009	^Intentional self-poisoning by and exposure to alcohol, occurrence at school, other institution and public administrative area (event)
		222107000	^Intentional self-poisoning by and exposure to alcohol, occurrence at sports and athletics area (event)
		222108005	^Intentional self-poisoning by and exposure to alcohol, occurrence on street and highway (event)
		222110007	^Intentional self-poisoning by and exposure to alcohol, occurrence at trade and service area (event)
		222111006	^Intentional self-poisoning by and exposure to alcohol, occurrence at industrial and construction area (event)

For peer review only

		222112004	^Intentional self-poisoning by and exposure to alcohol, occurrence on farm (event)
		222113009	^Intentional self-poisoning by and exposure to alcohol, occurrence at other specified place (event)
		222114003	^Intentional self-poisoning by and exposure to alcohol, occurrence at unspecified place (event)
		312963001	Methanol retinopathy
Y15	E860	222702003	^Poisoning by and exposure to alcohol, undetermined intent (event)
	980	222703008	^Poisoning by and exposure to alcohol, occurrence at home, undetermined intent (event)
		222704002	^Poisoning by and exposure to alcohol, occurrence in residential institution, undetermined intent (event)
		222705001	^Poisoning by and exposure to alcohol, occurrence at school, other institution and public administrative area, undetermined intent (event)
		222706000	^Poisoning by and exposure to alcohol, occurrence at sports and athletics area, undetermined intent (event)
		222707009	^Poisoning by and exposure to alcohol, occurrence on street and highway, undetermined intent (event)
		222708004	^Poisoning by and exposure to alcohol, occurrence at trade and service area, undetermined intent (event)
		222709007	^Poisoning by and exposure to alcohol, occurrence at industrial and construction area, undetermined intent (event)
		222710002	^Poisoning by and exposure to alcohol, occurrence on farm, undetermined intent (event)
		222711003	^Poisoning by and exposure to alcohol, occurrence at other specified place, undetermined intent (event)

		222713000	^Poisoning by and exposure to alcohol, occurrence at unspecified place, undetermined intent (event)
		274776000	Finding of alcohol in blood
Y90 (*note that no generalised mapping matches were available with SNO-MED although lexical matching suggest use of the 'Finding of alcohol in blood' code*)	*No alcohol-specific code available*	223333005	^Evidence of alcohol involvement determined by blood alcohol level (navigational concept)
		223334004	^Evidence of alcohol involvement determined by blood alcohol level of less than 20 mg/100 ml (navigational concept)
		223335003	^Evidence of alcohol involvement determined by blood alcohol level of 20-39 mg/100 ml (navigational concept)
		223336002	^Evidence of alcohol involvement determined by blood alcohol level of 40-59 mg/100 ml (navigational concept)
		223337006	^Evidence of alcohol involvement determined by blood alcohol level of 60-79 mg/100 ml (navigational concept)
		223338001	^Evidence of alcohol involvement determined by blood alcohol level of 80-99 mg/100 ml (navigational concept)
		223339009	^Evidence of alcohol involvement determined by blood alcohol level of 100-119 mg/100 ml (navigational concept)
		223340006	^Evidence of alcohol involvement determined by blood alcohol level of 120-199 mg/100 ml (navigational concept)
		223341005	^Evidence of alcohol involvement determined by blood alcohol level

For peer review only

			of 200-239 mg/100 ml (navigational concept)
		223342003	^Evidence of alcohol involvement determined by blood alcohol level of 240 mg/100 ml or more (navigational concept)
		223343008	^Evidence of alcohol involvement determined by presence of alcohol in blood, level not specified (navigational concept)
		25702006	Alcohol intoxication
Y91 (*note that generalised mapping matches were only available for Y91.1 and Y91.9 with SNO-MED although lexical matching suggest use of 'Alcohol intoxication' code*)	*No alcohol-specific code available*	230800004	Alcoholic coma
		82047000	Diarrhoea due to alcohol intake
		361267005	Alcohol-related fit
		223344002	^Evidence of alcohol involvement determined by level of intoxication (navigational concept)
		223345001	^Evidence of alcohol involvement determined by level of intoxication, mild alcohol intoxication (navigational concept)
		223346000	^Evidence of alcohol involvement determined by level of intoxication, moderate alcohol intoxication (navigational concept)
		223347009	^Evidence of alcohol involvement determined by level of intoxication, severe alcohol intoxication (navigational concept)
		223348004	^Evidence of alcohol involvement determined by level of intoxication, very severe alcohol intoxication (navigational concept)

		223349007	^Evidence of alcohol involvement determined by level of intoxication, alcohol involvement, not otherwise specified (navigational concept)

For peer review only

References

1. Toson B, Harvey LA, Close JC. New ICD-10 version of the Multipurpose Australian Comorbidity Scoring System outperformed Charlson and Elixhauser comorbidities in an older population. *J Clin Epidemiol* 2016;79:62-69. doi: 10.1016/j.jclinepi.2016.04.004 [published Online First: 2016/04/23]
2. Preen DB, Holman CD, Spilsbury K, et al. Length of comorbidity lookback period affected regression model performance of administrative health data. *J Clin Epidemiol* 2006;59(9):940-6. doi: 10.1016/j.jclinepi.2005.12.013 [published Online First: 2006/08/10]
3. NSW. IaPC. Statutory Guidelines on Research: Health Records and Information Privacy Act 2002 (NSW). 2002
4. Chikritzhs TC, P.; Stockwell, T.; Donath, S.; Ngo, H.; Young, D. and Mathews, S. Australian alcohol indicators, 1990-2001: Patterns of alcohol use and related harms for Australian states and territories. : Curtin University of Technology: National Drug Research Institute, 2003.

For peer review only