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Australian Suicide Prevention using Health-Linked Data (ASHLi): The study protocol

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Australian Suicide Prevention using Health-Linked Data (ASHLi):

The study protocol

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ABSTRACT

Introduction: In Australia suicide is the leading cause of death for people aged 15 - 44. Health professionals deliver most of our key suicide prevention strategies via health services, but other efficacious population-level strategies include means restriction and public awareness campaigns. Currently, we have no population-level data allowing us to determine which individuals, in what parts of Australia, are likely to utilise our most promising interventions delivered by health services. The aims of this study are to describe 1) health service utilisation rates in the year prior to death by suicide, and how this varies by individual case characteristics; 2) prescribed medicines use in the year prior to death by suicide, medicines used in suicide by poisoning and how this varies by individual case characteristics.

Methods and analysis: This is a population-based case series study of all suicide cases in Australia identified through the National Coronial Information System (NCIS) from 2013 - 2019. Cases will be linked to administrative claims data detailing health service use and medicines dispensed in the year before death. We will also obtain findings from the coronial enquiry, including toxicology. Descriptive statistics will be produced to characterise health service and prescribed medicine use and how utilisation varies by age, sex, method of death and socio-economic status. We will explore the geographical variability of health service and medicine use, highlighting regions in Australia associated with more limited access.

Ethics and dissemination: This project involves use of sensitive and confidential data. Data will be linked using a third-party privacy preserving protocol meaning that investigators will not have access to identifiable information once the data has been linked. Statistical analyses will be carried out in a secure environment. Findings will be published in peer-reviewed journals, presented at conferences and communicated to regulatory authorities, clinicians and policy makers.

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8 **Keywords:** Retrospective, Suicides, Medicines, Administrative data, Data linkage, mental
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10 health, health service utilisation, epidemiology
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STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is a population-based case series study of all suicide cases in Australia from 2013 – 2019.
- Coronial data will be linked to individual dispensing records for prescribed medicines, to create a comprehensive view of medicine access at time of death.
- By measuring geographical variability of health service use across the cohort, we will highlight regions in Australia with with reduced access to these important avenues for suicide prevention
- All cases in the study have died from suicide, therefore risk of suicide can not be established.

INTRODUCTION

Background

Suicide prevention is a worldwide public health priority (1). In Australia suicide is the leading cause of years of potential life lost, the leading cause of death for people aged between 15 and 44, and suicide rates have remained largely unchanged over the past decade (2).

The most effective suicide prevention strategies delivered by health services in Australia includes training general practitioners (GPs) to identify and support people in distress, similar training for other health personnel who are likely to encounter individuals at risk ('gatekeepers'), and psychosocial treatments (3). However, we do not have robust estimates of the proportion of people that will visit a GP, have contact with gatekeepers or receive psychosocial treatments before they die from suicide. In order to best estimate the scope of these promising interventions and, accordingly, reinforce or redirect our efforts, we need to know what health services were, and were not, utilised by people in Australia in the period prior to suicide.

Psychotropic medicines have complex modifying effects on the risk of suicide, that may change substantially with age, indication, agent and duration (4). These medicines are also some of the most common substances used in suicide by poisoning (5). Currently, however, we do not know what medicines have been prescribed to people who die of suicide, and what proportion use their prescribed medicines for self-poisoning. This is key information for prescribers and could influence future means-restriction activities.

The Australian Suicide Prevention using Health Linked Data (ASHLi) project is a population-based case series study. The overarching aims are to describe and characterise the following for all suicides in Australia between 2013 and 2019:

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3 1) health service utilisation rates (both general and mental health) in the year prior to death by
4 suicide, and how this varies by individual case characteristics; and 2) prescribed medicines
5 use in the year prior to death by suicide, medicines used in suicide by poisoning and how this
6 varies by individual case characteristics.
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15 ***Summary of existing literature***

16 *Healthcare utilisation prior to suicide using administrative claims data*

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18 The most recent review of healthcare utilisation prior to suicide (6) incorporated 13 population-
19 based studies using administrative claims and mortality data from six jurisdictions (USA,
20 Denmark, Taiwan, Republic of Korea, Canada, Sweden). The study found that contact with
21 primary healthcare professionals in the month before suicide ranged between 50% (USA
22 between 2000–2010) and 73% (Taiwan in 2006 and Canada 1992–2000). In the 12 months
23 preceding suicide, contact with a primary health professional ranged between 80% (Taiwan,
24 2001–2004) and 92% (Canada 1998–2011). The ranges were considerably lower when the
25 focus was on mental health contacts alone: from 7% (Sweden 1991–2003) to 30% (Canada,
26 1998–2011) in the month before suicide. In the 12 months prior to death mental health contact
27 ranged from 21% (UK, 1996–2005) to 25% (Sweden, 1991–2003). Therefore, estimates of
28 healthcare contact prior to suicide are highly variable which may be partly due to differences
29 in healthcare systems, study methodology and data quality. Importantly, there are pronounced
30 within-country differences in healthcare contact based on characteristics such as sex, age (6)
31 and race/ethnicity (7, 8).
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54 *Medicine use prior to suicide using administrative claims data and toxicology findings at time* 55 *of death* 56 57 58 59 60

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3 Most analyses of medicine linked data have been population-based cohort studies focused on
4 examining suicide risk amongst all users of individual drug classes within a population. We
5 identified only one retrospective study linking coroner records with person-level dispensing
6 data (9). This Northern Ireland study investigated the odds of suicide associated with
7 prescription of mental health and pain medicines, compared to living controls from the general
8 population. Use of both mental health and pain medicines were associated with higher odds of
9 suicide; an unsurprising finding given both mental health problems and pain conditions
10 increase the risk of suicide (10, 11). This study also uncovered that recent prescription of these
11 medicines (i.e., in the 3 months preceding death) was associated with the highest risk of suicide,
12 showing that pharmaceutical claims may have the ability to identify the emergence of mental
13 health symptoms in the lead up to suicide.
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31 Other information about prior medicine use in people that have died from suicide comes from
32 toxicology studies that investigate medicines detected at autopsy. A study investigating the
33 relative toxicity of a number of antidepressant medicines used in overdose reported wide
34 differences in toxicity between classes and recommended caution in prescribing particular
35 medicines to high-risk patients (12). A Canadian study reported that opioids, sedatives, tricyclic
36 antidepressants and over-the-counter medicines were the most frequent substances detected in
37 overdose from coroner's toxicology reports, again with authors advising caution in prescribing
38 and careful follow-up (5).
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53 Autopsy studies to date have yielded important information for means restriction and clinical
54 practice, yet interpreting medicine utilisation in autopsy-based analyses is subject to numerous
55 limitations—it is unknown: (i) what medicines detected at autopsy were prescribed to the
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3 individual; or (ii) whether medicines not detected are because the individual was not prescribed
4 the medicine; prescribed the medicine but not adherent at time of death; the samples collected
5 were insufficient for toxicological analysis; or analyses conducted did not have the range or
6 sensitivity to detect all therapeutic drug concentrations.
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15 *Healthcare and medicine use in the general Australian population*

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17 In Australia, a wide range of health services are subsidised through the Medicare Benefits
18 Scheme (MBS). Under the MBS all Australian citizens and residents receive subsidised
19 healthcare for out-of-hospital medical services and are guaranteed free treatment in public
20 hospitals. Using the MBS, the Australian Institute of Health and Welfare (AIHW) reported that
21 88% of the Australian population visited a general practitioner (GP) in 2017–2018, but that the
22 rate of use varied considerably depending on where people lived (13). Data show that people
23 living in remote areas have poorer access to, and use of, health services compared to people
24 living in major cities (14). In terms of mental health treatment, about 10% of the population
25 received MBS-subsidised services in 2017–18; this rate was higher in females (12.2%) than
26 males (8.3%) and people aged 35–44 accessed mental health services the most (13.8% of
27 people in this age group) (15).
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45 The Pharmaceutical Benefits Scheme (PBS) was established to subsidise a wide range of
46 prescription medicines for all Australian citizens and residents. Using the PBS data collection
47 the AIHW determined that 16.8% of the Australian population received prescriptions for
48 mental health related medicines in 2017–2018. Females had a higher proportion of mental
49 health related prescriptions compared to males (20% vs. 13.6%). Antidepressants were the most
50 common mental health medicine prescribed, followed by anxiolytics, sedatives and
51 antipsychotics (15).
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METHODS AND ANALYSIS

Design

ASHLi is a population-based case series study, which will detail the health service and medicine history of all suicides identified through the National Coronial Information System (NCIS) that occurred in Australian residents on/after 1 July 2013. All suicides will be linked to health service and medicine use that occurred in the year prior to death.

Case definition

The cases in our study are all deaths recorded by the NCIS as intentional or undetermined intent that occurred on/after 1st July 2013 until the 10th October 2019 (date of data extraction) across all Australian jurisdictions according to the following inclusion criteria:

- Case closed by coroner at the time of data extraction;
- Manner of death determined by the coroner to be intentional self-harm or undetermined intent.

The number of cases for each year are presented in Table 2.

Table 2: Number of suicide cases meeting study inclusion criteria per year, as identified by the NCIS access liaison officer

Year of death	Number of cases to be linked - AUSTRALIA	Number of cases to be linked – NSW	Percentage of all NCIS cases closed by coroner ^b
2013 ^a	1272	317	96.5
2014	2760	753	95.0
2015	2893	760	93.0
2016	2693	692	92.9
2017	2823	829	75.6
2018	1813	585	50.8
2019	285	128	19.9
Total	14639	4064	

^aOnly cases after 1st July in 2013 were used

^bAt time of data extraction

Cases will also be confirmed using information from the National Death Index (NDI). Any suicide cases from the NCIS that are not coded as suicide in the NDI will still be treated as a case; however, the level of agreement between the two data sources will be reported. Only cases that are successfully linked to their PBS/MBS (for all cases) and NSW Health records (for NSW cases) will be included in further analyses.

Data sources

Table 1 lists all the datasets that will be linked in ASHLi.

The National Coronial Information System (NCIS) captures Australia's coronial information for all deaths notified to a coroner since 2000, it is managed by the Victorian Department of Justice and Community Safety. All deaths that are intentional, accidental or of undetermined intent are reviewed by a coroner and hence suicides are well-captured. The NCIS carries detailed information, including demographics, autopsy and toxicology findings and details surrounding death (including method of death). Cases for which suicide is not a clear cause of death can be supported with information from the National Death Index (NDI), a national dataset of all causes of death held by the AIHW.

Australia-wide administrative data

Australia maintains a publicly funded, universal healthcare system entitling all citizens and permanent residents to subsidised medicines through the PBS. The PBS reimburses community pharmacies and private hospitals for PBS-listed medicines (16). The PBS data captures approximately 93% of prescription medicine use in Australia (17). The PBS does not subsidise medicines sold over-the-counter, complementary and alternative medicines, private

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3 prescriptions, medicines dispensed within public hospitals to inpatients, or opioid maintenance
4 treatments (methadone and buprenorphine) and, therefore, these medicines do not appear in the
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6 PBS collection. The MBS is Australia's government-funded healthcare subsidies scheme. The
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8 scheme subsidises a wide range of both public and private medical services including
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10 consultation fees for doctors and specialists, clinical psychology, diagnostic tests and
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12 examinations and most surgical and therapeutic procedures.
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19 *NSW administrative data*

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21 The NSW Emergency Department Data Collection (EDDC) collects data on presentations to
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23 emergency departments of public hospitals in NSW. The NSW Admitted Patient Data
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25 Collection (APDC) records all inpatient separations (discharges, transfers and deaths) from all
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27 public, private, psychiatric and repatriation hospitals in NSW, as well as public multi-purpose
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29 services, private day procedure centres and public nursing homes. The NSW Mental Health
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31 Ambulatory Data Collection (MH-AMB) includes information in relation to mental health day
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33 programs, psychiatric outpatients and outreach services (e.g. home visits). It also includes
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35 information regarding care provided by hospital based consultation liaison services to admitted
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37 patients in non-psychiatric and hospital emergency settings; care provided by community
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39 workers and clients in staffed community residential settings, mental health promotion and
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41 prevention services.
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Table 1: Data sources to be linked [in ASHLi](#)

Data Set	Data Description	Data Provider	Geographical Coverage	Coverage in years
Coronial Cases and Information	National repository containing data on deaths reported to a coroner in Australia and New Zealand. Register of all suicide deaths in Australia.	National Coronial Information System (NCIS)	Australia-wide	1 July 2013–10 October 2019
Medicines dispensing claims	Australia's Pharmaceutical Benefits Scheme (PBS) is a national drug subsidy program for approved prescription medication and captures dispensing of all PBS-approved medicines in Australia. Data will be extracted for each individual during the exposure period.	Australian Institute of Health and Welfare (AIHW)	Australia-wide	1 July 2012–latest available before death
Health service records	Medicare Benefits Scheme (MBS) is a listing of the Medicare services subsidised by the Australian government including any health care contacts, and any items used that are listed under the Mental Health Plan.	AIHW	Australia-wide	1 July 2012–latest available before death
Death records	The National Death Index (NDI) is a database developed and maintained by the Australian Institute of Health and Welfare in Canberra. The database is a listing of all deaths that have occurred in Australia since 1980.	AIHW	Australia-wide	1 July 2013–latest available
Admitted Patient Data	Database that contains records of all inpatient separations (discharges, transfers and deaths) from all public, private, psychiatric and repatriation hospitals in NSW.	NSW Health Admitted Patient Data Collection (APDC)	NSW	1 July 2012–latest available
Ambulatory Mental Health Data	The MH-AMB collection is dedicated to the assessment, treatment, rehabilitation or care of non-admitted patients. It may include mental health day programs, psychiatric outpatients and outreach services (e.g., home visits). The	NSW Health Data Ambulatory Mental Health Data (MH-AMB)	NSW	1 July 2012–latest available

	data records 'contacts' (as opposed to 'episodes of care') by clinicians to a patient.			
Emergency Department Data Collection	The EDDC provides information about patient presentations to the emergency departments of public hospitals in New South Wales. By 2016 the EDDC captured 100% of public hospitals in NSW, prior to this time the number of contributing hospitals steadily increased from 90/150 in 2010.	NSW Health Data Emergency Department Data Collection (EDDC)	NSW	1 July 2012–latest available

Measurements

Data from coroner reports

The information from the NCIS that will be extracted for each suicide is listed in Table 3. Data extraction from the toxicology, police and autopsy reports will be completed by research assistants and students. Study investigators (KC, RC and JP) will provide training in the data extraction processes and will be available to address any questions and reach consensus regarding coding for more complex cases.

Table 3: Information collected from the NCIS for each included suicide case

Variable(s)	Description
De-identified demographic variables	Date of death, age at time of death, sex, marital status, employment status, country of birth, years in country
ICD-10 Cause of Death	As determined during the Australian Bureau of Statistics mortality coding process
Medical Cause of Death	As determined by the coroner
Incident date and time	When the incident that caused death occurred
Mechanism and Object of Injury	Mechanism by which death occurred/objects involved in death
Geocoding result	Statistical Area 3 (SA3) and 4 (SA4) of residential address at time of death. Statistical areas are provided by the Australian Statistical Geography Standard for use by the Australian Bureau of statistics (ABS) and others to analyse spatially integrated information.

Toxicology report	We will document all drugs listed in each report, including their concentrations, the sample sites analysed, level of decomposition of the body and any other limitations to the toxicological testing.
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Data from PBS and MBS

The data from the PBS that will be linked to each case includes date the medicine was prescribed and date the medicine was dispensed, medicine name, form, strength, number of prescriptions dispensed, and speciality of the prescriber. The data from the MBS that will be linked to each case includes date and type of health service accessed.

Data from the APDC, EDDC and MH-AMB

Data from the APDC and EDDC that will be linked to each case includes dates of episodes of care, diagnosis codes associated with episode of care, and mode of arrival and separation. Additionally, the triage category assigned to ED visits will be linked. Data from the MH-AMB that will be linked to each case includes dates associated with each contact, mental health diagnoses associated with contact and type of service.

Data linkage

The data linkage in this study will adhere to the separation principle for data linkage. Identifying information is supplied to the data linkage staff by the NCIS data custodians. Once the relevant linkage processes have been performed, de-identified data will then be available to researchers for analyses.

The separation principle will be maintained throughout the data linkage process as follows:

1. The researchers will not have access to identifying information once they have received the linked data
2. Only approved research personnel will have access to the linked data and perform data analysis

Planned data analysis

Aim 1: To describe health service utilisation rates (both general and mental health) in the year prior to death by suicide, and how this varies by individual case characteristics

Using descriptive statistics, we will comprehensively describe and characterise the healthcare utilisation in the NSW cases within our sample in the year preceding suicide death by using the NSW Health data supplied by NSW Health and the MBS data supplied by AIHW. Categorical data will be described using frequencies and percentages.

Generalised linear models will be used to determine predictors of healthcare contacts before death. The dependent healthcare utilisation variables we will investigate include ambulatory mental health contact, acute mental health contact and no mental health contact. Independent variables and covariates examined will include: age, sex, SES, and class of medication prescribed. Odds ratios with 95% CIs will be reported for each predictor.

Spatial maps of age and sex standardised suicide rate according to the presence or absence of healthcare within a month of death will be generated for Australia using SA3 regions of residence at time of death.

Aim 2: To describe prescribed medicines use in the year prior to death by suicide, medicines used in suicide by poisoning and how this varies by individual case characteristics.

Using descriptive statistics, we will comprehensively describe and characterise the dispensed prescription medication use in our sample in the year preceding suicide death using the PBS data supplied by AIHW. Categorical data will be described using frequencies and percentages.

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3 For the prescription medicines that are not used to treat mental illness, such as antibiotics, ACE
4 inhibitors, gabapentinoids or isotretinoin, we will conduct disproportionality analysis (18) to determine
5 whether the rate of use in suicide cases is above that reported in the Australian population using other
6 available sources of national representative PBS dispensing data.
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13 Spatial maps of suicide according to the presence or absence of medicine within a month of death will
14 be generated for Australia using SA3 regions of residence at time of death.
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18 19 20 **ETHICS AND FUNDING**

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22 This study has been approved by the following data custodians and ethics committees: 1) the National
23 Coronial Information System (NCIS) (REF: M0400), 2) the Justice Department Human Research
24 Ethics Committee (REF: CF/17/23250), 3) the Western Australian Coroners Court (REF: EC 14/18
25 M0400); 4) the Australian Institute of Health and Welfare (REF: EO2017/4/366), 5) the Department
26 of Health; and 6) NSW Population & Health Services Research Ethics Committee
27 (REF:2017/HRE1204). This study has received funding from the National Health and Medical
28 Research Council (NHMRC) (REF: APP1157757).
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40 41 **LIMITATIONS**

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43 There will be an underascertainment of health service use for the cases in our study. MBS data
44 does not include enough detail on mental health services provided in hospital to allow the
45 identification of hospitalised self-harm and other emergency psychiatric presentations. Health service
46 data collected by State governments includes detailed data on hospitalisations and non-hospital
47 mental health services, therefore is not constrained by the same limitations. Therefore we will
48 supplement the MBS mental health data using NSW state data collections. Initially, we have chosen
49 to use this approach in NSW given its large population (around one third of Australians). By
50 comparing the estimates we receive from MBS alone to MBS plus NSW state collections we will be
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3 able to estimate the degree of underascertainment in other states in Australia and report on this
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5 accordingly.
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8 Medicine use will also be limited by under-ascertainment. It is possible to obtain scripts outside the
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10 PBS, such as private prescriptions, medicines dispensed within public hospitals to inpatients, or
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12 opioid maintenance treatments (methadone and buprenorphine) will not be captured. The study will
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14 also not capture medicines sold over-the-counter, complementary or alternative medicines.
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18 Another limitation is that all cases in the study have died from suicide, therefore risk of suicide
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20 associated with any healthcare or medicine use patterns can not be established. This study will instead
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22 highlight these patterns, so that further studies with appropriate control groups can be established.
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26 27 28 **IMPLICATIONS AND SIGNIFICANCE** 29

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31 Australia is one of the few countries in the world with an investment in data linkage infrastructure to
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33 allow a project of this scope to be achieved. This study will significantly advance knowledge of health
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35 service and medicine utilisation prior to suicide in Australia. The project outcomes will have a
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37 significant impact on suicide prevention initiatives by identifying gaps in our national suicide
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39 prevention strategy, and subsequently providing information on ways to optimise future approaches.
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46 ASHLi will result in the following central outcomes:
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- 49 1. *Identifying the reach of suicide prevention initiatives delivered via health services.*

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51 By identifying population characteristics associated with different types of health service use, this
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53 analysis will provide important information for targeting suicide initiatives. For example, if one type
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55 of service is used more commonly in younger females then reinforcing tailored programs toward this
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57 group within that service may increase efficacy of suicide prevention compared to broadly focussed
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3 interventions. Furthermore, locating where high/low service use occurs and determining when, in
4 relation to suicide, particular services are most commonly accessed, the analysis will provide specific
5 information about where and when to reinforce or redirect our current strategies.
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10 2. *Highlighting barriers to health service utilisation.*

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12 By interpreting health service use in concert with health service location we will shed light on whether
13 barriers to health service utilisation may be due to intrinsic factors (unwillingness by the individual to
14 seek help) vs. extrinsic factors (remoteness/lack of services). The former will highlight groups of
15 people for whom non-clinical forms of intervention may be the most efficacious and where they should
16 be targeted (i.e. online therapy, restricting means of suicide, public health campaigns).
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25 3. *Providing information to help target means restriction.*

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27 Means restriction is the primary mode of suicide prevention applicable to those who do not access
28 health services. Our analysis of the methods of suicide that are most commonly used in these people
29 will provide information on priority suicide methods to target, in what populations, and where.
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35 4. *Highlighting potentially harmful medicine use.*

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37 Information on medicines used in overdose will have important implications for regulatory authorities
38 and prescribers, especially when psychotropic medicine use occurs in the absence of mental health
39 service utilisation, which is against best practice recommendations. We will also provide further
40 evidence regarding concerns about pro-suicidal effects of several non-psychotropic medicines.
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47 5. *Foundational research for future studies*

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49 The rich data source created in order to achieve the aims of the current proposal will be used for many
50 further analyses by the study team. For example, with the addition of appropriate data from the general
51 population, we can zoom in on particular medicine classes of interest and conduct disproportionality
52 analysis to assess how use of medicines by our sample differs compared to the general population.
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3 **Contributors:** The Principal Investigator (KC) and NB were responsible for the conceptualisation of
4 ASHLi, KC, JP, RC, AS, NB, AP, GC, JR, SP were responsible for the protocol design. The manuscript
5 was drafted by KC and NG. All authors contributed to the final version.
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17 the manuscript.
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25 **Patient and Public Involvement Statement**

26 There were no funds or time allocated for patient and public involvement, so we were unable to
27 involve the public in the design of the study. However, we will develop a representative public
28 committee to help us develop our dissemination strategy to mental health advocacy groups and the
29 community.
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37 **Competing interests:** None
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Australian Suicide Prevention using Health-Linked Data (ASHLi): A population-based case series study

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3 Australian Suicide Prevention using Health-Linked Data (ASHLi):
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6 A population-based case series study
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ABSTRACT

Introduction: In Australia suicide is the leading cause of death for people aged 15 - 44. Health professionals deliver most of our key suicide prevention strategies via health services, but other efficacious population-level strategies include means restriction and public awareness campaigns. Currently, we have no population-level data allowing us to determine which individuals, in what parts of Australia, are likely to utilise our most promising interventions delivered by health services. The aims of this study are to describe: 1) health service utilisation rates in the year prior to death by suicide, and how this varies by individual case characteristics; 2) prescribed medicines use in the year prior to death by suicide, medicines used in suicide by poisoning and how this varies by individual case characteristics.

Methods and analysis: This is a population-based case series study of all suicide cases in Australia identified through the National Coronial Information System (NCIS) from 2013 - 2019. Cases will be linked to administrative claims data detailing health service use and medicines dispensed in the year before death. We will also obtain findings from the coronial enquiry, including toxicology. Descriptive statistics will be produced to characterise health service and prescribed medicine use and how utilisation varies by age, sex, method of death and socio-economic status. We will explore the geographical variability of health service and medicine use, highlighting regions in Australia associated with more limited access.

Ethics and dissemination: This project involves use of sensitive and confidential data. Data will be linked using a third-party privacy preserving protocol meaning that investigators will not have access to identifiable information once the data has been linked. Statistical analyses will be carried out in a secure environment. This study has been approved by the following ethics committees: 1) the Justice Department Human Research Ethics Committee (REF: CF/17/23250), 2) the Western Australian Coroners Court (REF: EC 14/18 M0400); 3) the Australian Institute of Health and Welfare (REF: EO2017/4/366), 4) NSW Population & Health

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3 Services Research Ethics Committee (REF:2017/HRE1204). Findings will be published in
4 peer-reviewed journals, presented at conferences and communicated to regulatory authorities,
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6 clinicians and policy makers.
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17 **Keywords:** Retrospective, Suicides, Medicines, Administrative data, Data linkage, mental
18 health, health service utilisation, epidemiology
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STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is a population-based case series study of all suicide cases in Australia from 2013 – 2019.
- Coronial data will be linked to individual dispensing records for prescribed medicines, to create a comprehensive view of medicine access at time of death.
- By measuring geographical variability of health service use across the cohort, we will highlight regions in Australia with reduced access to these important avenues for suicide prevention.
- All cases in the study have died from suicide, therefore risk of suicide can not be established.

INTRODUCTION

Background

Suicide prevention is a worldwide public health priority (1). In Australia suicide is the leading cause of years of potential life lost, the leading cause of death for people aged between 15 and 44, and suicide rates have remained largely unchanged over the past decade (2).

The most effective suicide prevention strategies delivered by health services in Australia includes training general practitioners (GPs) to identify and support people in distress, similar training for other health personnel who are likely to encounter individuals at risk ('gatekeepers') and implementation of psychosocial treatments (3). However, we do not have robust estimates of the proportion of people that will visit a GP, have contact with gatekeepers or receive psychosocial treatments before they die from suicide. In order to best estimate the scope of these promising interventions and, accordingly, reinforce or redirect our efforts, we need to know what health services were, and were not, utilised by people in Australia in the period prior to suicide.

Psychotropic medicines have complex modifying effects on the risk of suicide, that may change substantially with age, indication, agent and duration (4). These medicines are also some of the most common substances used in suicide by poisoning (5). Currently, however, we do not know what medicines have been prescribed to people who die of suicide, and what proportion use their prescribed medicines for self-poisoning. This is key information for prescribers and could influence future means-restriction activities.

The Australian Suicide Prevention using Health Linked Data (ASHLi) project is a population-based case series study. The overarching aims are to describe and characterise the following for all suicides in Australia between 2013 and 2019:

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3 1) health service utilisation rates (both general and mental health) in the year prior to death by
4 suicide, and how this varies by individual case characteristics; and 2) prescribed medicines
5 use in the year prior to death by suicide, medicines used in suicide by poisoning and how this
6 varies by individual case characteristics.
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15 ***Summary of existing literature***

16 *Healthcare utilisation prior to suicide using administrative claims data*

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19 The most recent review of healthcare utilisation prior to suicide (6) incorporated 13 population-
20 based studies using administrative claims and mortality data from six jurisdictions (USA,
21 Denmark, Taiwan, Republic of Korea, Canada, Sweden). The study found that contact with
22 primary healthcare professionals in the month before suicide ranged between 50% (USA
23 between 2000–2010) and 73% (Taiwan in 2006 and Canada 1992–2000). In the 12 months
24 preceding suicide, contact with a primary health professional ranged between 80% (Taiwan,
25 2001–2004) and 92% (Canada 1998–2011). The ranges were considerably lower when the
26 focus was on mental health contacts alone: from 7% (Sweden 1991–2003) to 30% (Canada,
27 1998–2011) in the month before suicide. In the 12 months prior to death mental health contact
28 ranged from 21% (UK, 1996–2005) to 25% (Sweden, 1991–2003). Therefore, estimates of
29 healthcare contact prior to suicide are highly variable which may be partly due to differences
30 in healthcare systems, study methodology and data quality. Importantly, there are pronounced
31 within-country differences in healthcare contact based on characteristics such as sex, age (6)
32 and race/ethnicity (7, 8).
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54 *Medicine use prior to suicide using administrative claims data and toxicology findings at time* 55 *of death* 56 57 58 59 60

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3 Most analyses of medicine linked data have been population-based cohort studies focused on
4 examining suicide risk amongst all users of individual drug classes within a population. We
5 identified only one retrospective study linking coroner records with person-level dispensing
6 data (9). This Northern Ireland study investigated the odds of suicide associated with
7 prescription of mental health and pain medicines, compared to living controls from the general
8 population. Use of both mental health and pain medicines were associated with higher odds of
9 suicide; an unsurprising finding given both mental health problems and pain conditions
10 increase the risk of suicide (10, 11). This study also uncovered that recent prescription of these
11 medicines (i.e., in the 3 months preceding death) was associated with the highest risk of suicide,
12 showing that pharmaceutical claims may have the ability to identify the emergence of mental
13 health symptoms in the lead up to suicide.
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31 Other information about prior medicine use in people that have died from suicide comes from
32 toxicology studies that investigate medicines detected at autopsy. A study investigating the
33 relative toxicity of a number of antidepressant medicines used in overdose reported wide
34 differences in toxicity between classes and recommended caution in prescribing particular
35 medicines to high-risk patients (12). A Canadian study reported that opioids, sedatives, tricyclic
36 antidepressants and over-the-counter medicines were the most frequent substances detected in
37 overdose from coroner's toxicology reports, again with authors advising caution in prescribing
38 and careful follow-up (5).
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53 Autopsy studies to date have yielded important information for means restriction and clinical
54 practice, yet interpreting medicine utilisation in autopsy-based analyses is subject to numerous
55 limitations—it is unknown: (i) what medicines detected at autopsy were prescribed to the
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3 individual; or (ii) whether medicines not detected are because the individual was not prescribed
4 the medicine; prescribed the medicine but not adherent at time of death; the samples collected
5 were insufficient for toxicological analysis; or analyses conducted did not have the range or
6 sensitivity to detect all therapeutic drug concentrations.
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15 *Healthcare and medicine use in the general Australian population*

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17 In Australia, a wide range of health services are subsidised through the Medicare Benefits
18 Scheme (MBS). Under the MBS all Australian citizens and residents receive subsidised
19 healthcare for out-of-hospital medical services and are guaranteed free treatment in public
20 hospitals. Using the MBS, the Australian Institute of Health and Welfare (AIHW) reported that
21 88% of the Australian population visited a general practitioner (GP) in 2017–2018, but that the
22 rate of use varied considerably depending on where people lived (13). Data show that people
23 living in remote areas have poorer access to, and use of, health services compared to people
24 living in major cities (14). In terms of mental health treatment, about 10% of the population
25 received MBS-subsidised services in 2017–18; this rate was higher in females (12.2%) than
26 males (8.3%) and people aged 35–44 accessed mental health services the most (13.8% of
27 people in this age group) (15).
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45 The Pharmaceutical Benefits Scheme (PBS) was established to subsidise a wide range of
46 prescription medicines for all Australian citizens and residents. Using the PBS data collection
47 the AIHW determined that 16.8% of the Australian population received prescriptions for
48 mental health related medicines in 2017–2018. Females had a higher proportion of mental
49 health related prescriptions compared to males (20% vs. 13.6%). Antidepressants were the most
50 common mental health medicine prescribed, followed by anxiolytics, sedatives and
51 antipsychotics (15).
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METHODS AND ANALYSIS

Design

ASHLi is a population-based case series study, which will detail the health service and medicine history of all suicides identified through the National Coronial Information System (NCIS) that occurred in Australian residents on/after 1 July 2013. All suicides will be linked to health service and medicine use that occurred in the year prior to death.

Case definition

The cases in our study are all deaths recorded by the NCIS as intentional or undetermined intent that occurred on/after 1st July 2013 until the 10th October 2019 (date of data extraction) across all Australian jurisdictions according to the following inclusion criteria:

- Case closed by coroner at the time of data extraction;
- Manner of death determined by the coroner to be intentional self-harm or undetermined intent.

The number of cases for each year are presented in Table 1.

Table 1: Number of suicide cases meeting study inclusion criteria per year, as identified by the NCIS access liaison officer

Year of death	Number of cases to be linked - AUSTRALIA	Number of cases to be linked – NSW	Percentage of all NCIS cases closed by coroner ^b
2013 ^a	1272	317	96.5
2014	2760	753	95.0
2015	2893	760	93.0
2016	2693	692	92.9
2017	2823	829	75.6
2018	1813	585	50.8
2019	285	128	19.9
Total	14639	4064	

^aOnly cases after 1st July in 2013 were used

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3 ^bAt time of data extraction
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8 Cases will also be confirmed using information from the National Death Index (NDI). Any
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10 suicide cases from the NCIS that are not coded as suicide in the NDI will still be treated as a
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12 case; however, the level of agreement between the two data sources will be reported. Only
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14 cases that are successfully linked to their PBS/MBS (for all cases) and NSW Health records
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16 (for NSW cases) will be included in further analyses.
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22 ***Data sources***

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24 Table 2 lists all the datasets that will be linked in ASHLi.

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26 The National Coronial Information System (NCIS) captures Australia's coronial information
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28 for all deaths notified to a coroner since 2000, it is managed by the Victorian Department of
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30 Justice and Community Safety. All deaths that are intentional, accidental or of undetermined
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32 intent are reviewed by a coroner and hence suicides are well-captured. The NCIS carries
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34 detailed information, including demographics, autopsy and toxicology findings and details
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36 surrounding death (including method of death). Cases for which suicide is not a clear cause of
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38 death can be supported with information from the National Death Index (NDI), a national
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40 dataset of all causes of death held by the AIHW.
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48 ***Australia-wide administrative data***

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50 Australia maintains a publicly funded, universal healthcare system entitling all citizens and
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52 permanent residents to subsidised medicines through the PBS. The PBS reimburses community
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54 pharmacies and private hospitals for PBS-listed medicines (16). The PBS data captures
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56 approximately 93% of prescription medicine use in Australia (17). The PBS does not subsidise
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58 medicines sold over-the-counter, complementary and alternative medicines, private
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3 prescriptions, medicines dispensed within public hospitals to inpatients, or opioid maintenance
4 treatments (methadone and buprenorphine) and, therefore, these medicines do not appear in the
5 PBS collection. The MBS is Australia's government-funded healthcare subsidies scheme. The
6 scheme subsidises a wide range of both public and private medical services including
7 consultation fees for doctors and specialists, clinical psychology, diagnostic tests and
8 examinations and most surgical and therapeutic procedures.
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10 11 12 13 14 15 16 17 18 19 *NSW administrative data*

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21 The NSW Emergency Department Data Collection (EDDC) collects data on presentations to
22 emergency departments of public hospitals in NSW. The NSW Admitted Patient Data
23 Collection (APDC) records all inpatient separations (discharges, transfers and deaths) from all
24 public, private, psychiatric and repatriation hospitals in NSW, as well as public multi-purpose
25 services, private day procedure centres and public nursing homes. The NSW Mental Health
26 Ambulatory Data Collection (MH-AMB) includes information in relation to mental health day
27 programs, psychiatric outpatients and outreach services (e.g. home visits). It also includes
28 information regarding care provided by hospital based consultation liaison services to admitted
29 patients in non-psychiatric and hospital emergency settings; care provided by community
30 workers and clients in staffed community residential settings, mental health promotion and
31 prevention services.
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49 **Patient and Public Involvement Statement**

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54 There were no funds or time allocated for patient and public involvement, so we were unable
55 to involve the public in the design of the study. However, we will develop a representative
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3 public committee to help us develop our dissemination strategy to mental health advocacy
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5 groups and the community.
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Table 2: Data sources to be linked in ASHLi

Data Set	Data Description	Data Provider	Geographical Coverage	Coverage in years
Coronial Cases and Information	National repository containing data on deaths reported to a coroner in Australia and New Zealand.	National Coronial Information System (NCIS)	Australia-wide	1 July 2013–10 October 2019
Medicines dispensing claims	Australia's Pharmaceutical Benefits Scheme (PBS) is a national drug subsidy program for approved prescription medication and captures dispensing of all PBS-approved medicines in Australia. Data will be extracted for each individual during the exposure period.	Australian Institute of Health and Welfare (AIHW)	Australia-wide	1 July 2012–latest available before death
Health service records	Medicare Benefits Scheme (MBS) is a listing of the Medicare services subsidised by the Australian government including any health care contacts, and any items used that are listed under the Mental Health Plan.	AIHW	Australia-wide	1 July 2012–latest available before death
Death records	The National Death Index (NDI) is a database developed and maintained by the Australian Institute of Health and Welfare in Canberra. The database is a listing of all deaths that have occurred in Australia since 1980.	AIHW	Australia-wide	1 July 2013–latest available
Admitted Patient Data	Database that contains records of all inpatient separations (discharges, transfers and deaths) from all public, private, psychiatric and repatriation hospitals in NSW.	NSW Health Admitted Patient Data Collection (APDC)	NSW	1 July 2012–latest available
Ambulatory Mental Health Data	The MH-AMB collection is dedicated to the assessment, treatment, rehabilitation or care of non-admitted patients. It may include mental health day programs, psychiatric outpatients and outreach services (e.g., home visits). The	NSW Health Data Ambulatory Mental Health Data (MH-AMB)	NSW	1 July 2012–latest available

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	data records 'contacts' (as opposed to 'episodes of care') by clinicians to a patient.			
Emergency Department Data Collection	The EDDC provides information about patient presentations to the emergency departments of public hospitals in New South Wales. By 2016 the EDDC captured 100% of public hospitals in NSW, prior to this time the number of contributing hospitals steadily increased from 90/150 in 2010.	NSW Health Data Emergency Department Data Collection (EDDC)	NSW	1 July 2012–latest available

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Measurements

Data from coroner reports

The information from the NCIS that will be extracted for each suicide is listed in Table 3. Data extraction from the toxicology, police and autopsy reports will be completed by research assistants and students. Study investigators (KC, RC and JS) will provide training in the data extraction processes and will be available to address any questions and reach consensus regarding coding for more complex cases.

Table 3: Information collected from the NCIS for each included suicide case

Variable(s)	Description
De-identified demographic variables	Date of death, age at time of death, sex, marital status, employment status, country of birth, years in country
ICD-10 Cause of Death	As determined during the Australian Bureau of Statistics mortality coding process
Medical Cause of Death	As determined by the coroner
Incident date and time	When the incident that caused death occurred
Mechanism and Object of Injury	Mechanism by which death occurred/objects involved in death
Geocoding result	Statistical Area 3 (SA3) and 4 (SA4) of residential address at time of death. Statistical areas are provided by the Australian Statistical Geography Standard for use by the Australian Bureau of statistics (ABS) and others to analyse spatially integrated information.

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Toxicology report	We will document all drugs listed in each report, including their concentrations, the sample sites analysed, level of decomposition of the body and any other limitations to the toxicological testing.
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Data from PBS and MBS

The data from the PBS that will be linked to each case includes date the medicine was prescribed and date the medicine was dispensed, medicine name, form, strength, number of prescriptions dispensed, and speciality of the prescriber. The data from the MBS that will be linked to each case includes date and type of health service accessed.

Data from the APDC, EDDC and MH-AMB

Data from the APDC and EDDC that will be linked to each case includes dates of episodes of care, diagnosis codes associated with episode of care, and mode of arrival and separation. Additionally, the triage category assigned to ED visits will be linked. Data from the MH-AMB that will be linked to each case includes dates associated with each contact, mental health diagnoses associated with contact and type of service.

Data linkage

The data linkage in this study will adhere to the separation principle for data linkage. Identifying information is supplied to the data linkage staff by the NCIS data custodians. Once the relevant linkage processes have been performed, de-identified data will then be available to researchers for analyses.

The separation principle will be maintained throughout the data linkage process as follows:

1. The researchers will not have access to identifying information once they have received the linked data
2. Only approved research personnel will have access to the linked data and perform data analysis

Planned data analysis

Aim 1: To describe health service utilisation rates (both general and mental health) in the year prior to death by suicide, and how this varies by individual case characteristics

Using descriptive statistics, we will comprehensively describe and characterise the healthcare utilisation in the NSW cases within our sample in the year preceding suicide death by using the NSW Health data supplied by NSW Health and the MBS data supplied by AIHW. Categorical data will be described using frequencies and percentages.

Generalised linear models will be used to determine predictors of healthcare contacts before death. The dependent healthcare utilisation variables we will investigate include ambulatory mental health contact, acute mental health contact and no mental health contact. Independent variables and covariates examined will include: age, sex, SES, and class of medication prescribed. Odds ratios with 95% CIs will be reported for each predictor.

Spatial maps of age and sex standardised suicide rate according to the presence or absence of healthcare within a month of death will be generated for Australia using SA3 regions of residence at time of death.

Aim 2: To describe prescribed medicines use in the year prior to death by suicide, medicines used in suicide by poisoning and how this varies by individual case characteristics.

Using descriptive statistics, we will comprehensively describe and characterise the dispensed prescription medication use in our sample in the year preceding suicide death using the PBS data supplied by AIHW. Categorical data will be described using frequencies and percentages.

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3 For the prescription medicines that are not used to treat mental illness, such as antibiotics, ACE
4 inhibitors, gabapentinoids or isotretinoin, we will conduct disproportionality analysis (18) to determine
5 whether the rate of use in suicide cases is above that reported in the Australian population using other
6 available sources of national representative PBS dispensing data.
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13 Generalised linear models will be used to determine predictors of prescribed medication use
14 patterns including: cases not dispensed a psychotropic medication, cases non-compliant with
15 psychotropic medication at time of death, initiation of a psychotropic medication within 1
16 month of death and discontinuation of a psychotropic medication within 1 month of death.
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27 Independent variables and covariates examined will include: age, sex, SES, method of death and class
28 of medication prescribed. Odds ratios with 95% CIs will be reported for each predictor.
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33 Spatial maps of suicide according to the presence or absence of medicine within a month of death will
34 be generated for Australia using SA3 regions of residence at time of death.
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39 **ETHICS AND DISSEMINATION**

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41 This project involves use of sensitive and confidential data. Data will be linked using a third-party
42 privacy preserving protocol meaning that investigators will not have access to identifiable information
43 once the data has been linked. Statistical analyses will be carried out in a secure environment. ASHLi
44 has been approved by the following data custodians and ethics committees: 1) the National Coronial
45 Information System (NCIS) (REF: M0400), 2) the Justice Department Human Research Ethics
46 Committee (REF: CF/17/23250), 3) the Western Australian Coroners Court (REF: EC 14/18 M0400);
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3 Findings will be published in peer-reviewed journals, presented at conferences and communicated to
4 regulatory authorities, clinicians, mental health advocacy groups and policy makers.
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10 **DISCUSSION**

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12 Australia is one of the few countries in the world with an investment in data linkage infrastructure to
13 allow a project of this scope to be achieved. This study will significantly advance knowledge of health
14 service and medicine utilisation prior to suicide in Australia. The project outcomes will have a
15 significant impact on suicide prevention initiatives by identifying gaps in our national suicide
16 prevention strategy, and subsequently providing information on ways to optimise future approaches.
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20 ASHLi will result in the following central outcomes:
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28 1. *Identifying the reach of suicide prevention initiatives delivered via health services.*

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30 By identifying population characteristics associated with different types of health service use, this
31 analysis will provide important information for targeting suicide initiatives. For example, if one type
32 of service is used more commonly in younger females then reinforcing tailored programs toward this
33 group within that service may increase efficacy of suicide prevention compared to broadly focussed
34 interventions. Furthermore, locating where high/low service use occurs and determining when, in
35 relation to suicide, particular services are most commonly accessed, the analysis will provide specific
36 information about where and when to reinforce or redirect our current strategies.
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47 2. *Highlighting barriers to health service utilisation.*

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49 By interpreting health service use in concert with health service location we will shed light on whether
50 barriers to health service utilisation may be due to intrinsic factors (unwillingness by the individual to
51 seek help) vs. extrinsic factors (remoteness/lack of services). The former will highlight groups of
52 people for whom non-clinical forms of intervention may be the most efficacious and where they should
53 be targeted (i.e. online therapy, restricting means of suicide, public health campaigns).
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3 3. *Providing information to help target means restriction.*
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5 Means restriction is the primary mode of suicide prevention applicable to those who do not access
6 health services. Our analysis of the methods of suicide that are most commonly used in these people
7 will provide information on priority suicide methods to target, in what populations, and where.
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13 4. *Highlighting potentially harmful medicine use.*
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15 Information on medicines used in overdose will have important implications for regulatory authorities
16 and prescribers, especially when psychotropic medicine use occurs in the absence of mental health
17 service utilisation, which is against best practice recommendations. We will also provide further
18 evidence regarding concerns about pro-suicidal effects of several non-psychotropic medicines.
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25 5. *Foundational research for future studies*
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27 The rich data source created in order to achieve the aims of the current proposal will be used for many
28 further analyses by the study team. For example, with the addition of appropriate data from the general
29 population, we can zoom in on particular medicine classes of interest and conduct disproportionality
30 analysis to assess how use of medicines by our sample differs compared to the general population.
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37 *Limitations*
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40 There are a number of limitations associated with the nature of the data used in this study. Firstly,
41 there will be an underascertainment of health service use for the cases in our study. MBS data does
42 not include enough detail on mental health services provided in hospital to allow the identification of
43 hospitalised self-harm and other emergency psychiatric presentations. Health service data collected
44 by State governments includes detailed data on hospitalisations and non-hospital mental health
45 services, therefore is not constrained by the same limitations. Therefore we will supplement the MBS
46 mental health data using NSW state data collections. Initially, we have chosen to use this approach in
47 NSW given its large population (around one third of Australians). By comparing the estimates we
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3 receive from MBS alone to MBS plus NSW state collections we will be able to estimate the degree
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5 of underascertainment in other states in Australia and report on this accordingly.
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8 Medicine use will also be limited by under-ascertainment. It is possible to obtain scripts outside the
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10 PBS, such as private prescriptions, medicines dispensed within public hospitals to inpatients, or
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12 opioid maintenance treatments (methadone and buprenorphine) will not be captured. The study will
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14 also not capture medicines sold over-the-counter, complementary or alternative medicines.
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18 Another limitation is that all cases in the study have died from suicide, therefore risk of suicide
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20 associated with any healthcare or medicine use patterns can not be established. This study will instead
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22 highlight these patterns, so that further studies with appropriate control groups can be established.
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26 **Contributors:** The Principal Investigator (KMC) and NAB were responsible for the conceptualisation
27
28 of ASHLi. KMC, JLS, RC, AS, NAB, AP, GC, JER, SAP were responsible for the protocol design.
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30 The manuscript was drafted by KMC and NJG. All authors contributed to the final version.
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43
44 the manuscript.
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50 **Competing interests:** None
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55 **Data Sharing Statement:** Only approved personnel may access the data. Researchers interested in
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57 collaborations or further information are invited to contact KMC at kate.chitty@sydney.edu.au.
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