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Suicidal and self-harm presentations to Emergency Departments: the challenges of identification through diagnostic codes and presenting complaints

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Abstract:	<p>Background: The accuracy of data on suicide-related presentations to Emergency Departments (EDs) has implications for the provision of care and policy development, yet research on its validity is scarce.</p> <p>Objective: To study the reliability of allocation of ICD-10 codes and presenting complaints in suicide-related presentations to ED.</p> <p>Methods: All presentations due to suicide attempts, non-suicidal self-injury (NSSI) and suicidal ideation between 1 July 2017 and 31 December 2017 were reviewed. The number of presentations identified through relevant ICD-10-AM codes and presenting complaints in Emergency Department Information System (EDIS) were compared to those identified through an application of an evolutionary algorithm and medical record review (gold standard).</p> <p>Results: 2,540 relevant presentations were identified through the gold standard methodology. Great heterogeneity of ICD-10-AM codes and presenting complaints was observed for suicide attempts (40 diagnostic codes and 27 presenting complaints), NSSI (27 and 16, respectively) and suicidal ideation (38 and 34, respectively). Relevant ICD codes applied as primary or secondary diagnosis had very low sensitivity in detecting cases of suicide attempts (18.7%), NSSI (38.5%) and suicidal ideation (42.3%). A combination of ICD-10-AM code and a relevant presenting complaint increased specificity, however substantially reduced specificity and positive predictive values for all types of presentations. ED data showed bias in detecting higher percentages of suicide attempts by Indigenous persons (10.1% vs 6.9%) or by cutting (28.1% vs 10.3%), and NSSI by female presenters (76.4% vs 67.4%).</p> <p>Conclusions: Suicidal and self-harm presentations are grossly under-enumerated in ED datasets and should be used with caution until a more standardised approach to their formulation and recording is implemented.</p>

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Manuscripts

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9 **Suicidal and self-harm presentations to Emergency Departments: the challenges of**
10 **identification through diagnostic codes and presenting complaints**
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Abstract

Background: The accuracy of data on suicide-related presentations to Emergency Departments (EDs) has implications for the provision of care and policy development, yet research on its validity is scarce.

Objective: To study the reliability of allocation of ICD-10 codes and presenting complaints in suicide-related presentations to ED.

Methods: All presentations due to suicide attempts, non-suicidal self-injury (NSSI) and suicidal ideation between 1 July 2017 and 31 December 2017 were reviewed. The number of presentations identified through relevant ICD-10-AM codes and presenting complaints in Emergency Department Information System (EDIS) were compared to those identified through an application of an evolutionary algorithm and medical record review (gold standard).

Results: 2,540 relevant presentations were identified through the gold standard methodology. Great heterogeneity of ICD-10-AM codes and presenting complaints was observed for suicide attempts (40 diagnostic codes and 27 presenting complaints), NSSI (27 and 16, respectively) and suicidal ideation (38 and 34, respectively). Relevant ICD codes applied as primary or secondary diagnosis had very low sensitivity in detecting cases of suicide attempts (18.7%), NSSI (38.5%) and suicidal ideation (42.3%). A combination of ICD-10-AM code and a relevant presenting complaint increased specificity, however substantially reduced specificity and positive predictive values for

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9 all types of presentations. ED data showed bias in detecting higher percentages of suicide
10 attempts by Indigenous persons (10.1% vs 6.9%) or by cutting (28.1% vs 10.3%), and
11 NSSI by female presenters (76.4% vs 67.4%).
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16 **Conclusions and Implications:** Suicidal and self-harm presentations are grossly under-
17 enumerated in ED datasets and should be used with caution until a more standardised
18 approach to their formulation and recording is implemented.
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26 **Keywords MeSH:** Clinical Coding, Data Quality, ICD-10-AM, Hospital Information
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Background

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Around 800,000 people die by suicide every year worldwide, with estimates of at least 25-times that number engaging in non-fatal suicidal behaviours (WHO, 2014). The most recent available statistics for Australia show that in 2017, 3,128 Australians took their life (Australian Bureau of Statistics, 2018). Emergency departments (EDs) are important settings for suicide prevention, as they are often the primary point of engagement with health professionals for people at risk of suicide or after a suicide attempt (Da Cruz et al., 2011). Accurate surveillance of suicide attempts and self-harm represents a core element of the public health model of suicide prevention; however, ED administrative datasets vary significantly in completeness and quality, particularly regarding morbidity due to external causes (Hedegaard et al., 2018). These inconsistencies hinder the determination of the true rate of suicidal and self-harm presentations to hospital settings at regional or national levels, allocation of appropriate resources, and creation of targeted interventions (Barczyk et al., 2018; Spicer and Miller, 2000).

Research on the validity of data on suicidal and self-harm presentations in ED records is scarce (Walkup et al., 2012). Study outcomes from the UK, US and Canada suggest that administrative data underestimate the volume of presentations after suicide attempts and self-harm by around 60%, when evaluated against clinical records or assessments of suicidality with standardised tools (Clements et al., 2016; Randall et al., 2017; Stanley

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9 et al., 2017). The magnitude of this under-enumeration may be particularly high for
10 females and ethnic minorities (Barczyk et al., 2018), and patients with more complex
11 clinical pictures (Stanley et al., 2017).
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16 Diagnostic codes are often used to inform on performance outcomes (Boyle et al., 2018;
17 Australian Council on Healthcare Standards, 2017). In Australia, different states use
18 different ED coding systems for diagnoses assigned to presentations. Mapping of these
19 codes is done at the national level and collated in the the National Non-Admitted Patient
20 Emergency Department Care Database which produces consistent ED data for research,
21 health care and service planning. The suitability of ED discharge diagnoses for
22 monitoring health outcomes has been questioned before (Howell et al., 2014), yet no
23 study to date has evaluated their utility in the context of suicidal and self-harm
24 presentations.
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37 The aim of the present work was to test the reliability of ED coding (specifically,
38 diagnostic codes and presenting complaints) assigned to suicide and self-harm related
39 presentations to EDs within the Gold Coast Hospital and Health Service (GCHHS) in
40 Queensland, Australia. Analysis of their specificity is pertinent following Queensland
41 Health's recent introduction of a performance indicator monitoring the follow-up of
42 suicidal patients discharged from ED (State of Queensland, 2018). This work also
43 represents an important component of the implementation and evaluation of the
44 GCHHS' Suicide Prevention Strategy (SPS) (Gold Coast Health, 2016). SPS is based on
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9 the Zero Suicide Framework (Covington et al., 2011), a systems approach to suicide
10 prevention within a healthcare setting with an underpinning continuous quality
11 improvement approach. The current challenges surrounding availability of reliable data
12 that can be provided to clinical teams in a timely manner and thus inform further
13 systems improvements represent a significant barrier to this process.
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24 **METHODS**

25 *Context of the study*

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27 This analysis was conducted within the GCHHS which provides public mental health
28 services for a population of approximately 560,000 people. GCHHS has two EDs that
29 represent the largest primary points of presentation for persons of all ages at risk of
30 suicide. A cohort of suicidal and self-harm related presentations between 1 July 2017
31 and 31 December 2017 was examined.
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41 *The Emergency Department Information System*

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43 The Emergency Department Information System (EDIS) is an electronic health record
44 system that captures ED attendance data across Queensland. At the point of triage, each
45 presentation is allocated a presenting complaint that best describes the underlying
46 symptoms and further informs diagnosis and management. No international standard
47 exists for presenting complaints entries (Malmström et al., 2012). Across Queensland, a
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9 drop-down menu of around 95 presenting complaints is available in EDIS; each is
10 depicted by a unique code and corresponding description.
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14 Upon discharge from ED, one or more diagnostic codes from the Australian
15 Modification of the International Statistical Classification of Diseases and Health
16 Related Problems, 10th revision (ICD-10-AM) (National Centre for Classification in
17 Health (2018) are assigned by the discharging clinician. In EDIS systems used across
18 Queensland, a drop-down menu of a limited sub-set of codes is available, with 28 of
19 those describing psychiatric disorders which include presentations due to suicidal
20 thoughts or behaviours. It is notable that in ICD-10-AM, suicidal and self-harm
21 behaviours are captured in the range X60-X84, however in the EDs included in our
22 study, only the code X84 "Intentional self-harm by unspecified means" was available as
23 a discharge diagnosis.
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37 EDIS was used as the primary source of information for identification of suicidal and
38 self-harm presentations within GCHHS. A software program "Searching EDIS for
39 Records of Suicidal Presentations (SERoSP)" was developed in MATLAB to identify
40 relevant cases. It was based on an evolutionary algorithm which weights 136 variables
41 (demographic characteristics, diagnostic codes, presenting complaints, key words
42 appearing in the triage text, treatment received, etc) from a training dataset of data from
43 2015, where 10,462 suicidal presentations were identified by a psychiatrist. The
44 program "learned" from trial and error, over 150 successive generations, using 100
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9 variations of variable weights per generation. SERoSP was then run on a psychiatrist-
10 rated validation dataset of 7,786 cases from 2017, using the weights generated by the
11 evolutionary algorithm. Receiver Operating characteristics (ROC) curves were used to
12 determine an optimum scoring cut-off, sensitivity and specificity. Ultimately, SERoSP
13 was shown to have a 95% sensitivity and 92% specificity in identifying suicidal and
14 self-harm presentations (Stapelberg et al., submitted), and is currently being used in the
15 GCHSS' evaluation of SPS.
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25 ***Variables extracted***

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27 For each presentation, the patient's age, sex (male/female), Indigenous background
28 (yes/no), Unit Record Number, date and time of presentation, triage free-text narrative,
29 presenting complaint, and primary and secondary diagnoses following ICD-10-AM
30 were extracted.
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38 ***Identification of cases using diagnostic codes and presenting complaints***

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40 The ICD-10-AM code X84 "Intentional self-harm by unspecified means" was used to
41 identify cases of suicide attempts and self-harm (as this was the only code denoting
42 suicidal and self-harm behaviours in EDIS). The ICD-10-AM code R45.81 "Suicidal
43 ideation" was used to identify cases of suicidal ideation. Relevant cases in all three
44 categories (suicide attempts, self-harm and suicidal ideation) were also identified
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9 through the application of the presenting complaint 30005 "Suicidal-homicidal
10 ideation".
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14 ***Gold standard: Medical record review***
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17 A team of trained research officers performed medical record review for the identified
18 presentations using clinical databases Consumer Integrated Mental Health Application
19 (CIMHA) and Electronic Medical Record (eMR). The officers reviewed cases
20 independently of each other, however, regular meetings were held between them to
21 ensure a standardised coding process, and a clinical expert assisted in the resolution of
22 more complex cases.
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31 Each presentation extracted by SERoPS was categorised into one of the following
32 groups, using definitions based on previous literature (De Leo et al., 2006) and the
33 World Health Organization's (WHO) Practice Manual for Establishing and Maintaining
34 Surveillance Systems for Suicide Attempts and Self-Harm (WHO, 2016):
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41 *1) Not applicable* (no evidence of any type of suicidality), *2) Suicidal ideation*
42 (including thoughts of suicide, ranging from passive to active, and behaviours such as
43 threats, preparatory acts, and interrupted or aborted suicide attempts); *3) Non-suicidal*
44 *self-injury* (NSSI; self-harming behaviour without intent to die); *4) Suicide attempt*
45 (self-harming behaviour with intent to die); or *5) Ambiguous* (inadequate evidence to
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9 decide on any of the above categories). Cases categorised as Not applicable and
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11 Ambiguous were excluded from analysis.
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14 Frequencies of ICD-10-AM codes and presenting complaints were calculated for all
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16 cases identified through the gold standard approach. A range of additional statistics -
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18 sensitivity, specificity, positive predictive value (PPV) and negative predictive value
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20 (NPV) - were calculated for ICD-10-AM codes X84 and R45.81, and the presenting
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22 complaint "Suicidal-homicidal ideation", in identifying each type of presentation
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24 (suicide attempts, NSSI and suicidal ideation). Demographic information (age, gender,
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26 Indigenous status), and methods used in suicide attempts were compared between cases
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28 identified through the two approaches using t-test and Chi square statistics.
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33 All analyses were performed with SPSS, version 24.
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35 36 ***Ethics***

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38 This work was performed as part of the project Gold Coast Mental Health and Specialist
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40 Services Suicide Prevention Strategy: Evaluation. It was recognised as Quality Activity
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42 by the GCHSS Human Research Ethics Committee and thus granted a research ethics
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44 exemption (LNR/2018/QGC/47473).
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Results

Description of sample

A total of 3,417 presentations between July and December 2017 were identified using SERoPS. Of those, 873 were categorised as Not applicable, 1,611 as Suicide ideation, 187 as NSSI, 742 as Suicide attempts, and four cases as Ambiguous. Not applicable and Ambiguous cases were excluded from further analysis, yielding a total sample of 2,540 presentations.

Persons presenting with suicide attempts and suicidal ideation had a similar mean age (around 33 years), with presentations due to NSSI being on average younger (mean age 25.7 years). More females than males presented with suicide attempts and NSSI, but the sex ratio was reversed in presentations due to suicidal ideation (46.4% were females and 53.6% were males). The percentage of persons of Indigenous background was the highest among presentations due to suicide attempts (6.9%) and lowest among NSSI cases (3.7%).

- *Insert Table 1 about here* -

Distribution of ICD-10-AM codes and Presenting complaints

Table 2 lists a total of 40 different ICD-10-AM codes used as primary diagnoses for cases of suicide attempts, 27 for cases of NSSI, and 38 for cases of suicidal ideation (exact frequencies are shown only for diagnoses assigned to four or more cases). The most frequent codes among suicide attempts were T50.9 "Other drug poisoning" (20.8%), followed by 17.5% of cases with code X84 "Intentional self-harm by unspecified means", and 12.0% with R45.81 "Suicidal ideation". Among cases of NSSI, code X84 was allocated to 36.4% of cases, and code R45.81 to 16.0% of cases. Among presentations with suicidal ideation, 41.4% were coded as R45.81, 15.8% as F43.9 "Reaction to severe stress", followed by a substantial percentage of cases for which primary diagnoses denoted various mental illnesses (e.g. depression, psychotic episode, anxiety, and personality disorder).

- *Insert Table 2 about here* -

Table 3 shows that presentations with suicide attempts were allocated a total of 27 different presenting complaints (most frequently 30005 "Suicidal-homicidal ideation" in 32.3% of cases and 9038 "Overdose/toxic exposure" in 29.0%). NSSI presentations had 16 different presenting complaints (most frequently 30005 "Suicidal-homicidal

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9 ideation" in 32.1% and 30000 "Mental health" in 26.2%). Cases with suicidal ideation
10 had 34 different presenting complaints, most commonly 30005 "Suicidal-homicidal
11 ideation" (51.3%) and 30000 "Mental health" (23.5%). As above, only presenting
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16 complaints assigned to four or more cases are shown with exact frequencies.
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21 - *Insert Table 3 about here* --
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25 ***Sensitivity, specificity, PPV and NNV***

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27 For calculation of specificity statistics, ICD-10-AM codes used to identify suicidal and
28 self-harm cases were expanded to include secondary diagnoses. The inclusion of X84 as
29 a secondary diagnosis expanded the sample of suicide attempts by 9 cases (from 130
30 identified through primary diagnosis; increase of 6.5%), NSSI by 3 cases (from 68
31 identified through primary diagnosis; increase of 4.2%) and the inclusion of R45.81 as
32 secondary diagnosis increased cases of suicidal ideation by 14 cases (from 667
33 identified through primary diagnosis; increase of 2.1%) (results not tabulated).
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44 Sensitivity statistics shown in Table 4 were calculated for three different approaches to
45 identifying cases of suicide attempts, NSSI and suicide ideation: through primary or
46 secondary diagnostic codes, through the presenting complaint "Suicidal-homicidal
47 ideation", and finally through a combination of diagnostic codes and presenting
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9 When compared to cases identified through gold standard methodology, ICD-10-AM
10 diagnostic codes had low sensitivity in detecting cases of suicide attempts (18.7%;
11 95%CI 16.0% - 21.7%), NSSI (38.5%; 95%CI 31.5% - 45.9%) and suicidal ideation
12 (42.3%; 95%CI 39.8% - 44.7%). In comparison, the use of presenting complaint
13 "Suicidal-homicidal ideation" had higher sensitivity for suicide attempts (32.5%; 95%CI
14 29.4% - 36.4%) and suicide ideation (51.4%; 95%CI 48.9% - 53.9%) but lower for
15 NSSI presentations (32.1%; 95%CI 27.0% - 41.4%). In both methods of case
16 identification, PPV values were highest for suicide ideation and lowest for NSSI cases
17 which reflects the much higher prevalence of cases with suicidal ideation in the total
18 sample.
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32 Expanding the criteria of diagnostic codes with the presenting complaint "Suicidal-
33 homicidal ideation" increased sensitivity for all types of presentations, bringing the
34 ability to identify true cases of suicide attempts to 44.6% (95%CI 41.0% - 48.3%),
35 NSSI to 58.8% (95%CI 51.4% - 65.9%) and suicide ideation to 69.3% (95%CI 67.0% -
36 71.6%). However, increased sensitivity significantly reduced levels of specificity
37 suggesting that a combination of these approaches would inadvertently detect a large
38 number of false negatives.
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9 Table 5 shows a comparison of characteristics of presentations identified through
10 diagnostic codes X84 and R45.81 (allocated as primary or secondary diagnoses) and
11 through the gold standard methodology.
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24 The code X84 was allocated disproportionately to persons of Indigenous background
25 presenting to ED following suicide attempts, when compared to suicide attempts
26 identified through the gold standards (10.1% vs 6.9%; $\chi^2(2)=7.15$, $p=.028$). Suicide
27 attempts identified through the X84 code also had an uneven distribution of methods
28 ($\chi^2(4)=71.79$, $p<.001$), capturing more attempts by cutting (28.1% vs 10.3%) but less
29 presentations due to poisoning (59.7% vs 81.6%), when compared to the gold standard.
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31 Within cases of NSSI, code X84 identified larger number of female presenters than the
32 gold standard (76.4% vs. 67.4%, $\chi^2(1)=4.32$, $p=.038$). No significant differences were
33 observed in relation to presentations with suicidal ideation.
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Discussion:

This is the first Australian study into the reliability of ED coding data on suicidal and self-harm presentations, adding to the limited body of international research on this topic. Results revealed marked heterogeneity in allocated primary diagnostic codes and presenting complaints, as well as gross under-enumeration of these events in the ED administrative dataset.

ICD-10-AM code X84 correctly identified 18.7% of suicide attempts and 38.5% of cases of NSSI presenting to ED, while the code R45.81 identified 42.3% of cases with suicide ideation. Similar ranges of sensitivity (from 13.8% to 65.0%) and PPV (4.0% to 100%) were noted in a systematic review of six administrative datasets from US and Canada (Walkup et al., 2012), although several methodological variations between studies need to be noted.

Our analysis also tested the sensitivity when expanding diagnostic criteria to include the presenting complaint "suicidal-homicidal ideation". Subsequently, the sensitivity for all three categories increased more than twofold, however, specificity values of around 50% indicate that half of cases included in the analysis would be due to non-suicidal complaints. Comparable results were previously reported by Randall (2017) who found that expanding criteria from codes X60-X84 to include events of undetermined intent and accidental poisonings slightly improved the detection of true cases, but at the expense of a reduced specificity and PPV. In the future, alternative criteria for

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9 identifying suicidal and self-harm presentations could be explored, such as by inclusion
10 of codes denoting poisoning / overdoses (ICD-10-AM T36-T50 "Poisoning by drugs,
11 medicaments and biological substances").
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16 The study also identified that the X84 code is currently more likely to be assigned to
17 presentations by persons of Indigenous background, those presenting with suicide
18 attempts by cutting, and NSSI cases by females. A similar skewness of epidemiological
19 data has recently been observed on intentional self-poisoning cases by young females in
20 hospital datasets (McGill et al., 2018). Stanley et al. (2017) concluded that such
21 misrepresentation of particular cohorts is systematic and that certain groups of patients
22 are more likely to have miscoded representations than others (though their observations
23 related to clinical rather than demographic characteristics). This may represent a
24 substantial issue with regards to over-representation of Indigenous presentations in ED
25 statistics, for example.
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40 A noteworthy caveat of the present research is the unavailability of codes other than
41 X84 in the identification of relevant cases presenting to ED, which has contributed to
42 the observed incongruities when compared to a gold standard of reviewing medical
43 records. The impact of this on the identification of relevant presentations could be
44 moderated through the allocation of this code as a secondary diagnosis code, yet our
45 study revealed that overall, only around 5% of suicidal or self-harm presentations to ED
46 had a secondary diagnosis recorded in EDIS. Consequently, it is reasonable to assume
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9 that for many presentations, patients' concomitant conditions were more likely to be
10 noted instead of suicidality (Randall et al., 2017).

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14 Other reasons have been proposed for the frequency of miscoded suicidality at ED
15 triage. Primarily, the busy ED environment suffers from the lack of privacy and time
16 constraints which prevents the necessary mental health assessment to occur at the time
17 coding (Howell et al., 2014). Further, ED staff do not receive the training required to
18 reliably apply these codes, which is further exacerbated by variations in clinicians'
19 experience (Phillips et al., 2015) and the fact that patients are often reluctant to divulge
20 information due to stigma, fluidity of intent, or memory gaps (Berk and Asarnow, 2015;
21 Freedenthal, 2007).

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33 Several limitations need to be noted regarding this research. First, the utilised gold
34 standard methodology may have missed true suicidal or self-harm presentations as per
35 the reported sensitivity and specificity of SERoPS (Stapelberg et al., submitted). An
36 additional caveat was the inability to perform inter-rater reliability analysis, which was
37 partially alleviated through the involvement of the adjudicator with a wealth of clinical
38 expertise and the exclusion of ambiguous cases for which the decision could not be
39 reached. Next, this work did not differentiate between patients hospitalised following
40 their presentation to ED from those discharged directly from ED. The accuracy of data
41 is arguably better for admitted patients, as their medical records are coded by clinical
42 coders who are highly trained in the classification of diagnoses. This inevitably creates
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9 discrepancies in the accuracy of codes when compared to those available via the coding
10 system utilised in the ED. Further, it is possible that the greater severity of presentations
11 in admitted patients reduces the likelihood for miscoding (Randall et al., 2017). Further
12 analysis is required into the accuracy of ED coding data depending on the assessments
13 undertaken at ED and their outcomes.
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21 Last, the generalisability of our findings may be limited as different EDs may have
22 different coding practices that can affect the ability to accurately detect suicidal and
23 self-harm presentations through their administrative datasets (for example, by having
24 available a larger number of codes to choose from when assigning the most relevant
25 diagnosis).
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32 **Conclusion**

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36 Healthcare managers, clinicians and researchers should use ED administrative data on
37 suicidal and self-harm presentations with great caution until a more standardised
38 approach to the formulation and recording of ED diagnosis is implemented at the
39 national level (Howell et al., 2014). Standardisation of clinical coding in the hospital
40 and health service included in this study is scheduled for April 2019. With it, an
41 alternative diagnostic classification set - Systematized Nomenclature of Medicine
42 (SNOMED) - will be introduced in place of ICD. SNOMED codes have been used to
43 extract suicidal and self-harm presentation in other Australian studies (Perera et al.,
44 2018) and while some have argued they improve the quality of information about why
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9 people present to EDs (Lawley et al., 2017), their utility for suicidological research
10 remains unknown. There is a need to develop a more sensitive algorithm to improve
11 their identification (Walkup et al., 2012). The SERoPS tool (Stapelberg et al.,
12 submitted), used in the development of the gold standard methodology in this study,
13 could be efficiently used to inform healthcare management and resource allocation in
14 the future.
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26 **Acknowledgement:** We wish to acknowledge Mr Pete Fugelli from Clinical Excellence
27 Division at Department of Health Queensland for his assistance in extracting data from
28 EDIS database.
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9 **Tables**

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12 *Table 1. Demographic characteristics of the sample of suicidal and self-harm*
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14 *presentations*

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	Suicide attempt N =742	NSSI N=187	Suicidal ideation N=1,611
Age (mean)	33.3 (SD=16.0)	25.7 (SD=12.0)	33.7 (SD=15.3)
Sex			
Female	63.9%	67.4%	46.4%
Male	36.1%	32.6%	53.6%
Indigenous status			
Indigenous	6.9%	3.7%	4.3%
Not Indigenous	93.1%	96.3%	95.7%

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Table 2. Distribution of ICD-10-AM codes as primary diagnosis assigned to suicidal and self-harm presentations

SUICIDE ATTEMPTS (N = 742)			
ICD-10-AM code	ICD-10-AM description	n	%
T50.9	Other drug poisoning	154	20.8
X84	Intentional self-harm by unspecified means	130	17.5
R45.81	Suicidal ideation	89	12.0
T39.1	Paracetamol poisoning	88	11.9
T42.4	Benzodiazepine poisoning	56	7.5
T43.9	Antidepressant poisoning	50	6.7
T43.5	Antipsychotic poisoning	24	3.2
F32.9	Depression	19	2.6
F43.9	Reaction to severe stress	15	2.0
T40.0	Opiate toxicity	14	1.9
T44.3	Anticholinergic poisoning	10	1.3
T71	Asphyxiation, strangulation, hanging	10	1.3
F10.0	Alcohol intoxication	8	1.1
T44.7	Beta-blocker poisoning	8	1.1

T43.69	Amphetamine poisoning	7	0.9
T45.0	Antiemetic poisoning	7	0.9
F19.2	Drug addiction	5	0.7
S51.9	Lacerated forearm	5	0.7
T39.3	Nonsteroidal anti-inflammatory poisoning	5	0.7
F29	Psychotic episode	4	0.5
Z53.2	Medical advice on medication	4	0.5
<p>ICD-10-AM codes with frequency of 3 or less: F09 Unspecific organic or symptomatic mental disorder, F10.3 Alcohol withdrawal syndrome, F20.9 Schizophrenia, F41.9 Anxiety, F50.0 Anorexia nervosa, F60.9 Personality disorder, F91.9 Behavioural problems – child, S11.8 Lacerated neck, S61.9 Lacerated hand or wrist, S83.6 Knee sprain / strain, S91.7 Lacerated ankle and foot, T01.2 Multiple lacerations, T14.6 Lacerated tendon and/or muscle, T38.3 Other antidiabetic poisoning, T39.0 Salicylate poisoning, T45.5 Antihistamine poisoning, T46.1 Warfarin poisoning, T58 Carbon monoxide inhalation, T88.7 Other medication side-effect.</p>			
NON- SUICIDAL SELF INJURY (N = 187)			
ICD-10-AM code	ICD-10-AM description	n	%
X84	Intentional self-harm by unspecified means	68	36.4

R45.81	Suicidal ideation	30	16.0
F43.9	Reaction to severe stress	18	9.6
S51.9	Lacerated forearm	12	6.4
F32.9	Depression	10	5.3
F91.9	Behavioural problems - child	7	3.7
F60.9	Personality disorder	6	3.2
T00.9	Multiple superficial injuries	4	2.1
Z53.2	Medical advice on medication	4	2.1
<p>ICD-10-AM codes with frequency of 3 or less: F10.0 Alcohol intoxication, F19.2 Drug addiction, F29 Psychotic episode, F32.3 Depression – psychotic, F41.9 Anxiety, F99 Mental illness - no diagnosis, S31.1 Lacerated abdomen or lower back, S41.1 Lacerated upper arm, S61.9 Lacerated hand or wrist, S71.1 Lacerated thigh, S81.9 Lacerated lower leg, T01.2 Multiple lacerations, T14.6 Lacerated tendon and/or muscle, T42.4 Benzodiazepine poisoning, T43.69 Amphetamine poisoning, T43.9 Antidepressant poisoning, T44.7 Beta-blocker poisoning, T50.9 Other drug poisoning.</p>			
SUICIDAL IDEATION (N=1,611)			
ICD-10-AM code	ICD-10-AM description	n	%
R45.81	Suicidal ideation	667	41.4

F43.9	Reaction to severe stress	254	15.8
F32.9	Depression	172	10.7
F10.0	Alcohol intoxication	86	5.3
F29	Psychotic episode	55	3.4
F41.9	Anxiety	52	3.2
F60.9	Personality disorder	48	3.0
F91.9	Behavioural problems - child	42	2.6
F99	Mental illness - no diagnosis	31	1.9
X84	Intentional self-harm by unspecified means	29	1.8
F19.9	Drug induced mental disorder	25	1.6
F20.9	Schizophrenia	20	1.2
Z53.2	Medical advice on medication	17	1.1
F19.2	Drug addiction	15	0.9
F10.3	Alcohol withdrawal syndrome	13	0.8
F31.1	Bipolar affective disorder - manic	12	0.7
Z60.9	Did not wait	9	0.6
T50.9	Other drug poisoning	8	0.5
I20.0	Possible cardiac chest pain	7	0.4
F32.3	Depression - psychotic	5	0.3

F41.0	Panic attack	5	0.3
F50.0	Anorexia nervosa	5	0.3
F31.3	Bipolar affective disorder - depressed	4	0.2
T42.4	Benzodiazepine poisoning	4	0.2
<p>ICD-10-AM codes with frequency of 3 or less: B34.9 Viral infection, E86 Dehydration, F51.0 Insomnia – non-organic, R07.3 Non-cardiac chest pain, R55 Syncope / collapse, S62.6 Fracture of other finger, T00.9 Multiple superficial injuries, T39.1 Paracetamol poisoning, T40.0 Opiate toxicity, T43.69 Amphetamine poisoning, T43.9 Antidepressant poisoning, T44.3 Anticholinergic poisoning, T71 Asphyxiation, strangulation, hanging, Z04.8 Examination and observation for other specified reasons.</p>			

Table 3. Distribution of presenting complaints assigned to suicidal and self-harm presentations

SUICIDE ATTEMPTS (N = 742)			
Presenting complaint - code	Presenting complaint – description	n	%
30005	Suicidal-homicidal ideation	240	32.3
9038	Overdose / Toxic exposure	215	29.0
36000	Symptoms signs	100	13.5
30000	Mental health	89	12.0
21001	Altered LOC	17	2.3
9000	Injury	14	1.9
9033	Laceration / Skin tear	14	1.9
31000	Altered mental state / Neurological symptoms	11	1.5
30003	Mood disturbance	10	1.3
30001	Addiction / Dependency	6	0.8
9040	Strangulation / Asphyxia	4	0.5
11002	Anxiety / Agitation	4	0.5
Presenting complaints with frequency of 3 or less cases: 1 Multi-trauma, 9012 Fall, 9036 MVC-driver, 11001 Aggression, 16003 Hallucinations, 17001 Planned ED recall or			

review, 17002 Admission / Transfer, 17004 Inpatient team review, 21020 Seizure, 25004 Abdo / pelvis / perineal pain, 25006 Chest pain, 25011 Limb / joint pain, 25013 Neck / throat pain, 36010 Diarrhoea, 36015 Nausea / Vomiting.

NON- SUICIDAL SELF INJURY (N = 187)			
Presenting complaint – code	Presenting complaint – description	n	%
30005	Suicidal-homicidal ideation	60	32.1
30000	Mental health	49	26.2
9033	Laceration / Skin tear	22	11.8
9000	Injury	12	6.4
11002	Anxiety / Agitation	10	5.3
36000	Symptoms signs	8	4.3
9038	Overdose / Toxic exposure	7	3.7
30003	Mood disturbance	6	3.2
Presenting complaints with frequency of 3 or less cases: 9023 Penetrating injury, 9029 Blunt injury, 9030 Burn / scald, 11001 Aggression, 16003 Hallucinations, 17005 Requesting investigation, 30001 Addiction / dependency, 30004 Sleep disturbance.			
SUICIDAL IDEATION (N=1,611)			

Presenting complaint - code	Presenting complaint – description	n	%
30005	Suicidal-homicidal ideation	826	51.3
30000	Mental health	379	23.5
30003	Mood disturbance	107	6.6
36000	Symptoms signs	103	6.4
11002	Anxiety / Agitation	67	4.2
31000	Altered mental state / Neurological symptoms	32	2.0
16003	Hallucinations	22	1.4
11001	Aggression	17	1.1
30001	Addiction / Dependency	10	0.6
9038	Overdose / Toxic exposure	5	0.3
17000	Reviews / Admissions	5	0.3
25006	Chest pain	4	0.2
Presenting complaints with frequency of 3 or less cases: 30004 Sleep disturbance, 9000 Injury, 9012 Fall, 9029 Blunt injury, 9033 Laceration / skin tear, 9036 MVC-driver, 17007 Social concern (includes child protection), 17008 Unplanned ED representation, 21001 Altered LOC, 21002 Altered sensation, 21020 Seizure, 25004 Abdo / pelvis / perineal pain, 25005 Back pain, 30002 Eating disorder, 32001 Altered breathing, 36002			

Cough / rhinorrhoea, 36010 Diarrhoea, 36012 Gait disturbance, 36014 Hypertension / hypotension, 36015 Nausea / vomiting, 36018 Unsettled, 36020 Weight gain / loss.

Note: These presenting complaints in use across Queensland.

For Peer Review

Table 4. Sensitivity statistics for identification of suicidal and self-harm presentations through diagnostic codes and presenting complaints

	ICD-10-AM code X84		Presenting complaint "Suicidal-homicidal ideation" (SHI)		X84 + SHI	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Suicide attempt						
Sensitivity	18.7%	16.0% - 21.7%	32.5%	29.4% - 36.4%	44.6%	41.0% - 48.3%
Specificity	94.0%	92.8% - 95.1%	50.8%	48.1% - 52.8%	46.9%	44.6% - 49.2%
PPV	56.3%	50.4% - 62.0%	21.4%	27.3% - 30.9%	25.7%	24.0% - 27.5%
NPV	73.7%	73.0% - 74.4%	64.6%	63.1% - 66.2%	67.3%	65.5% - 69.0%
NSSI						
Sensitivity	38.5%	31.5% - 45.9%	32.1%	27.0% - 41.4%	58.8%	51.4% - 65.9%

Specificity	92.6%	91.4% - 93.6%	54.7%	52.4% - 56.5%	50.0%	48.0% - 52.1%
PPV	29.1%	24.6% - 34.1%	5.3%	4.4% - 6.5%	8.5%	7.6% - 9.6%
NPV	95.0%	94.4% - 95.5%	91.0%	90.0% - 91.8%	93.9%	92.8% - 94.8%

	ICD-10 code R45.81		Presenting complaint "Suicidal-homicidal ideation" (SHI)		R45.81+ SHI	
	Estimate	95% CI	Estimate	95% CI	Estimate	95% CI
Suicidal ideation						
Sensitivity	42.3%	39.8% - 44.7%	51.4%	48.9% - 53.9%	69.3%	67.0% - 71.6%
Specificity	86.2%	83.8% - 88.3%	67.7%	63.9% - 70.1%	60.8%	57.6% - 63.9%
PPV	84.1%	81.7% - 86.2%	73.3%	71.2% - 75.3%	75.3%	73.7% - 76.9%
NPV	46.4%	45.2% - 47.6%	44.6%	42.9% - 45.6%	53.4%	51.2% - 55.7%

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9 Note: ICD-10-AM code X84 - Intentional self-harm by unspecified means, ICD-10-AM
10 code R45.81 - Suicidal ideation, NSSI – Non-suicidal self-injury, SHI – Suicidal-
11 homicidal ideation, PPV – Positive predictive value, NPV – Negative predictive value.
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For Peer Review

Table 5. Characteristics of suicidal and self-harm presentations identified through ICD-10-AM codes and gold standard

	Suicide attempt			Non-suicidal self-injury			Suicidal ideation		
	X84 (N=139)	Gold standard (N=742)	<i>p</i>	X84 (N=71)	Gold standard (N=187)	<i>p</i>	R45.81 (N=681)	Gold standard (N=1,611)	<i>p</i>
Age (mean)	31.2 (SD=16.1)	33.3 (SD=16.0)	.156	23.7 (SD=10.4)	25.6 (SD=11.9)	.235	33.1 (SD=15.1)	33.7 (SD=15.4)	.383
Sex			.847			.038			.597
Female	63.3%	64.0%		76.4%	67.4%		47.1%	46.4%	
Male	36.7%	36.0%		23.6%	32.6%		52.9%	53.6%	
Indigenous status			.028			.422			.971
Indigenous	10.1%	6.9%		2.8%	4.3%		4.5%	4.3%	
Not Indigenous	89.9%	93.1%		97.2%	95.7%		95.5%	95.7%	

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Method			<.001	N/A
Poisoning	59.7%	81.6%		
Cutting	28.1%	10.3%		
Hanging/ strangulatio n	4.3%	4.5%		
Combinatio n of methods	6.5%	2.8%		
Other	1.4%	0.8%		

Note: ICD-10-AM code X84 - Intentional self-harm by unspecified means; ICD-10-AM code R45.81 - Suicidal ideation; Indigenous status – Aboriginal and/or Torres Strait Islander background.