Improving injury surveillance data quality: a study based on hospitals contributing to the Victorian Emergency Minimum Dataset

Dianne M. Sheppard,[1] Jane Hayman,[1] Trevor J. Allen,[1] Janneke Berecki-Gisolf[1]

Abstract

Objective: In this paper, we describe the design and baseline data of a study aimed at improving injury surveillance data quality of hospitals contributing to the Victorian Emergency Minimum Dataset (VEMD).

Methods: The sequential study phases include a baseline analysis of data quality, direct engagement and communication with each of the emergency department (ED) hospital sites, collection of survey and interview data and ongoing monitoring.

Results: In 2019/20, there were 371,683 injury-related ED presentations recorded in the VEMD. Percentage unspecified, the indicator of (poor) data quality, was lowest for 'body region' (2.7%) and 'injury type' (7.4%), and highest for 'activity when injured' (29.4%). In the latter, contributing hospitals ranged from 3.0–99.9% unspecified. The 'description of event' variable had a mean word count of 10; 16/38 hospitals had a narrative word count of <5.

Conclusions: Baseline hospital injury surveillance data vary vastly in data quality, leaving much room for improvement and justifying intervention as described.

Implications for public health: Hospital engagement and feedback described in this study is expected to have a marked effect on data quality from 2021 onwards. This will ensure that Victorian injury surveillance data can fulfil their purpose to accurately inform injury prevention policy and practice.

Key words: injury prevention, injury surveillance, data quality, protocol, emergency department

Worldwide, injuries are a major cause of morbidity and mortality. In 2017/18 in Australia, there were more than half a million (532,562) injury-related hospital admissions and 13,028 injury-related deaths.[1] Victoria is the most densely populated state in Australia with a population of 6.6 million. In 2018/19, more than 128,000 injury-related hospital admissions were recorded in Victoria, as well as over 372,800 injury-related emergency department (ED) presentations.[2]

To address the injury problem using a public health approach, four key questions have been outlined by the World Health Organization: i) how many injuries are there in the population and who is at risk?; ii) how are these injuries caused?; iii) what are effective interventions?; iv) how can these be implemented?[3] The first two questions can be addressed by means of a population-based injury surveillance system. Population-based injury rates need to be monitored[4] to inform injury prevention policy and practice. Injury rates can be tracked over time and they can be compared by cause, place of occurrence and patient demographics.

The Victorian Injury Surveillance Unit (VISU) has been analysing, interpreting and disseminating Victorian injury data for more than 25 years. Injury statistics are used to underpin government injury prevention policies, stimulate research and develop prevention strategies. These include community awareness initiatives and education, legislative and regulatory changes and safety-related product design improvements. To track rapid changes in injury rates, such as those that were observed during the 2020 lockdown periods in Victoria,[5] VISU is reliant on emergency department presentations data in the Victorian Emergency Minimum Dataset (VEMD). The VEMD holds de-identified clinical information on ED presentations at the 38 Victorian public hospitals with a designated 24-hour emergency department. The VEMD contains seven injury surveillance items: activity when injured; body region; description of the injury event; human intent; injury cause; nature of the main injury; and place where the injury occurred.[6]

Injury surveillance through the VEMD provides immense research potential and is crucial to the development of effective injury prevention and safety promotion. Injury statistics are provided to key injury prevention stakeholders such as the State Government, workers' compensation state statutory authority, the state road transport statutory insurer, not-for-profit organisations dedicated to the prevention of child injury, and many others. This information is

1. The Victorian Injury Surveillance Unit (VISU), Monash University Accident Research Centre, Monash University, Victoria

Correspondence to: A/Prof Janneke Berecki-Gisolf, The Victorian Injury Surveillance Unit (VISU), Monash University Accident Research Centre, Building 70, 21 Alliance Lane, Monash University, Clayton, Victoria, 3800; e-mail: janneke.berecki-gisolf@monash.edu

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disseminated through VISU's data request service, bulletins, reports, journal articles; hospital admission statistics are also available through the online Victorian Injury Atlas. However, the extent to which the VEMD fulfils its injury surveillance purpose depends on the quality of the collected data. The quality of the data differs by injury surveillance item[7]; data quality also differs per hospital[8] and it can fluctuate over time. Injury surveillance data quality in the VEMD is known to be affected by factors such as ED staff awareness and training, ED time constraints and software problems.[9] This can lead to data artefacts such as regional differences in injury rates, and upward or downward trends that merely reflect inter-hospital differences and fluctuations in data quality and completeness (respectively). For the VEMD to be effective in providing reliable injury surveillance data, injury data quality needs to be regularly evaluated, improved and intermittently monitored. Key barriers to injury surveillance data quality have not been assessed in recent times; moreover, many changes have occurred in the 16 years since the previously reported study.[9] Changes including more sophisticated software to collect and manage injury surveillance data, a new version of the ICD-10 with new disease and injury diagnostic codes, and significant increases in numbers of injury presentations for emergency departments justify a thorough re-assessment of current hospital-specific barriers to effectively collecting injury data.

The purpose of the study outlined by this paper is to improve VEMD injury surveillance data quality by identifying barriers and facilitators to injury data collection, and by providing contributing hospitals with tailored feedback and suggestions. This is to be achieved by: i) analysing VEMD injury surveillance items to determine patterns of missing and poor quality data; ii) providing hospitals with information on how the data are used in injury surveillance, as well as specific feedback on their injury surveillance data quality; iii) conducting a survey to gain hospital-specific information on how, when and by whom the injury surveillance data are recorded; iv) conducting ED staff interviews at each contributing hospital to explore perceived barriers to high-quality injury data collection; v) providing hospital-specific feedback and recommendations; and vi) ongoing monitoring of data quality. In this paper, we aim to: i) provide a baseline for the collective injury surveillance data quality of the 38 hospitals that collect injury data and contribute to the VEMD; and ii) describe the protocol for improvement of injury surveillance data quality in the VEMD. Importantly, this is the first study to conduct an in-depth analysis (including qualitative interview data) of barriers and facilitators of obtaining high-quality injury surveillance data, and also the first to provide hospital-specific feedback and recommendations to improve data quality.

Methods

The study protocol consists of four sequential phases: the first is a data analysis phase, which is followed by the second and third phases requiring direct engagement and communication with each of the emergency department hospital sites. The fourth and final phase involves ongoing monitoring. Each sequential phase is outlined below.

Phase 1: Analysing VEMD injury surveillance data

This first phase comprises a detailed analysis of the VEMD injury surveillance data for completeness, consistency and content. Data from the period June 2013 to July 2020 were sampled for this purpose. Injury cases were selected from the VEMD as cases with any of the three diagnosis fields in the range of S00-T75, or T79 (injury and poisoning; not including complications of medical or surgical care), or cases that have any of the injury surveillance items completed. However, completed injury surveillance items in the absence of an injury in the principal diagnosis were rare (0.5%).

The percentage of items that were coded as 'unspecified' (i.e. a lack of informative content) for each of the injury surveillance items is the primary measure of data quality, as well as a high-level content analysis (primarily average length of the string variables) of the 'description of the injury' free text or narrative. The data were explored to identify the presence of any hospital-specific response patterns that may be affecting the data, such as particular data entry settings (for example, the organisation of response options and default or custom response settings) or systematic data entry issues (for example, related to the mode of arrival or discharge). This analysis also investigated data incompleteness that may be due to data transfer from hospitals to the VEMD, or from the VEMD to the data extraction delivered to VISU.

Hospital-specific reports and presentations are subsequently provided to each of the ED sites, once contact is established with ED directors or their representatives to plan and schedule the hospital virtual site visits. It was intended that these site visits be conducted in person with representatives of the VISU team attending each hospital site in person; however, due to the restrictions imposed in early 2020 due to COVID-19, the protocol was modified to be conducted using a videoconference platform.

Phase 2: Provision of Phase 1 feedback and ED data collection

Following the engagement of a key staff member at each emergency department, the VISU research team schedules a 'virtual site visit' via videoconference (to comply with ongoing COVID-19 restrictions) with each hospital site in Victoria that contributes data to the VEMD. During this 'virtual visit', the research team will:

- discuss the importance of injury surveillance in informing policy and practice
- present an overview of injury statistics and how they are used to inform injury prevention, providing insight into the importance of the VEMD injury surveillance items
- provide an outline of the hospital's injury surveillance data quality in comparison to other hospitals (in a de-identified manner); any particular issues related to the narrative quality, data entry and default settings are also discussed
- investigate (pending appropriate ethics/governance approval) the hospital-specific procedures for capturing data, using a brief online survey and telephone interviews with two key ED staff members, one in more of a managerial role and the other with direct experience capturing the injury surveillance data. No specific ED staff member roles are targeted in particular; instead, skill set, knowledge and/or experience is emphasised as important for selection.

Data captured by the *survey* include staffing involved, process or model of data capture, timing and time lags, data collection software and software customisation and settings (Supplementary File 1). The *interviews* focus

on the challenges or barriers, as well as any facilitators, to obtaining high-quality injury surveillance data (Supplementary File 2).

Phase 3: Provision of site-specific feedback

The survey and interview data are collated and further analysed during Phase 3 to determine how the data collection system and procedures can be optimised in terms of time efficiency and data quality. The provision of feedback in the form of a final site-specific report includes best practice recommendations stemming from characteristics of ED hospital sites that deliver the highest quality injury surveillance data and that use a system that is also perceived by relevant staff as efficient. Such recommendations are intended to cover data collection software, use of guidelines and settings, and optimal processes or data capture models, including the timing of data entry. Finally, staff training and education, and awareness among staff of the importance of injury surveillance data are also covered in the recommendations.

Phase 4: Ongoing monitoring of injury data quality

Phase 4 comprises regular monitoring of data quality and completeness in the form of intermittent analysis and feedback of VEMD injury surveillance data quality. Ideally, this will take place every three to six months in the first year to ensure that hospitals are provided with timely feedback for their efforts.

Data analysis techniques

The survey study data are imported into SPSS and categorical variables are recoded, folded or grouped as required. Hospital-specific statistics that can be obtained from the VEMD are added to the database: these include ED patient caseload; ED injury patient caseload; injury/overall caseload ratio, per ED. Publicly available hospital location information is also captured, to determine the remoteness level of the hospital, using the Accessibility and Remoteness Index of Australia (ARIA). Data quality is described in descriptive statistics (mean, counts) as well as using multivariable linear models. Data quality of coded items is summarised by summing the percentage of unspecified data across coded injury surveillance items, per hospital. Narrative data quality is summarised as the average word count of the injury narrative, per hospital. These outcomes (coded data quality; narrative data quality) are each modelled as a function of the key survey results such as data entry software type, system customisation, data entry procedure details, IT support, management attitudes and workplace culture.

The interview data are transcribed and coded using NVivo qualitative research software (Version 12.6.0, QSR International). The coding scheme is developed using both inductive and deductive techniques. That is, it is based on a combination of the existing evidence base,[9-11] and the issues emerging from the first 4–6 interviews (i.e. 2–3 ED sites). The use of the coding scheme allows segments of the interview data to be coded that correspond to key influences on data quality, i.e. factors that are perceived as either acting as barriers or facilitators of quality. For example, the high-level theme (parent node) of staff-related influences encompasses several subthemes or nodes including work scheduling (workload/time pressure) and staffing (roles entering and managing data). The presentation of the qualitative results is descriptive in order to represent the data in a meaningful and relevant way for the target audience (the ED sites). This aligns with a descriptive method of qualitative data analysis.[12]

Site-specific data from the survey and the interviews are summarised in the final report and used as a foundation to make specific recommendations. In this paper, we present an overview of the phase 1: hospital-specific data quality results.

Results

Hospital overview

There are 38 hospitals that contribute data to the VEMD; each of these is required to collect injury surveillance data. An overview of these hospitals is provided in Table 1. The majority of these hospitals (58%) are located in metropolitan Victoria; only four hospitals (11%) are in outer regional Victoria. One-third of hospitals had more than 50,000 patients presenting to the ED annually. Approximately one in four ED presentations related to injuries, although in eight hospitals, this proportion was less than one in five. Some hospitals were specialised; this information is relevant to this study. For example, a maternity hospital may only rarely encounter injury-related ED presentations and it can therefore be expected that injury surveillance data collection is less well established or prioritised.

Injury surveillance coded items

VEMD-contributing hospitals vary vastly in terms of injury surveillance data quality. Data quality for each of the coded items is shown in Table 2: all 38 hospitals are included. In total, 371,683 injury-related ED presentations were recorded in 2019/20. The percentage unspecified was lowest for the body region and injury type variables, and highest for the activity when injured item. A high percentage unspecified signifies poor data quality. The ranges are also given in Table 2: it should be noted that the low end of the range was often found in specialised hospitals, which may not regularly encounter injury-related ED presentations.

Figure 1 shows trends in data quality for six of the injury surveillance items over the seven-year period 2013/14 to 2019/20. Quality of the 'injury type' variable improved over time, with the percentage of unspecified cases decreasing from 11% in 2013/14 to 7% in 2019/20. For the 'body region', there was a large improvement in quality over time, with a decrease in the proportion unspecified from 10% in 2013/14 to 3% in 2019/20. 'Injury cause' showed a slight improvement over time, decreasing from 17% of cases unspecified in 2013/14 to 14% in 2019/20. 'Place of injury' showed little variation in quality over time, with the

Table 1: Overview of VEMD-contributing hospitals (2019/20).

	N hospitals	%
Regionality		
Metropolitan	22	57.9%
Inner regional	12	31.6%
Outer regional	4	10.5%
ED Patients, annually		
<20,000	12	31.6%
20-50,000	14	36.8%
>50,000	12	31.6%
% of cases coded as injury, annually		
< 20%	8	21.1%
20-24%	15	39.5%
25-29%	14	36.8%
>30%	1	2.6%
Specialisation		
Eye & ear; Maternity, Children	3	7.9%
Not specialised	35	92.1%
Total	**38**	**100%**

proportion unspecified ranging between 24 and 26% in the seven-year period. Similarly, 'activity when injured' showed little change over time, ranging between 28 and 31% of cases unspecified. The 'human intent' variable showed some improvement in quality, with the proportion coded as either unspecified, other specified or cannot be determined decreasing from 15% in 2013/14 to 10% in 2019/20.

Injury surveillance narrative

In 2019/20, the number of words in the 'description of event' text variable ranged from 1 to 208, with a mean of 10.1 words (SD 10.5). Sixteen hospitals had a mean word count of five or less. Three hospitals had no blank entries. Blank entries comprised 3% of total entries, ranging from 1 to 11% among the 35 remaining hospitals.

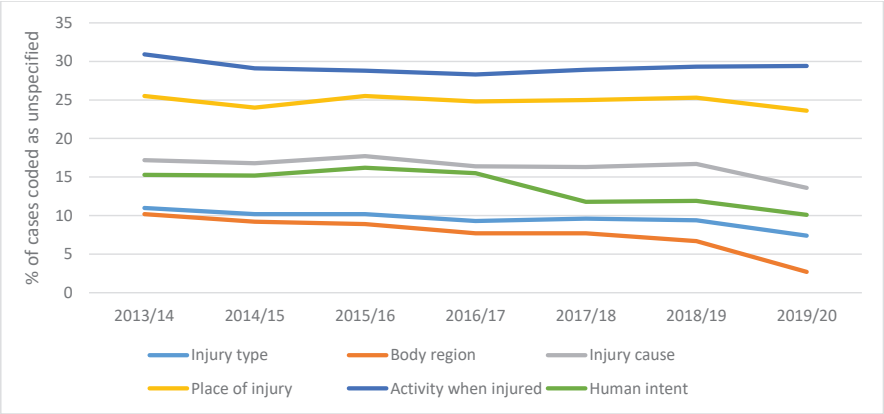
Table 2: Injury surveillance data quality in 2019/20.

Injury surveillance item	N cases in total	N (%) unspecified, overall	% unspecified, range across 38 hospitals
Injury cause	371,682	50,592 (13.6%)	(2.3–30.4%)
Injury type	371, 682	27,628 (7.4%)	(0–23.5%)
Body region	371, 682	10,205 (2.7%)	(0–12.1%)
Activity when injured	371, 682	109,277 (29.4%)	(3.0–99.9%)
Place of occurrence	371, 682	87,611 (23.6%)	(4.8–99.9%)
Human Intent[a]	371, 682	37,698 (10.1%)	(0.3–29.3%)

Note:

a: After 2016/17 the human intent codes 'other specified' and 'unspecified' were replaced with 'cannot be determined'. In 2019/20, a small number of hospitals continued to use the unspecified category. Percentages in Table 2 represent the combined total of unspecified and cannot be determined cases in that year.

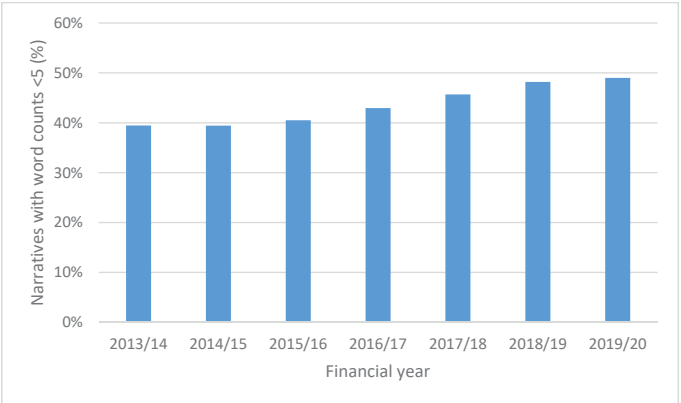
Figure 1: Trends in data quality for six of the injury surveillance items, 2013/14 to 2019/20.



Note:

Poor data quality was defined as the percentage unspecified for all but the human intent variable. Due to coding changes after 2016/17, the categories used to define data quality for human intent have changed over time. For human intent, percentages in this figure represent the combined total of unspecified, other specified and cannot be determined cases in each financial year.

Figure 2: Proportion of all injury narrative items (Description of Event) that had word counts of five or less, 2013/14 to 2019/20.



For the overall study period 2013/14 to 2019/20, the number of words in the description of event text variable ranged from 0 to 209, with a mean of 10.4 words (SD 9.4). Eleven hospitals had a mean word count of five words or less, indicative of relatively poor quality. Overall, blank entries comprised 1.6% of the total, with blank entries for individual hospitals ranging from 0 to 6% of cases for the seven-year period.

Figure 2 shows that the proportion of the description of event variable with a word count of five or less increased over time from 40% in 2013/14 to 49% in 2019/20, indicating a decline in data quality for the text descriptions.

Discussion

In this paper, we describe the four phases of the study to measure, improve and monitor data quality of injury surveillance data items in the VEMD in Victoria, Australia. An overview of baseline data quality is presented: there are vast differences in injury data quality both between hospitals and between injury data items; data quality also changes over time. Injury type and body region were mostly reported well with only 7% and 3% unspecified, respectively: this can be expected as this information is closely related to diagnosis, which is also routinely captured in non-injury ED presentations. However, other injury items were not universally well-coded: in particular, activity when injured and place of occurrence were often poorly coded, with 29% and 24% of cases coded as unspecified, respectively.

Activity when injured and place of injury are of particular relevance to injury surveillance: for example, sports injury case selection utilises both.[13] Hospital-treated sports injuries in Victoria were reported to have a substantial economic burden of $265 million in a 2015 study, which also reported increasing rates over time.[14] The measuring and tracking of sports injuries are paramount for sports injury prevention: this relies on ED injury data quality.

Place of injury coding is also required for surveillance of injuries in the home. This is of particular relevance since the onset of the pandemic, which has had a profound impact on home injuries and overall injury profiles.[15-19] The effect of lockdowns and stay-at-home orders on home injury patterns and trends needs to be monitored for the

overall evaluation of the impact of the pandemic, and also for adequate allocation of health service resources. The Victorian Injury Surveillance Unit has tracked changes in home injuries since the onset of the pandemic[5]; these statistics rely on adequate coding of the place of injury.

Narrative (free text) is another essential component of the injury surveillance data suite in the VEMD: injury narrative was not universally well populated. Narrative data are used to provide context, beyond the coded information in the injury items: they can provide the 'story' of how the injury occurred. This type of information is particularly useful for informing prevention efforts. However, narrative data are also essential for the selection of injury causes that are not captured in the coded data. Examples are product-related injuries, such as trampoline injuries[20]; specific mobility vehicle-related injuries, such as those resulting from quad bikes[21]; and specific pharmaceuticals in pharmaceutical poisoning, such as various opioid types[22,23] and antidepressants.[24] When the injury narrative is left blank or only sparsely populated, or if the narrative only contains information that duplicates what is already captured in the coded injury items, these types of studies will (often vastly) underestimate the actual number of cases in the population.

This study provides baseline measures of the quality of injury data collected in the VEMD in Victoria, Australia. The study is multifaceted and the first of its type: the rolling out of hospital data quality feedback, presentations to ED staff, and surveys and data collection are expected to have a marked effect on data quality from 2021 onwards. This change is expected to occur through: i) motivation of ED staff and management, by providing information on how the data are used to inform injury prevention policy and practice; ii) providing clarity regarding the various injury items, and what is expected (a video is in preparation, explaining, for example, the type of information that is required for the narrative field); iii) general advice on how to collect injury data efficiently and effectively, based on the overall findings from the surveys and interviews; and iv) individual, hospital-specific recommendations that particularly address the barriers identified at each ED site. The approach is to provide hospitals with information on what has been found to work well, in terms of the injury surveillance software and software settings, roles and responsibilities regarding data entry and other initiatives. For example, this can include allocating an 'injury data champion' among the ED staff and carrying out internal data quality audits.

The strengths of this study are the multi-faceted, thorough approach; the study consists of a range of intervention, data collection and feedback components, followed up by ongoing monitoring. Establishing contact with the various hospitals contributing to the VEMD will also help to open up discussions and interactions regarding the injury data collection, and the provision of injury surveillance reports, fact sheets and statistics to the hospitals will help hospital staff to feel engaged in injury prevention. There are limitations in the results presented in this study. Data quality is quantified as the proportion of the data that are marked as 'unspecified'. While this does not evaluate the accuracy of cases that have been incorrectly specified, past research has indicated that the coded injury data within the VEMD are typically (in more than 80% of cases) valid and reliable.[25] The practice of reverting to default settings cannot be picked up in this method, although over-representation of certain injury causes (activities, places) are manually checked during the data analysis. Finally, there is no way that undercounting of injury cases can be quantified in the VEMD. If the diagnosis is coded as non-injury in cases where it should have been coded as an injury, this results in undercounting that cannot be quantified retrospectively. Further to this, using word count as a measure of the quality (i.e. completeness) of the narrative injury description item has limitations: although poor-quality narratives generally have low word counts, not all narratives with low word counts are of poor quality. Future research should explore whether the narrative provides *informative* text regarding the injury that is not provided in the other items, such as product information. This was considered beyond the scope of the present study.

Conclusions and public health implications

In conclusion, in this study, we present the study outline and the baseline injury data quality of the VEMD. There is significant room for injury surveillance data quality improvement, particularly in the 'activity when injured' and 'place of injury' items: as there are vast differences between hospitals, it is anticipated that the poorest performers will benefit the most from the study. Injury data quality will be measured and reported over time, to determine the impact of the study on the data quality overall and underperforming hospitals in particular. If successful, a similar approach can be adopted in other areas of emergency department data collection, and injury surveillance in other jurisdictions.

Hospital engagement and feedback described in this study is expected to have a marked effect on data quality from 2021 onwards. This will ensure that Victorian injury surveillance data can fulfil their purpose to accurately inform injury prevention policy and practice.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary File 1: VEMD data quality survey.

Supplementary File 2: VEMD Interview script for the ED manager and data entry staff.