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Journal article

**Development of a data registry to evaluate the quality and safety of nursing practice****Sim, Jenny, Joyce-McCoach, Joanne, Gordon, Rob and Kobel, Conrad**

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## **Development of a data registry to evaluate the quality and safety of nursing practice**

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## **Development of a data registry to evaluate the quality and safety of nursing practice.**

### **Abstract:**

**Aim:** To describe the development, testing and implementation of a data registry of nursing-sensitive indicators for measuring the quality and safety of nursing practice.

**Background:** Recent research has established causal links between nurse staffing and patient outcomes. Unit level data is necessary for the implementation of evidence-based strategies on nurse staffing and nursing care processes.

**Design:** Multi-site, cross-sectional design

**Methods:** Retrospective data were collected from administrative data sets on nurse staffing, patient flow and adverse events in three hospitals in 2016. Periodic observational surveys on pressure injury prevalence, hand hygiene practices and documentation of processes of care were also conducted. Prospective data were collected from patients at the time of discharge using the Caring Assessment Tool. Nurses' perceptions of their practice environment were assessed using the Nursing Work Index-Revised: Australian. Data from annual Press Ganey® surveys on patient satisfaction/experience were obtained.

**Results:** The Australian Nursing Outcomes Collaborative data registry was developed in three phases. Phase one involved development of a data codebook; phase two involved the development and testing of data collection methods; and phase three involved development of data reports and data dissemination strategies. This paper provides an overview of these phases and includes a summary of the descriptive statistics from the indicator set.

**Conclusion:** Unit level data is pivotal for measuring the quality and safety of nursing care.

Data from the Australian Nursing Outcomes Collaborative can be feasibly collected and used to benchmark nursing performance, evaluate patient outcomes, and identify areas for practice improvement.

Keywords: nursing, nursing-sensitive indicators, evaluation, data registry

## **SUMMARY STATEMENT**

### **Why is this research or review needed?**

- The Australian Nursing Outcomes Collaborative data registry has been developed to holistically examine the impact nursing care has on patient outcomes. The feasibility of the data registry now needs to be explored.
- Meaningful data is needed to make evidence-based decisions about nurse staffing and nursing processes that can lead to improvements to patient outcomes.

### **What are the key findings?**

- The findings from this research provide evidence that the Australian Nursing Outcomes Collaborative data registry can be feasibly collected.
- Data from the Australian Nursing Outcomes Collaborative data registry can be used by managers to measure, monitor and improve the impact nursing care has on patient outcomes.

### **How should the findings be used to influence policy/practice/research/education?**

- This research provides action-able data for hospital managers to inform decision making about the cost and efficacy of patient care that is influenced by nurses and nursing processes.
- The findings from the Australian Nursing Outcomes Collaborative data registry can be used to acknowledge areas of good practice and identify areas for development through education, practice improvement and translation of evidence into practice.

## INTRODUCTION

Eminent nurse researchers have established a link between the number and qualifications of nursing staff and improved patient outcomes (Aiken et al., 2017). Relationships between the nursing practice environment and patient outcomes such as mortality have also been established (Ball et al., 2017; Cho et al., 2015; McHugh et al., 2016). Although seminal studies have been undertaken to examine the causal relationship between nurse staffing and patient outcomes, the translation of this evidence into practice has been slow and inconsistent. Nurses continue to practice in units where: staffing is sub-optimal; the skill mix has, and continues to be diluted; and the practice environment requires substantive improvements.

Investments in nursing will improve patient outcomes. Aiken and colleagues (2014) in the RN4CAST research programme have shown that increasing a nurse's workload in an inpatient unit by one patient, leads to a seven percent increase in mortality within 30 days of admission. Similarly for each 10 point increase in the percentage of baccalaureate prepared nurses, there is an 11 percent decrease in the odds of death (Aiken et al., 2017). Although this research has been published in prestigious, high ranking, peer reviewed journals the findings are not easily translated into units and departments where decisions about nurse staffing and evaluation of patient outcomes occur on a shift by shift basis (Needleman, 2017). The struggle in translating these findings into practice relate to financing investments in nursing within a limited healthcare budget. All countries have finite resources for healthcare. Because nurses make up a large percentage of the healthcare workforce, their salaries and wages have a substantial impact on healthcare expenditure and are frequently regarded as a significant cost (Pappas & Welton, 2015). This emphasis on cost can lead to reductions in nurse staffing and dilution of skill mix to fund other ever-expanding healthcare requirements regardless of the quality of the evidence that supports investments in nursing practice. The tension between

nursing as a cost, and nursing as an investment, make it difficult for nurse managers (who typically have limited autonomy in setting budgets) to make financial decisions to translate this seminal research into their practice environments. One reason for the difficulty in translating these findings into practice may be the absence of local unit level data for evaluation of outcomes. The lack of local data makes it difficult if not impossible for nurse managers to convince decision makers to support evidence-based decision making on nurse staffing and nursing processes.

## BACKGROUND

For over three decades, researchers have been investigating the contribution of nurses and nurse staffing on patient outcomes. Nursing-sensitive indicator (NSI) research has used a variety of different approaches over this time. They include: cross-sectional studies that use administrative data and data collection instruments (e.g. RN4CAST) (Sermeus et al., 2011); data abstractions from large administrative data sets to measure mortality and / or the prevalence of specific adverse events as coded within medical records (e.g. Harvard Public Health Study) (Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002; Twigg, Duffield, Bremner, Rapley, & Finn, 2011); nursing minimum data sets so that nursing interventions and outcomes can be evaluated (e.g. Nursing Outcomes Classification) (Moorhead, Johnson, Maas, & Swanson, 2008); nursing metrics (e.g. NHS Safety Thermometer) (Foulkes, 2011); and the use of nursing outcomes databases such as the National Database for Nursing Quality Indicators (NDNQI) so that unit level data can be collated and benchmarked (Press Ganey, 2017). All of these approaches have merit.

Organisations that collect data as part of a nursing data registry [e.g. NDNQI, and Collaborative Alliance for Nursing Outcomes (CALNOC)] demonstrate improvements in patient outcomes over time (Aydin, Donaldson, Stotts, Fridman, & Brown, 2015; Press Ganey, 2018b). Nursing data registries capture data on nurse staffing, nursing processes and

nurse-sensitive patient outcomes at the unit level and use that data to benchmark outcomes over time, with peer units and against national targets (CALNOC, 2017; Press Ganey, 2018b). Evidence from CALNOC has shown that participating organisations have reduced hospital acquired pressure injuries (all stages) from 10.4% in 2003 to 1.8% in 2010 (Stotts, Brown, Donaldson, Aydin, & Fridman, 2013). There are also numerous examples of published studies reporting on unit or hospital wide improvement initiatives related to either NDNQI or CALNOC data (Aydin et al., 2015; Morehead & Blain, 2014). The primary feature of nursing data registries is the use of unit level data for benchmarking and comparisons.

Measuring and reporting on patient outcomes at the unit level is pivotal to improving patient outcomes. The vast majority of Australian hospitals do not have access to timely, unit level NSIs (Heslop, 2015). One jurisdiction in Australia (Queensland) has recently implemented a set of seven NSIs which include structure, process and outcome measures that focus on nurse staffing, hand hygiene compliance rates and adverse events (falls, pressure injuries and medication administration errors) (Robertson, Mitchell, Moss, & Casey, 2017). The Queensland Health NSIs reflect the findings of a literature review that identified a focus in NSI research on nurse staffing and patient safety indicators or adverse events (Burstion, Chaboyer, & Gillespie, 2014). This focus on nurse staffing and safety indicators is also seen in nursing data registries such as NDNQI and CALNOC.

The historical focus on patient safety outcomes within NSI research can most likely be attributed to foundational reports on avoidable error in the healthcare system, such as *To Err is Human* (Institute of Medicine, 2000). More recent reports such as the Francis Report into health system failings in the Mid Staffordshire General Hospital NHS Trust in England (Francis, 2013) have highlighted the impact that workplace culture can have on patient outcomes. Research which focuses on the nursing practice environment, the use of person-



centred care (McCance, Wilson, & Kornman, 2016) and patient-reported outcome measures (PROMs) (Williams, Sansoni, Morris, Grootemaat, & Thompson, 2016) have all broadened the scope of NSI research. The ability for a data registry to collect such a comprehensive suite of NSIs has not previously been attempted. This paper describes the development, testing and implementation of a data registry which includes a broad cross-section of NSIs. The research draws on studies undertaken within a doctoral project to conceptualise and identify an indicator set for measuring both the quality and safety of nursing care (Sim 2015).

## THE STUDY

### Aim

The purpose of this paper is to describe the development, testing and implementation of a data registry on nursing-sensitive patient outcomes that holistically examines the impact that nursing care has on patient outcomes. The data registry collects data on structural elements of care, nursing care processes and patient outcomes to provide action-able data for unit and hospital managers; evaluate evidence-based decisions about nurse staffing, nursing processes and improvements to patient outcomes; and provide data to influence decision making about the cost and efficacy of patient care that is influenced by nurses and nursing processes. The development, data collection methods and the lessons learned during implementation of the AUSNOC data registry are the focus of this paper.

### Design

A multi-site, cross-sectional design was used to collect retrospective data from existing administrative datasets; observational data on nursing processes and/or outcomes; and survey data from nurses and patients about their experiences.

### Sample

The sample consists of three acute care hospitals in NSW, Australia. All participating hospitals were private hospitals with a mixture of medical (n=3), surgical (n=4) and sub-acute

(rehabilitation) (n=1) units participating in the project. All hospitals were part of the one organisation and had the same data management systems.

### Measures

Tables 1–3 provide the indicators and their abbreviated standardized definitions. Table 1 provides details on the structural indicators collected within the data registry from administrative data and nurse surveys on the practice environment. Table 2 provides details on the safety indicators and includes data from administrative data and observational studies. Table 3 provides details on the patient reported indicators and includes data from patients in the Caring Assessment Tool survey and the Press Ganey® Patient Satisfaction survey.

### *Reliability*

Data reliability was assessed by randomly auditing administrative data with Nurse Managers in each unit to determine accuracy in nurse staffing and admission, discharges and transfers data. Adverse events (falls, hospital acquired pressure injuries and medication errors) recorded in risk management data were cross checked with coded medical records to ensure that all documented events were included within the administrative data. A small number of events were added to the risk management data following this audit process. Interrater reliability for observational audits (Pressure Injury Prevalence, Processes of Care and Hand Hygiene Compliance) was built into the design of each audit.

Pressure Injury Prevalence audits used European Pressure Ulcer Advisory Panel (EPUAP) methodology (James, Evans, Young, & Clark, 2010; Vanderwee, Clark, Dealey, Gunningberg, & Defloor, 2007) with two independent auditors who had successfully completed the NDNQI Pressure Ulcer Training module (Pressure Injuries and Staging) prior to commencing the audit. During audits, both auditors agreed on the pressure injury stage of all identified pressure injuries as part of documentation. The International NPUAP/EPUAP/PPPIA Pressure Ulcer Classification system (National Pressure Ulcer

Advisory Panel, European Pressure Ulcer Advisory Panel, & Pan Pacific Pressure Injury Alliance, 2014) was used to stage pressure injuries and was used to clarify areas of disagreement (if they had occurred).

The Processes of Care audit was completed at the time of the Pressure Injury Prevalence audit and used the same two independent auditors who had been orientated to the nursing documentation being used in the unit. The Hand Hygiene Compliance audit was completed using the methodology of Hand Hygiene Australia and includes an annual validation process for all auditors (Hand Hygiene Australia, 2018b).

For the self-report instruments, internal consistency reliability was examined. Data from the Caring Assessment Tool survey is being examined using confirmatory factor analysis and will be reported separately. The internal reliability of the overall scale was 0.98 with subscales ranging from 0.97 to 0.96. The Nursing Work Index Revised: Australian has an internal reliability of 0.76 with subscales ranging from 0.70 to 0.87. The Press Ganey<sup>®</sup> patient satisfaction surveys were undertaken by each hospital and included official HCAHPS program questions as well as additional questions examining patient experience (Press Ganey, 2018a).

### *Validity*

Content validity for most of the individual indicators has been previously established by NDNQI, CALNOC and the RN4CAST research projects (CALNOC, 2017; Press Ganey, 2018b; Sermeus et al., 2011). The Caring Assessment Tool was added to provide data about the nurse-patient relationship and the achievement of person centred care (Duffy 2014, Authors own 2018a). Data were collected in the AUSNOC data registry on all key concepts within the conceptual framework for measuring the quality and safety of nursing practice (Sim et al., 2018).

All administrative data were checked for incomplete data following data submission and resubmission was requested where necessary. Observational surveys did not contain any missing data due to the data collection procedures that were adopted. Participation rates in the observational surveys ranged from 91% to 100% indicating adequate representation of the population. Self-report surveys were removed from analysis if missing data were received. Caring Assessment Tool surveys that were completed on paper-based forms were given a unique identifier and data entry accuracy was verified in a random selection of surveys.

#### Data Collection

At the commencement of the study, AUSNOC team members visited each site to orientate key stakeholders to the project and its scope. Nursing leaders, hospital executive staff, the data system architect and AUSNOC team members formed a consultative group to plan data collection, data analysis and data dissemination. This group identified a key contact in each hospital who worked directly with the AUSNOC team when data collection issues were identified in a hospital. The data systems architect worked with the AUSNOC team to develop protocols for data collection and data transmission of all administrative data via Secure File Transfer Protocol (SFTP).

#### *Administrative data*

A data codebook was developed to ensure all staff were aware of data definitions and details about data collection for each indicator. A one month period of trial data were examined with nurse managers to ensure consistent application of the codebook and accuracy of data definitions within transmitted data. The trial data were not included in data analysis. Adverse event data were analysed four weeks after discharge from the unit to allow coded medical records to be included in the risk management system, thereby increasing the accuracy of data from documented adverse events.

#### *Observational audits*

One of the researchers (JS) undertook all Pressure Injury Prevalence and Processes of Care audits at all sites. The second auditor was a hospital representative with expertise in pressure injury staging and was nominated at each site. Neither individual was involved in care of the patients on the units being studied and were supernumerary to staffing requirements on the day of the survey. Every patient on each unit was asked to participate in the observational audits. In rare cases, patients refused to participate or were excluded due to end-stage care. The percentage of patients assessed was 91% to 100% in each unit. Participating patients were visually inspected for pressure injuries over all bony prominences and other pressure injury prone regions (e.g. under medical devices). Location and stage of pressure injuries were recorded for each patient as well as whether the pressure injury had been present on admission. Processes of Care audits involved assessment of nursing documentation in the patients' medical record for risk assessments of pressure injuries, skin inspections, use of pressure injury risk mitigation strategies, risk assessment for falls, falls management strategies, restraint prevalence and the presence of patient identification. The Hand Hygiene Compliance audit was conducted by a trained and validated assessor using the Hand Hygiene Australia methodology (Hand Hygiene Australia, 2018a). The auditor was a nominated staff member from each unit but was supernumerary to staffing requirements during the audit.

### *Surveys*

All patients in participating units were invited to participate in the Caring Assessment Tool survey at time of discharge. The survey was completed using an online survey tool in RedCap software (Harris et al., 2009) via an iPad™, or by completing a paper-based form that was then entered into the online survey tool by a nominated administration staff member in each ward. The data on patient satisfaction / experience were obtained from pre-existing

surveys undertaken in each hospital by Press Ganey<sup>®</sup>. There was no burden on staff for collection of the patient satisfaction / experience data.

Nurses were invited to complete the Nurse Survey which included demographic questions and the Nurses Work Index – Revised: Australian. Nurses received an email from a hospital representative with a link to the online survey. Information about the survey and how the data would be shared were included in the email. All nurses who worked full time, part time or on a casual basis in each participating ward were invited to complete the survey. Nurses who worked in multiple wards were asked to complete a separate survey for each ward. This survey was completed once during the study period.

#### Ethical Considerations

The University of Wollongong approved the study (Approval No HE2015/425). No identifiable data were collected from any participant. All data obtained in the project was transmitted via SFTP and subsequently stored securely on password protected computer systems at the University of Wollongong. Participant consent was obtained for all observational audits and surveys prior to data collection.

#### Data Analysis

Descriptive analysis of all data were undertaken to provide quarterly reports. Data were presented for each unit using means and standard deviations as required. Data for medical and surgical units were benchmarked by specialty type and hospital averages were also presented.

## RESULTS

### Development, testing and implementation of AUSNOC

The development, testing and implementation of the data registry occurred in three phases.

*Phase 1:* The AUSNOC data registry began with recruitment of three hospitals in 2015.

Workshops were held with key stakeholders in each hospital to examine the proposed indicators and develop data definitions using accepted data definitions from NDNQI, CALNOC or other research projects (wherever possible). Development of data definitions included evaluation of individual hospital indicators and reaching a shared understanding of the data definitions and how they would be applied in practice. This process involved developing a data codebook for all data elements within the data registry. Achieving consensus on all data elements was a lengthy process.

*Phase 2:* The next step involved identification of administrative data from within patient administrative systems, human resource systems and risk management systems. Data capture was piloted prior to the project commencing. This involved manual transfer of data from the administrative systems for all units and auditing of these against the data codebook developed in phase 1. Data transfer procedures were then automated and scheduled to occur monthly SFTP. Data was received each month within 2016 at a scheduled date and time. On occasions when data was late an email reminder was sent to the data systems architect. All data were screened for out-of-range elements, reconciled with nurse managers and analysed descriptively.

Observational audit tools were developed and pilot-tested during phase 2. This included: 1) the Pressure Injury Prevalence survey which uses EPUAP methodology; 2) a Processes of Care audit examining pressure injury and falls risk management processes, restraint prevalence, and patient identification; and 3) a Hand Hygiene Compliance audit using Hand Hygiene Australia methodology which is based on the World Health Organisation's five moments of hand hygiene (Hand Hygiene Australia, 2018b).

Three cross-sectional surveys were also used. The Caring Assessment Tool was developed as an online survey in RedCap software (Harris et al., 2009) and was completed by

patients at time of discharge via an iPad™, or a paper-based form that was subsequently entered into the online survey tool. The Nurse survey was developed as an annual online survey in RedCap software (Harris et al., 2009) and was distributed as a link in an email to all nursing staff (full time, part time and casual) who worked in each participating unit. Patient experience / satisfaction data were obtained from existing Press Ganey® Patient Satisfaction surveys that were undertaken at each hospital bi-annually.

*Phase 3:* Following completion of 3 months of data collection, a variety of unit-level reports benchmarked by unit type were produced for each unit and each hospital. Consultation on report design, report format and report interpretation occurred with nurse managers and hospital executive staff. Data presentation then evolved over the project with the aim of ensuring that data were reported in a meaningful way for nursing staff in each unit as well as managers and executive staff. Achieving meaningful data presentation and improving the timeliness of reports were two of the biggest challenges within the project. Initial data reports contained many graphs and tables and reported data by benchmarking between units and against agreed performance indicators. As additional data were analysed, the data was presented using trends that highlighted current performance against peers and over time. Producing reports was labour intensive and required large amounts of statistical support. Automation of data formats and analysis was developed over time.

#### Data Collection burden

Most data within the AUSNOC data registry was collected from data that was available within administrative data management systems. This decreased the burden of data collection which can be seen in some data registries. The Pressure Injury Prevalence and the Processes of Care audits were undertaken as observational audits and did involve additional staffing for the purpose of data collection. The additional staffing involved the time of one member of the research team (JS) and one staff member per survey per ward for an 8 hour



period. This had a financial cost for each participating unit and may require revision for the ongoing feasibility of data collection. Data from the Caring Assessment Tool was collected from patients at the time of discharge. While data collection occurred on an iPad for most participants, patients were prompted to complete the survey by a staff member and some surveys were completed on paper based forms when this was the preference of the patient. Both of these strategies impacted on staff and resulted in lower than anticipated completion rates of the Caring Assessment Tool survey. The length of the Caring Assessment Tool survey was also perceived to be a burden and future refinements would include a shorter survey or change in the approach for data collection. The use of retrospective patient experience data decreased burden in data collection but it meant that the data was not contemporaneous and this had significant limitations.

#### Summary of descriptive data

The AUSNOC data registry contains data on the structure, process and outcomes of nursing practice. A descriptive summary of the data that was collected is provided in the next few paragraphs. The AUSNOC data registry includes 65,000 bed days, 12,654 admissions, 12,627 discharges and 22,956 transfers of patients between units. A total of 69,120 hours of staffing has been analysed with data available on numbers of staff, skill mix and Nursing Hours Per Patient Day (NHPPD) for each hour of each day in each participating ward.

Nurses completed a total of 108 surveys on their practice environment using the NWI-R:A which constituted a response rate of 35 % of all invited staff. Data from 249 patient experience questionnaires were analysed. This equates to a response rate among sampled patients of between 32.3% and 39.4% in each hospital. In addition, 2,103 patients completed surveys at the time of discharge on the caring attitudes and actions of nursing staff using the Caring Assessment Tool.

A total of 370 adverse events were recorded in the data registry. This included 66 hospital acquired pressure injuries, 254 patient falls and 50 medication errors. A total of 224 patients participated in pressure injury prevalence and processes of care surveys. Hospital acquired pressure injury prevalence rates of between 13% and 35% were reported in each hospital. The overall prevalence rate was 22% with 49 pressure injuries observed during point prevalence surveys. Data on processes of care included risk assessments and care planning for falls and pressure injuries. Risk assessments for falls and documentation of a falls management plan (within 24 hours of admission) were completed for 84.8% and 87.1% of patients respectively. Risk assessment and skin assessments for pressure injuries were completed (within 24 hours of admission) for 60.3% and 52.7% of patients respectively. Skin assessments on the most recent three days of care were documented for 52.2% of patients. Repositioning regimes for patients unable to independently reposition (n=44) were documented in 50.0% of patients.

## DISCUSSION

The AUSNOC data registry has demonstrated that it is feasible to comprehensively collect a dataset that examines the impact of nursing practice on patient outcomes. The unique contribution AUSNOC makes is in the breadth of concepts covered within the data collected. The data registry explicitly examines concepts related to the quality and safety of nursing care and includes Care and Caring; Communication; Coordination & Collaboration and Safety (Sim, 2015). This data is then shared with nurses, nurse managers and hospital managers so that all nurses can engage in and focus on the impact nursing care has on patient outcomes. The dissemination of data at the unit level, aims to ensure nurse managers have local data available to support discussions with healthcare executives and governance bodies to enable evidence-based decision making on nurse staffing and nursing processes. In

addition, findings from AUSNOC have enabled benchmarking between hospital and units in relation to staffing, patient flow, nursing processes and patient outcomes.

Data from AUSNOC can be used by ward nurses, managers and organisational leaders to inform evidence based decision making on nurse staffing, nursing care processes and patient experience in units where it is implemented. As an example, one of the hospitals in this study identified high rates of pressure injury prevalence during the pressure injury prevalence audits conducted in phase 2 of the project. Repeat pressure injury prevalence studies were conducted in phase 3 after implementation of education programs for staff, changes to equipment and improved screening practices on admission. These changes resulted in significant improvements to nursing care processes (risk assessment procedures and care planning to improve skin assessments and risk mitigation strategies) which improved patient outcomes (reduction in pressure injury prevalence).

Data quality and data management practices are vital when implementing a data registry. The use of data definitions is important to ensure data is collected in a consistent fashion between all participants. Data validation is also important and all data outside a standardised range was assessed for accuracy to ensure data entry error had not occurred. Automation of standardised data from all administrative systems also minimised risk of data entry error. In addition, data dissemination at unit level is vital. Ownership of data occurred when larger numbers of people were involved in collection of nursing process data. The engagement in data collection enabled them to link the outcomes by which they were measured with the nursing processes for which they were responsible. This process helped individual staff to understand what was being collected as part of the AUSNOC data registry and involvement in collection of the nursing care process data supported engagement in the project. As an example of this, one unit identified a reduction in compliance with

documentation of falls management plans for high risk patients and implemented local education programs to improve staff knowledge of best practices in falls management.

While most data from the data registry was gathered from administrative data, data from observational surveys such as the Pressure Injury Prevalence and Processes of Care Audit were seen as burdensome by some units. This was because data collection involved two staff for an entire 8-hour shift to comprehensively collect the associated data in each unit. Familiarity with the data collection tool and the nursing notes and medical record systems in each ward did decrease time for completion over the course of the study. Development of an online data collection tool may further decrease this time and burden. Similarly, data collected from the Caring Assessment Tool was seen as burdensome in some units. Data was collected at the time of discharge and involved an administrative staff member approaching each patient being discharged and asking them if they would like to complete the survey. An online data collection form via an iPad was the preferred method of data collection but a paper based form was also available. When an administrative staff member was unavailable then patients were frequently not asked to complete the survey. This had an impact on numbers of surveys completed in some wards.

The relationships that developed between the research team and stakeholders in all hospitals contributed to the development of the AUSNOC data registry. Hospital staff were supported by the research team to implement evidence-based practice initiatives including assisting key decision makers to identify the best evidence (relevant to context). In addition, reports from the AUSNOC data registry assisted staff to meet accreditation and regulation requirements. This resulted in the AUSNOC data registry being mapped to the National Safety and Quality Health Service (NSQHS) Standards developed by the Australian Commission on Safety and Quality in Health Care (Australian Commission on Safety and Quality in Health Care, 2017).

## Limitations

The AUSNOC data registry has been implemented in three hospitals in the State of New South Wales in Australia. All hospitals were private hospitals run by the same company. Given the small number of hospitals involved in this trial, expansion into other hospitals and in the public sector is required to further test the scalability of AUSNOC infrastructure and examination of the data elements. Other limitations include the use of retrospective patient experience data as part of the AUSNOC data registry. Ongoing development of the data registry will incorporate collection of patient experience data at the time of discharge.

Measuring nursing practice in isolation from other influences within the hospital setting is complex. Nurses do not provide care in isolation from other healthcare providers and outcomes are not solely dependent upon nurses. Despite these issues measuring nursing practice is important and the AUSNOC data registry is attempting to this in a comprehensive way so that the structure, process and outcome of nursing practice can be measured. The AUSNOC data registry does not claim to measure holistic patient outcomes but it does attempt to measure the impact of nurses and nursing practice on the patients we care for. It is inevitable that the AUSNOC data registry elements will evolve over time.

## CONCLUSION

This paper describes the development, testing and implementation of a data registry on nursing-sensitive patient outcomes. Routine collection and reporting of data that examines the quality and safety of nursing care and the impact that nursing care has on patient outcomes is vital for healthcare organisations. This data needs to be collected at unit level so that local managers have data to support evidence-based decision making on nurse staffing and nursing care processes. If nurse managers don't have data to support discussions on these important components of nursing practice then decisions on staffing and nursing care processes are based on intuition rather than facts. Patients deserve better than that.

International research (Aiken et al., 2017; Ball et al., 2017; McHugh et al., 2016) has demonstrated the impact nursing care has on patient outcomes. Nurse Managers need local data to help them convince local health care executives of the impact nursing care has on patient outcomes. AUSNOC assists Nurse Managers to collect and use this data. Further development of AUSNOC will see web-based reporting of outcomes and streamlining of data collection and data analysis processes to facilitate scalability and expansion of AUSNOC to other hospitals in Australia.

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### CONFLICT OF INTEREST

No conflict of interest has been declared by the author(s).

### AUTHOR CONTRIBUTIONS

All authors have agreed on the final version and meet at least one of the following criteria [recommended by the ICMJE (<http://www.icmje.org/recommendations/>)]:

- substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
- drafting the article or revising it critically for important intellectual content.

Table 1: AUSNOC Structural indicators

| Indicator   | Brief definition   | Level of data  | Data Collection Methods |
|---|--|----------------|-------------------------|
| <b>Ward type</b>                                    | Categorisation of ward: Medical; Surgical; Rehabilitation  | Unit           | Administrative data     |
| <b>Admissions</b>                                   | Number of admissions to ward   | Unit (Hourly)  | Administrative data     |
| <b>Discharges</b>                                   | Number of discharges from ward   | Unit (Hourly)  | Administrative data     |
| <b>Transfers</b>                                    | Number of transfers from ward  | Unit (Hourly)  | Administrative data     |
| <b>Census (Total numbers of admitted patients)</b>  | Total number of admitted patients in ward  | Unit (Hourly)  | Administrative data     |
| <b>Total number of individual patients</b>          | Sum of total number of individual patients admitted to ward per month  | Unit (Monthly) | Administrative data     |
| <b>Patient bed days per month</b>                   | Sum of total number of patient bed days in ward per month  | Unit (Monthly) | Administrative data     |
| <b>Length of stay</b>                               | Average Length of stay for patients admitted to the ward   | Unit (Monthly) | Administrative data     |
| <b>Average occupancy</b>                            | Average occupancy in ward per day  | Unit (Daily)   | Administrative data     |
| <b>Average turnover</b>                             | Sum of admissions, discharges & transfers divided by hourly census, reported as a daily average                  | Unit (Daily)   | Administrative data     |
| <b>Nursing care hours: Total</b>                    | Total productive hours worked by nurses in direct patient care   | Unit (Hourly)  | Administrative data     |
| <b>Nursing Care hours: RN</b>                       | Total productive hours worked by RNs in direct patient care  | Unit (Hourly)  | Administrative data     |
| <b>Nursing care hours: EN</b>                       | Total productive hours worked by EN's in direct patient care   | Unit (Hourly)  | Administrative data     |
| <b>Nursing Care hours: AIN</b>                      | Total productive hours worked by AIN's in direct patient care  | Unit (Hourly)  | Administrative data     |
| <b>Nursing Hours Per Patient Day (NHPPD): Total</b> | Total numbers of nursing hours worked per patient day  | Unit (Daily)   | Administrative data     |
| <b>Nursing Hours Per Patient Day (NHPPD): RN</b>    | Total number of nursing hours worked by Registered Nurses (RN) per patient day                                   | Unit (Daily)   | Administrative data     |
| <b>Nursing staff mix</b>                            | Proportion of different levels of nursing staff (e.g. RN, EN, AIN)   | Unit (Hourly)  | Administrative data     |
| <b>Full-time &amp; part-time hours (%)</b>          | Percentage of productive hours worked by nurses in direct patient care that are performed by permanent employees | Unit (Hourly)  | Administrative data     |
| <b>Casual staff hours (%)</b>                       | Percentage of productive hours worked by nurses in direct patient care that are performed by casual employees    | Unit (Hourly)  | Administrative data     |
| <b>Agency hours (%)</b>                             | Percentage of productive hours worked by nurses in direct patient care that are performed by agency nurses       | Unit (Hourly)  | Administrative data     |
| <b>Overtime hours (%)</b>                           | Percentage of productive hours worked by nurses in direct patient care that are overtime                         | Unit (Hourly)  | Administrative data     |
| <b>Sick hours (%)</b>                               | Percentage of hours worked by nurses in direct patient care that are on sick leave                               | Unit (Hourly)  | Administrative data     |
| <b>Nursing headcount</b>                            | Total number of permanent nursing staff employed on unit   | Unit (Monthly) | Administrative data     |
| <b>Nursing resignations</b>                         | Number of nurses leaving organisation in the month   | Unit (Monthly) | Administrative data     |

|  |   |                |                     |
|--|---|----------------|---------------------|
| <b>Nursing staff turnover</b>  | Turnover over of nursing staff (resignations) as a percentage of total number of permanent staff employed on unit   | Unit (Monthly) | Administrative data |
| <b>Nursing staff education &amp; experience</b>  | Years of education, highest nursing degree, years of nursing experience   | Unit (Annual)  | Nurse Survey        |
| <b>NWI-R:A Total Score</b>   | Overall experiences of the nursing practice environment   | Unit (Annual)  | Nurse Survey        |
| <b>NWI-R:A – Subscale: Nursing Foundations for Quality of Care (QC)</b>                  | Nursing staff perceptions of the quality of care provided (Items 7,22,28,30,34,37,38, 44, 45)                       | Unit (Annual)  | Nurse Survey        |
| <b>NWI-R:A – Subscale: Nurse Manager Ability, Leadership and Support of Nurses (MLS)</b> | Nursing staff perceptions of the Manager’s ability, leadership skills and advocacy for nurses (Items 4, 13, 18, 32) | Unit (Annual)  | Nurse Survey        |
| <b>NWI-R:A – Subscale: Nurse Participation in Hospital Affairs (NP)</b>                  | Nurses perceptions of nursing’s role in hospital activities (Items 8, 9, 14, 23, 26, 33, 35, 39, 41)                | Unit (Annual)  | Nurse Survey        |
| <b>NWI-R:A – Subscale: Staffing and Resource Adequacy (SR)</b>                           | Nurses perceptions of staffing adequacy and availability of resources (Items 1, 11, 12, 16)                         | Unit (Annual)  | Nurse Survey        |
| <b>NWI-R:A – Subscale: Collegial Nurse-Physician Relations (NPR)</b>                     | Nurses perception of collegiality and collaboration with medical staff (Items 2, 24, 36)                            | Unit (Annual)  | Nurse Survey        |



Table 2: AUSNOC Safety indicators

| <b>Safety indicators</b>   | <b>Brief Definition</b>  | <b>Level of data</b> | <b>Data Collection Methods</b> |
|--|--|----------------------|--------------------------------|
| <b>Patient falls - incidence</b>   | The rate per 1,000 patient days at which patients experience an unplanned descent to the floor   | Unit (Monthly)       | Administrative data            |
| <b>Patient falls with injury - incidence</b>   | The rate per 1,000 patient days at which patients experience an unplanned descent to the floor with injury documented on incident report.  | Unit (Monthly)       | Administrative data            |
| <b>Hospital acquired pressure injury (HAPI) incidence – all stages</b>                         | The number of patients with a hospital acquired pressure injury (all stages) as a percentage of the total number of admitted patients in the unit over one month   | Unit (Monthly)       | Administrative data            |
| <b>Hospital acquired pressure injury (HAPI) incidence - by Stage</b>                           | Number of patients with a hospital acquired Stage 1 / Stage 2 / Stage 3 /Stage 4 / Unstageable /Suspected deep tissue injury as a percentage of the total number of admitted patients in the unit over one month   | Unit (Monthly)       | Administrative data            |
| <b>Medication administration errors - incidence</b>  | The rate per 1,000 bed days where a medication error occurs (a medication error is defined as a deviation from the medication ordered by the medical officer with the error committed during administration)   | Unit (Monthly)       | Administrative data            |
| <b>Staphylococcus Aureus bloodstream infections (hospital onset)</b>                           | The rate per 10,000 bed days of the number of patients with a Staphylococcus Aureus bloodstream infection (hospital onset)   | Hospital (6 monthly) | Administrative data            |
| <b>Pressure injury prevalence</b>  | The percentage of all patients on the day of the prevalence study with any stage of pressure injury  | Unit (Periodic)      | Observational Audit            |
| <b>Hospital acquired pressure injury prevalence</b>  | The percentage of all patients on the day of the prevalence study with any stage of pressure injury that occurred or worsened following hospital admission   | Unit (Periodic)      | Observational Audit            |
| <b>Restraint use prevalence</b>  | The percentage of all patients on the day of the prevalence study that are restrained (any method of restricting a patient's freedom of movement, physical activity, or normal access to his or her body)  | Unit (Periodic)      | Observational Audit            |
| <b>Pressure injury risk assessment in place (on admission)</b>                                 | The percentage of all patients on the day of the prevalence study that had documentation of a pressure injury risk assessment completed within 8 hours of admission to the ward  | Unit (Periodic)      | Observational Audit            |
| <b>Comprehensive skin assessment documented (on admission)</b>                                 | The percentage of all patients on the day of the prevalence study that had a comprehensive skin assessment documented within 8 hours of admission to the ward  | Unit (Periodic)      | Observational Audit            |
| <b>Pressure injury risk assessment in place (for patients at risk of pressure injury)</b>      | The percentage of all patients who were at risk of a pressure injury on the day of the prevalence study, that had documentation of a pressure injury risk assessment completed on each of the most recent 3 days (if in hospital for less than 3 days then score for total days in hospital) | Unit (Periodic)      | Observational Audit            |
| <b>Pressure injury prevention equipment in place (for patients at risk of pressure injury)</b> | The percentage of all patients who were at risk of a pressure injury on the day of the prevalence study, that had pressure injury prevention equipment in use at time of pressure injury prevalence survey   | Unit (Periodic)      | Observational Audit            |

|   |  |                  |                        |
|---|--|------------------|------------------------|
| <b>Falls risk assessment in place (on admission)</b>                                      | The percentage of all patients on the day of the prevalence study that had documentation of a falls risk assessment completed within 8 hours of admission to the ward  | Unit (Periodic)  | Observational Audit    |
| <b>Falls risk assessment and management plan in place (for patients at risk of falls)</b> | The percentage of all patients who were at risk of a falls on the day of the prevalence study, that had documentation of a falls risk assessment and management plan completed on each of the most recent 3 days (if in hospital for less than 3 days then score for total days in hospital) | Unit (Periodic)  | Observational Audit    |
| <b>Valid restraint order in place (for patients who were being restrained)</b>            | The percentage of all patients who were restrained on the day of the prevalence study, that had a valid restraint order documented in the medical record   | Unit (Periodic)  | Observational Audit    |
| <b>Hand-washing practices</b>   | The percentage of compliance with the 5 moments of hand hygiene as indicated from systematic recording & observation of 100 hand hygiene opportunities for each participating unit   | Unit (3 monthly) | Observational Audit    |
| <b>Patient identification practices</b>   | The percentage of patients with a patient identification band insitu which clearly identifies the patient using Patient Name, DOB, and MRN as identified during prevalence study   | Unit (Periodic)  | Observational Audit    |
| <b>Patient experience with “feeling secure”</b>   | Patient perception of “feeling secure” within nominated inpatient setting  | Unit (Annual)    | Cross-sectional Survey |

Table 3: AUSNOC Patient reported indicators / outcomes

| <b>Patient reported indicators / outcomes</b>   | <b>Measurement Tool</b>            | <b>Level of data</b> | <b>Data Collection Methods</b> |
|---|------------------------------------|----------------------|--------------------------------|
| <b>Caring Assessment Tool – Global Score</b>  | Caring Assessment Tool – version V | Unit                 | Patient Survey                 |
| <b>Patient satisfaction: Overall Ward Rating</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Promptness in responding to the call bell</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Nurses’ attitude towards requests</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Attention to special / personal needs</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Staff attitude towards visitors</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Extent felt ready for discharge</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Instructions provided about care at home</b>   | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: How well your pain was controlled</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Staff address emotional / spiritual needs</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Staff concern for your privacy</b>   | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Courtesy of the nurses</b>   | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Nurses kept you informed</b>   | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Nurse efforts to include you in decision making</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Information given to your family about condition / treatment</b>   | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Extent to which you have a better understanding of your medical condition than when you entered the hospital</b> | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Communication between doctors and nurses regarding care</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient experience: Staff worked together for you</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient satisfaction: Likelihood of recommending hospital</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |
| <b>Patient satisfaction: Overall rating of care provided</b>  | Patient experience survey          | Unit                 | Cross-sectional survey         |

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