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Research paper

ACCCN Workforce Standards for Intensive Care Nursing: Systematic and evidence review, development, and appraisal

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ABSTRACT

Background: The intensive care nursing workforce plays an essential role in the achievement of positive healthcare outcomes. A growing body of evidence indicates that inadequate nurse staffing and poor skill mix are associated with negative outcomes for patients, and potentially compromises nurses' ability to maintain the safety of those in their care. In Australia, the Australian College of Critical Care Nurses (ACCCN) has previously published a position statement on intensive care staffing. There was a need for a stronger more evidence based document to support the intensive nursing workforce.
Objectives: To undertake a systematic and evidence review of the evidence related to intensive care nurse staffing and quality of care, and determine evidence-based professional standards for the intensive care nursing workforce in Australia.
Methods: The National Health and Medical Research Council standard for clinical practice guidelines methodology was employed. The English language literature, for the years 2000-2015 was searched. Draft standards were developed and then peer- and consumer-reviewed.
Results: A total of 553 articles was retrieved from the initial searches. Following evaluation, 231 articles met the inclusion criteria and were assessed for quality using established criteria. This evidence was used as the basis for the development of ten workforce standards, and to establish the overall level of evidence in support of each standard. All draft standards and their subsections were supported multi-professionally (median score >6) and by consumers (85–100% agreement). Following minor revisions, independent appraisal using the AGREE II tool indicated that the standards were developed with a high degree of rigour.
Conclusion: The ACCCN intensive care nursing nurse workforce standards are the first to be developed using a robust, evidence-based process. The standards represent the optimal nurse workforce to achieve the best patient outcomes and to maintain a sustainable intensive care nursing workforce for Australia.

1. Introduction

Since the publication of the Institute of Medicines report *To Err Is Human*,[1] the relationship between hospital characteristics such as intensive and critical care nurse staffing and the quality of care has become central to issues of healthcare delivery, research and policy. In the acute hospital setting, there is a long-standing, consistent and robust evidence base that demonstrates the positive associations between the numbers of registered nurses (RN) employed to care for patients, the quality of their education, and improved patient outcomes.[2,3] Furthermore, in intensive care units (ICU), there is evidence that higher ratios of RN staff to patients (specifically, 1:1 or 1:2) increase patient safety and improve patient outcomes.[1–5]

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Specifically, higher ratios of RNs providing direct patient care are associated with reduced length of stay in the intensive care unit, reduced incidence of nosocomial infection, fewer adverse events, and lower ICU mortality.[6]

Although there are many factors that influence the safety and outcomes of critically ill patients, it is indisputable that patient-centred care provided by an appropriately qualified nursing workforce makes a significant difference. In 2012, the Australian Department of Health and Ageing commissioned a review of Australian government health workforce programs, with a focus on how to support the delivery of a high-quality, well-distributed, optimally utilised and responsive health workforce for Australia.[7] The chair of the review stated, "It is critical that workforce innovation results in not only improved productivity, improved retention and job satisfaction but also that the safety and quality of care is not affected" (p. 72).

Although Australia adopted intensive care nursing as a speciality in the 1970s,[8] its clinical context and nursing provision are quite different to most other nations.[9] Australia boasts high quality intensive care nursing clinical practice, education and research; specialist intensive care nursing postgraduate education is well established and national specialist practice standards guide clinical practice.[10] Specifically, practice is equitably collaborative and requires high levels of knowledge, technical skills and critical thinking.[9,10] Australian intensive care nurses routinely operate mechanical ventilators, independently assess and adjust ventilator settings to patient needs, suction and maintain an airway. They manage highly technical devices such as extracorporeal therapy and intra-aortic balloon pumps, measure cardiac output from highly technical hemodynamic devices and titrate vasoactive drugs. They have not only technical skills but also knowledge, and can apply these skills and knowledge to patient-centred care. It is usual that each specialist critical care nurse cares for and manages the multiple and complex needs of one critically ill intensive care patient. Unlike some other countries, the intensive care workforce is not complemented by specialised allied health practitioners such as respiratory therapists or dialysis nurses. Normally, one appropriately qualified RN operates, manages and problem-solves all the technical equipment issues required to provide life support to a critically ill patient. All elements of patient care, including those that may seem basic and non-technical, such as washing and patient positioning, enable the intensive care nurse to gather vital information about the patient. For instance, skin condition and venous return to dependent body parts, haemodynamic stability when re-positioned, and purposefulness of patient interaction and movement when sedated are all evaluated during routine patient care activities. The bedside nurse provides the constant surveillance and decision-making that is required to optimise outcomes and reduce complications in the critically ill patient. This somewhat unique advanced Australian critical care clinical practice model provides less variation in practice and more stability in critically ill patients' condition.[11] Notably, Australian ICUs have among the best patient outcomes in the world, including a lower prevalence of hospital acquired infections, lower rates of patient restraint and comparably reduced sedation levels which is due, at least in part, to the patient-centred focus of its nursing workforce.[9,11,12]

An intensive care nurse providing direct patient-centred care is the conduit for information, effective communication and consultation from the many medical units and intensive care specialists that have input into a patients care.[13] The intensive care nurse is also a vital support person for family members of critically ill patients, providing information, guidance and support during the patient's stay in the intensive care unit.[14–16] To subdivide elements of care between different care providers is inefficient as it would fragment care and potentially compromise patient safety, especially as the critically ill are so vulnerable. The provision of direct patient- and family-centred care to a critically ill patient is a key strength of Australian intensive care provision, and this model of care should not be dismantled without good evidence that adverse outcomes will not occur as a result.[9,14–16]

2. Background

In 2001, a senate inquiry[17] into the critical care workforce developed key statements that were later included in the *ACCCN ICU Staffing Position Statement (2003) on Intensive Care Nursing Staffing*.[18] This position statement was informed by a literature review of existing evidence and an expert panel review, from which consensus recommendations were made for ICU staffing requirements.[19] It served the profession well until the cuts in healthcare spending that resulted from the global financial crisis; which led to reductions in the critical care nursing workforce and affected the quality of patient-centred care.[20] Such decisions were based on simplistic assumptions about the numbers of nurses, rather than on evidence from research about critical care nurse staffing and workforce, such as their experience, qualifications, education and fitness for purpose.[21] The reduced staff numbers and overall staff quality after the global financial crisis resulted in an increased number of health-related adverse events, poorer productivity and poorer outcomes for patients.[20–22] While the 2003 position statement provided important national guidance on intensive care nursing staff levels, its effectiveness was limited because it did not establish specific standards for practice.[19]

In the wake of the workforce issues described above, ACCCN received requests from the critical care nursing profession to develop a more robust evidence-based position on the ICU nursing workforce so that the quality and safety of patient-centred care of critically ill patients could be protected and maintained.

2.1. Aim

The aim was to develop a set of standards that defined a safe and sustainable intensive care nursing workforce that would ensure the best outcomes for critically ill patients. The scope of the standards was to include all adult, paediatric or mixed adult/paediatric intensive care units in Australia with the intention that they would be used by intensive and critical care nurses; ICU managers, allied health and medical staff; hospital managers; health service district managers and executives; government health services administrators, managers and executives; hospital-based and university-based educators; and the public.

3. Methods and Results

The ACCCN Board of Directors established a working party that consisted of experts from each state and members of the *ACCCN Workforce Advisory Panel* to review the 2003 position statement and its evidence base, and use it as a baseline from which to develop new standards. The standards were developed in several stages. Initially, expert consultation and a systematic review of relevant evidence was undertaken. The National Health and Medical Research Council (NHMRC) standard for clinical practice guidelines methodology was employed which included a systematic review and then an evidence review.[23] Draft standards were then produced. A consultation and review phase followed in which the standards were revised, followed by independent appraisal using the AGREE II tool.[23,24]

3.1. Consultation and systematic review

Several teleconferences and a face-to-face workshop of the Workforce Standards Development Group were conducted, to

identify the overall approach to the development of the Standards, and the key words and questions relevant to the systematic literature search. Then, a preliminary search was undertaken using the Web of Science database without date limitation; some of these articles were included in the development of the standards. Themes sourced from this search validated the use of the 2003 ACCCN position statement[18,19] as the basis for the standards review. Subsequently, ten standard themes and questions were drafted by the Workforce Standards Development Group. Based on the draft standards, the main literature search and systematic review using the NHMRC standard for clinical practice guidelines methodology was performed in 2014 and updated in 2015. This was done to accrue literature related to the standards in general, and then repeated specifically for each standard. The search encompassed electronic databases, reference lists from selected electronic articles, and Internet search engines. The following electronic databases were searched: Medline, Cummulative Index of Nursing and Allied Health Literature (CINAHL), Cochrane, Google Scholar, Embase, and Scopus.

3.1.1. Search terms

The following terms and their combinations were used for the main search: 'nurses', 'nursing staff, hospital', 'intensive or critical care', 'nursing standards', 'nursing administration research', 'personnel staffing and scheduling', 'nursing education research', 'health care quality, access and evaluation', 'health services research', 'outcome assessment (health care)', 'personnel administration', 'hospital', 'patients', 'length of stay' and 'mortality'. See Supplemental Digital Content, for standards questions and search strategies in all databases. The searches were performed in May 2015.

3.1.2. Inclusion and exclusion criteria

The search was limited to articles written in the English language that were published in the previous 15 years (January 2000 to May 2015). Articles were included in the review if they were: original research (quantitative or qualitative) that measured or described nurse staffing and workforce in association with patient outcomes. Patient outcomes included mortality, hospital acquired infections, adverse events, length of stay, ventilator hours, variability of care and patient experience. Descriptive reviews, systematic reviews, book chapters, editorials, dissertations and theses were also included for the evidence review. The grey literature was sourced from Internet searches and communications with other specialist organisations.

3.1.3. Quality assessment

As per the NHMRC standard for clinical practice guidelines methodology, the full text of each article was assessed independently by three researchers to determine its suitability, quality and risk of bias for full review. Consensus was required from all three independent reviewers for inclusion. Due to the heterogeneity of methodological approaches and measured outcomes a meta-analysis or meta-synthesis were not performed.

3.1.4. Results of the systematic review

A total of 381 articles was retrieved from the initial search in 2012, and the search was repeated again in 2014 and 2015, resulting in a total of 553 articles with the exclusion of 322 articles. Only seven qualitative studies were found. Refer to the PRISMA flow diagram, Fig. 1 for search results.

3.1.5. Evidence review

Further evidence review and analysis and grading of included studies were performed using the NHMRC levels of evidence (grade I–IV). Consideration was given to the quantity, level and quality of the evidence, the consistency of the evidence across the included studies, the clinical impact (relevance) of the evidence, the generalisability of the results to the population (for whom the standard was intended), and the applicability of the results to the Australian healthcare setting. These five components were rated using the NHMRC body of evidence matrix.[23] The NHMRC dimensions of evidence criteria[23] were used to assess the evidence review of included studies in terms of: strength of evidence (level, quality, statistical precision); effect size; and relevance of evidence (appropriateness of outcomes, relevance of study question). Qualitative studies were assessed using the National Institute for Clinical Excellence qualitative appraisal checklist.[25]

The bodies of evidence in relation to each draft standard were assessed using the NHMRC grades of recommendation (A–E) for guidelines[25] and are shown in Online Supplementary Content Appendix A. As a result of the systematic and evidence review, all ten draft standards were judged to be supported by a body of evidence at grade C or above. Each draft standard was revised to ensure that it was consistent with its identified evidence base (Table 1).

3.2. Expert consultation

The second draft of the standards was invited for review and comment by multi-professionals and consumers. The following organisations and groups participated in this phase: ACCCN advisory panels (e.g. Paediatric, Quality, Resuscitation); Australia and New Zealand Intensive Care Society (ANZICS); College of Intensive Care Medicine (CICM); Council of National Nursing and Midwifery Organisations (CoNNMO); critical care nurses (nurse mangers and educators); and state-based consumer groups [Health Care Consumers Association (ACT), Health Consumers Alliance (SA), Health Consumers Council (WA), Health Consumers Queensland (Qld), Health Consumers Network (NSW), Health Issues Centre (Vic)]. A broad range of end-users was consulted, although weighting was towards intensive care nurses and clinicians as they were the intended primary end-users of the standards.

3.2.1. Professional review

Each professional organisation and the ACCCN committees of each state were invited to nominate representatives to participate in an online survey, which was sent by email. Each participant was asked to rate their strength of agreement with each draft standard using a 9-point rating scale ranging from 1 (strongly disagree) to 9 (strongly agree). The level of consensus was set at a median of 7. A total of 33 responses was received but not all respondents gave responses to all statements. A large majority agreed with all standards. All subsections, with the exception of only two (6.3.1 and 8.3) achieved a median cut-off score of 7 required for approval (see Table 2). A large number of constructive comments was also received.

3.2.2. Consumer review

Consumer representatives were invited to comment on the draft standards and indicate support for their use (yes, yes with modification, no) via a simplified online survey. In total, 14 consumers provided feedback about their overall agreement with each standard (see Table 3). All standards were supported by a large majority, with written suggestions for modifications. Minor revisions were made to the standards as a result of the surveys and the comments received during this phase.

3.3. Appraisal

As part of the NHMRC standard for clinical practice guidelines methodology, the standards were subjected to appraisal, using the AGREE II instrument, by an independent group of assessors that were not involved in the development of the standards. Eight

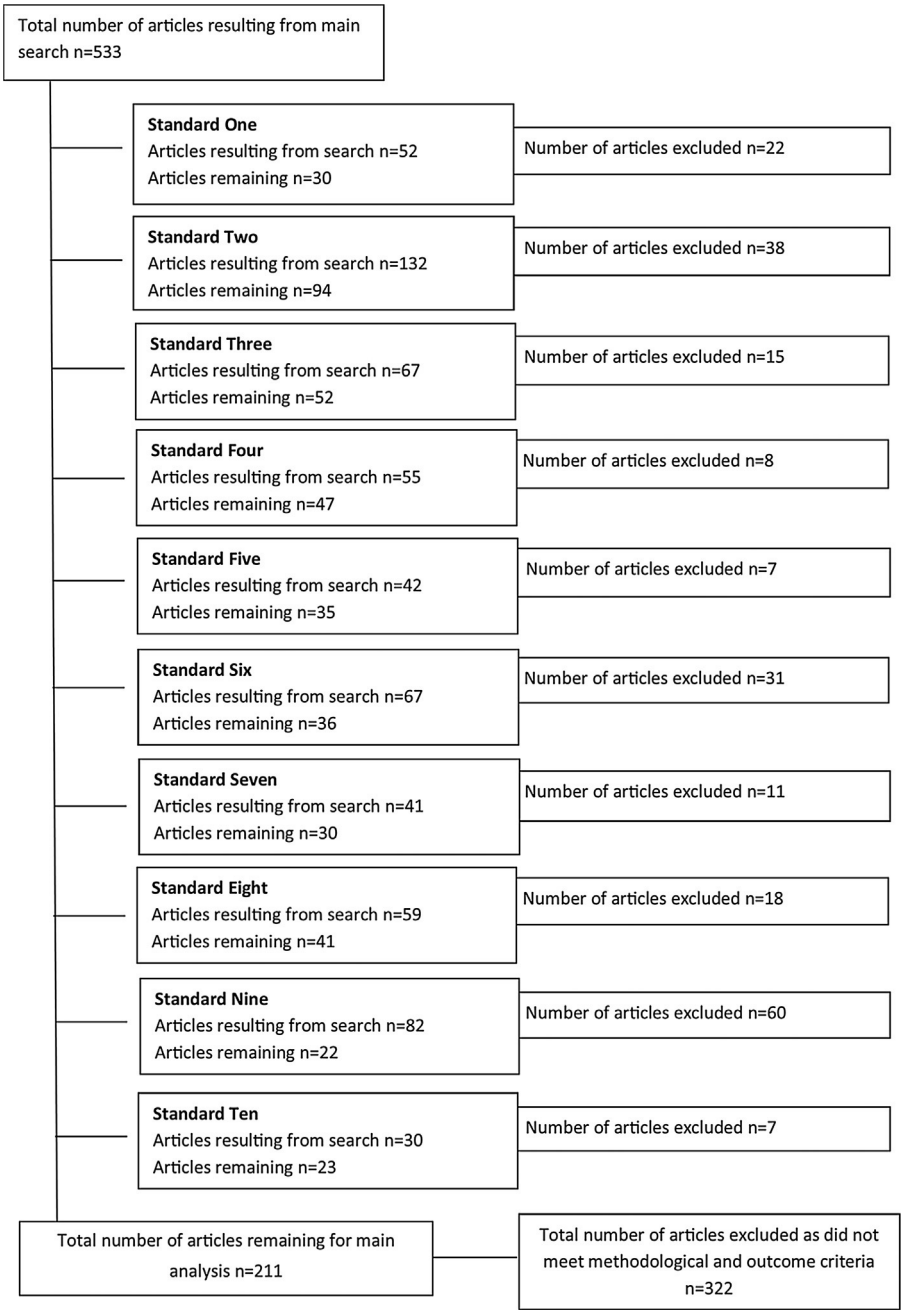

Fig. 1. Prisma flow diagram for search results.

appraisers from the Intensive Care Services Network, Agency for Clinical Innovation NSW participated in this phase: 1 nurse manager, 2 nurse unit managers, 3 clinical nurse consultants, and 2 clinical nurse educators. The standards were appraised within six domains, comprised of between two to seven questions, each scored on a scale of 1 (strongly disagree) to 7 (strongly agree). The maximum minus the minimum possible scores was divided by the sum of the reviewers' scores minus the minimum possible scores for each domain to give scaled domain percentage scores. The results are shown in Table 4. In terms of overall assessment, the standards were scored 738.5 out of a possible total score of 1104 = 67%. This is equivalent to an overall rating of 5 on the AGREE II rating scale [1 (strongly disagree)–7 (strongly agree)]. The relatively low score achieved in the *Applicability* domain was felt to be related to the design of the AGREE II tool, which was intended for assessment of *clinical practice* guidelines. However, in the absence of a specific tool to appraise *professional* standards, the AGREE II tool was considered the best available. The results of the AGREE II appraisal were reviewed by ACCCN Board of Directors and no further amendments to the standards were deemed necessary. The final version of the standards was approved by ACCCN Board of Directors in October 2016.

4. Discussion

The ACCCN Workforce Standards for Intensive Care Nursing extend and expand significantly upon the original position statement, with each statement presented with supporting evidence graded using NHMRC criteria. They have been designed to improve intensive care patient outcomes and safety. They advocate for and

Table 1
Workforce Standards for Intensive Care Nursing.

Standard	Grade of evidence	Sub-sections
Standard 1 The ICU patient case mix and unit design must determine the appropriate nursing service, knowledge and skills required for the nursing workforce and support staffing of each unit. In addition to the minimum levels of staffing identified in Standards 1-9, each ICU must be evaluated objectively in terms of its unique patient case mix, design and environment to determine whether additional staffing is required to safely meet the needs of its patients.	Grade B Body of evidence can be trusted to guide practice	1.1 Paediatric Services:In ICUs that provide services for paediatric patients only, the critical care postgraduate qualification noted in each section of these standards refers to a paediatric specific speciality. 1.2 Mixed Adult/Paediatric:In ICUs that have a mixed adult/ paediatric population, there should be a designated paediatric critical care nurse leader who holds a paediatric-specific critical care qualification. 1.3 Special Needs: For critically ill patients with special needs e.g. maternity, oncology or morbidly obese patients, due consideration must be given to the requirement for additional, appropriate staff support to ensure that the patient's needs are met. 1.4 Design and Layout: The design and layout of the ICU must be considered when determining nurse staffing and skill mix. In ICUs where there is a large number of single rooms, the nursing skill mix must be reviewed in order to ensure the safety and needs of the critically ill patient. [See also 6.3.]
Standard 2 A specified (formula/ratio-based) number of nursing staff, with suitable knowledge and skills, must be employed to provide direct patient- and family-centred care to critically ill patients. Grade of Evidence Level B	Grade B Body of evidence can be trusted to guide practice	2.1 Critically ill patients, as determined clinically, require at a minimum one RN to care for them in close proximity (less than 3 metres) at all times. 2.2 The minimum professional qualification requirement is that of an RN; to ensure accountability for direct patient and family-centred care for the needs of critically ill patients. 2.3 The RN-to-patient ratio must be at least: 2.3.1 One RN to one patient for ventilated patients and any other patient in the ICU that the nurse-in-charge deems to be clinically unstable or at risk; 2.3.2 One RN to two patients for patients requiring a high complexity level of care, (e.g. stable non-ventilated patients improving from their critically ill state). Deteriorating patients require a 1:1 ratio. 2.4 On occasions when a patient has very complex needs, more than one RN to one patient may be required, as deemed necessary by the nurse-in-charge or ICU specialist (e.g. a labouring obstetric patient or a patient with multiple extra-corporal technology, major trauma or burns). 2.5 Non-RN staff [e.g. enrolled nurses (EN) and patient care assistants] are additional to the above ratios and should not replace an RN. They may only assist in the care of patients under the direct supervision of an RN. 2.6 The ratio applies to all adult, paediatric or mixed adult/ paediatric ICUs in Australia.
Standard 3 A specified (formula/ratio-based) proportion of the nursing staff in an ICU must hold a specialist critical care nursing qualification. Grade of Evidence Level B	Grade B Body of evidence can be trusted to guide practice	3.1 A minimum of 50% of the RN staff that provide direct patient care in an ICU should hold a recognised postgraduate intensive care (critical care) nursing qualification 3.2 The qualification will meet at a minimum an Australian Qualifications Framework level 8 and the Australian Clinical Practice Outcome Standards for critical care nurse education.[1] 3.3 The optimal proportion of critical care specialist qualified RNs is 75%. The remaining 25% should be working towards a post graduate qualification. The ratio applies to all adult, paediatric or mixed adult/paediatric ICUs in Australia.
Standard 4 The nursing management of the ICU must be provided by a specialist critical care RN who contributes to the planning of the intensive care service and collaborates actively with the hospital executive regarding all ICU matters.	Grade C Body of evidence can be trusted to guide practice in most situations	4.1 Every ICU must have a specialist critical care RN that is dedicated exclusively to a nursing manager role. 4.1.1 The ICU nurse manager should possess a postgraduate qualification in management or similar, and be prepared to Master's level in a recognised degree in either management, critical care or similar. 4.2 The ICU nurse manager must be supernumerary to the allocation needs of clinical patient care. 4.3 In larger units (i.e. units with more than 10 beds), a broader array of management support nurses may be required (e.g. more than one nurse manager, assistant nurse managers); each must be supernumerary to the RN requirement for direct patient care stated in 2.3. 4.4 In addition to the ICU nurse manager, a clinical coordinator is required. This role is responsible for appropriate clinical allocation and bed management. The clinical coordinator may also provide an element of clinical support. 4.4.1 The clinical coordinator must be a critical care qualified RN. 4.4.2 There should be at least one clinical coordinator who is supernumerary per shift (i.e. in addition to staff providing direct patient care). 4.4.3 In larger units (i.e. units with more than 10 beds), there may be a need for more than one clinical coordinator per shift. For example, there may be a need for one clinical coordinator per 'pod' (e.g. 8-12 beds).
Standard 5 A specified level of education and educational support must be provided within the ICU for all levels of its nursing staff. Nursing knowledge and skills must be maintained at an appropriate level to ensure high quality care for a complex case mix of critically ill patients.	Grade C Body of evidence can be trusted to guide practice in most situations	5.1 One full-time equivalent (FTE) ICU nurse educator (not to be interchanged with the term clinical facilitator; these are different roles) is required per 50 ICU nursing staff head count (not FTE). 5.2 The ICU nurse educator must be an ICU specialist RN with a critical care master's degree and an education qualification. 5.3 To optimise their contribution to ICU nursing practice, ICU nurse educators will be based in the ICU as part of its workforce, as opposed to a generic nurse education unit. The nurse educator should work in collaboration with the ICU nurse manager. 5.4 All new nursing staff will undergo an ICU specific orientation and induction program.

		5.5 Different levels of education support will be provided depending on the size of the ICU, the complexity of patient care, the staff skill mix and the proportion of intensive care qualified staff. 5.5.1 ICU nurse education specialists(a clinical nurse specialist that has been allocated a specific education role by the ICU nurse educator or similar)will provide ICU orientation, induction and mandatory ICU competency programs. 5.5.2 ICU nurse education specialists will provide transition programs for novice RNs (e.g. in the first year following graduation) and educational support to RNs who are new to the ICU environment. 5.5.3 ICU nurse education specialists will provide support to RNs who are postgraduate intensive care or critical care nursing students. This will be in partnership with the relevant university. This role may also be termed a clinical facilitator. 5.5.4 ICU nurse education specialists will provide continuing educational opportunities in collaboration with senior experienced intensive care nurses.
Standard 6 A pre-determined (formula-based) number of ACCESS nurses must be rostered to maximise ICU bed utility and optimise safety. [ACCESS = Assistance, Coordination, Contingency (for a late admission on the shift, or staff sick mid-shift), Education (of junior staff, relatives, and others), Supervision, and Support. ACCESS nurses hold a specialist critical care qualification.] ACCESS nurse term has been used in enterprise bargaining and is now legislated with the definition as above, and will be used nationally as per its definition.	Grade C Body of evidence can be trusted to guide practice in most situations	6.1 A predetermined number of ACCESS nurses should be rostered to provide 'on-the-floor' support to nurses so that ICU bed utility is maximised and safety is optimised. 6.2 ACCESS nurses are in addition to nurses providing direct patient care as defined in 2.3, and other staff identified in Standards 3-5. 6.3 The minimum requirement for ACCESS nurses is as follows: 6.3.1 In ICUs with less than 50% qualified ICU nurses and/ or where 80% or more of the ICU beds are in single rooms, one ACCESS nurse is required per four patients per shift. 6.3.2 In ICUs with 50-75% qualified ICU nurses and less than 80% of the ICU beds are in single rooms, one ACCESS nurse is required per six patients per shift. 6.3.3 In ICUs with greater than 75% of qualified ICU nurses and less than 80% of the ICU beds are in single rooms, one ACCESS nurse is required per eight patients per shift. 6.4 Patients with very complex needs will require one ACCESS nurse to a smaller ratio of ICU beds compared to that which is stipulated in 6.3. HDU patients in an ICU bed will still require the minimum ACCESS nurse ratio as stipulated. 6.5 ACCESS nurse ratios will need re-evaluation in times that are contingent to unexpected late admissions, patient deterioration, or adjustments in ICU staffing.
Standard 7 Life support equipment for specialised diagnostic or therapeutic procedures is managed by a suitably skilled and qualified RN.	Grade C Body of evidence can be trusted to guide practice in most situations	7.1 The ICU equipment nurse should be a critical care qualified RN that is an ICU equipment and technology specialist. 7.2 Larger units (i.e. greater than 10 beds) should have a dedicated equipment nurse to manage the complex array of equipment used in the intensive care environment (e.g. ventilators, renal replacement therapy equipment) and oversee an appropriate quality control program in regards to the equipment. 7.3 Smaller units may have the equipment nurse role as part of a senior portfolio. 7.4 The ICU equipment nurse works collaboratively with biomedical engineering expertise. 7.5 Equipment non-nurse technicians do not possess the expertise to provide patient centred care related to technical support and equipment (e.g. urgent bronchoscopy or problem solving patient mechanical ventilator interactions that are technically based).
Standard 8 A liaison nurse service must be provided to optimise the use of the ICU within the hospital.	Grade B Body of evidence can be trusted to guide practice	8.1 A liaison nurse service will be managed by a suitably skilled and qualified RN to coordinate and facilitate the intensive care liaison team. ICU liaison nurses must possess a critical care qualification, an expert knowledge base, and skills to make complex decisions and must be clinically competent in expanded practice. 8.2 ICU liaison nurses are part of the ICU staff and on the ICU roster, but are additional to the ICU staffing needs articulated in Standards 2-7. This position is supernumerary to direct patient care and management roles. 8.3 One ICU liaison nurse must be provided per 10 ICU beds. 8.4 The ICU liaison nurse role includes clinical services delivery and consultancy with and between hospital wards. The role is inclusive of quality improvement activities, education, leadership and research in the liaison service. The role may include Rapid Response Team and/or Code Blue response.
Standard 9 Intensive care nursing practice must be supported by a suitably skilled and qualified RN researcher.	Grade C Body of evidence can be trusted to guide practice in most situations	9.1 In larger ICUs (i.e. greater than 10 beds), there will be a nominated lead nurse researcher who is a critical care specialist RN. The minimum qualification for this role is a research master's degree, but possession of a PhD is preferable. Partnerships will be linked with a tertiary institution (e.g. via a joint appointment). The nurse researcher will initiate and coordinate nurse-oriented research and is considered part of the ICU nursing workforce. This position is supernumerary to direct patient care needs. 9.2 The RN researcher is a dedicated role to nursing research. It is not a support role to medical or pharmaceutical research and clinical trials. 9.3 Smaller units should consider a fractional appointment to support nursing research in the unit. 9.4 Smaller units should link with larger units to facilitate nursing research.

(*continued on next page*)

Table 1 (*continued*)

Standard	Grade of evidence	Sub-sections
Standard 10 Non-nursing staff, such as administrative, clerical, cleaning and equipment support staff that are based in the ICU, must be provided to support service delivery and ensure that the nursing staff is able to focus on the delivery of patient-centred care for critically ill patients.	Grade C Body of evidence can be trusted to guide practice in most situations	10.1 A dedicated ward clerk (or equivalent), whose role includes managing telephone enquiries, clerical duties and responding to visitors' requests to enter the ICU, will be rostered seven days per week between 08.00 to 20.00 hours or equivalent. Extra ward clerk support must be provided In ICUs where there are separate pods. 10.2 Dedicated non-nursing staff must be on hand to ensure that ICU cleanliness is maintained, bed areas are available for use for new patients, consumables are re-stocked, and samples etc. are collected and delivered as required in a timely manner. 10.3 The value and cost of using RNs for administrative or cleaning purposes is not justifiable unless the work requires specialised and professional knowledge or skills.

[1] Gill FJ, Leslie GD, Grech C, et al. (2015). Development of Australian clinical practice outcome standards for graduates of critical care nurse education. Journal of Clinical Nursing 24(3–4): 486–499.

Table 2
Professionals' agreement with draft standards.

Standard	Overall agreement (%)			Section	Score			*n*
	Yes	Yes, with modification	No		Range	Median	Mean (SD)	
1. The ICU patient case mix and unit design must determine the appropriate nursing service, knowledge and skills required for the nursing workforce and staffing of each unit.	81.3	18.7	0	1.1. In ICUs that provide services for paediatric patients only, the critical care postgraduate qualification noted in each section of these standards refers to a paediatric specific speciality.				32
				1.2. In ICUs that have a mixed adult/paediatric population, there should be a designated paediatric critical care nurse leader who holds a paediatric-specific critical care qualification.	3–9	9	7.78 (1.65)	32
				1.3. Due consideration must be given to the requirement for additional, appropriate staff support to ensure that the patient's needs are met.	3–9	9	8.19 (1.45)	32
				1.4. In ICUs where there is a large number of single rooms, the nursing skill mix must be reviewed in order to ensure the safety and needs of the critically ill patient.	5–9	9	8.22 (1.34)	32
[a]2. A specified number (formula-based) of nursing staff, with suitable knowledge and skill, must be employed to provide direct patient-centred care to critically ill patients.	84.9	15.1	0	2.1. Critically ill patients, as determined clinically, require one registered nurse (RN) to care for them at all times.	6–9	9	8.73 (.62)	33
				2.2. To provide direct patient care and accountability for the needs of the critically ill patient for the shift, the minimum professional qualification requirement is that of RN.	4–9	9	8.70 (1.0)	33
				2.3.1. One RN to one patient for ventilated patients and any other patient in the ICU that the nurse in charge deems to be clinically unstable or at risk.	6–9	9	8.79 (.64)	33
				2.3.2. One RN to two patients for patients requiring a high dependency level of care i.e. less than that defined in 2.3.1, above.	6–9	9	8.48 (.89)	33
				2.4. On occasions when a patient has very complex needs, more than one RN to one patient may be required, as deemed necessary by the nurse-in-charge. For example, a labouring obstetric patient, a patient with multiple extra-corporal technology, major trauma or burns.	6–9	9	8.73 (.71)	33
				2.5. Non-RN staff e.g. enrolled nurses (EN) and patient care assistants are additional to the above ratios and may not replace a RN. They may only assist in the care of patients under the direct supervision of a RN.	4-9	9	8.15 (1.52)	33

[a]3. A specified proportion (formula-based) of the nursing staff in an ICU must hold a specialist critical care nursing qualification.	72.7	24.2	3.0	3.1. A minimum of 50% of the registered nursing staff who provide direct patient care in an ICU should hold a recognised post-graduate intensive care (critical care) nursing qualification.	5–9	9	8.0 (1.28)	33
				3.2. The optimal proportion of critical care specialist qualified RNs is 75%.	2–9	8	7.48 (1.56)	33
4. The nursing management of the ICU must be provided by a specialist critical care RN who contributes to the planning of the intensive care service and collaborates actively with the hospital executive regarding all ICU matters.	53.1	46.9	0	4.1. Every ICU must have a master's degree prepared, specialist critical care RN dedicated exclusively to a nursing manager role.	3–9	7	6.66 (1.88)	32
				4.1.1. The ICU nurse manager should also possess a post-graduate qualification in management or similar.	2–9	7	7.0 (1.98)	32
				4.2. The ICU nurse manager must be supernumerary to clinical patient care allocation needs.	5–9	9	8.5 (1.03)	32
				4.3. In larger units, for example those with greater than ten beds, a broader array of management support nurses may be required e.g. more than one nurse manager, assistant nurse managers, and clinical nurse specialists; each must be supernumerary to the RN requirement for direct patient care stated at 2.3, above.	4–9	8.5	7.75 (1.58)	32
				4.4.1. The clinical coordinator must be a critical care qualified RN.	5–9	9	8.44 (1.25)	32
				4.4.2. There should be at least one clinical coordinator per shift, who is supernumerary i.e. in addition to staff providing direct patient care.	2–9	9	8.09 (1.770)	32
				4.4.3. In larger units, i.e. those with greater than ten beds, there may be a need for more than one clinical coordinator per shift. For example, there may be a need for one clinical coordinator per 'pod' (e.g. 8–12 beds).	4–9	8.5	7.69 (1.65)	32
5. A specified level of education and educational support must be provided within the ICU for all levels of its nursing staff. Nursing knowledge and skill must be maintained at an appropriate level to ensure high quality care for a complex case mix of critically ill patients.	53.1	43.8	3.1	5.1. One full time equivalent (FTE) ICU nurse educator is required per 50 ICU nursing staff head count (not FTE).	5–9	8.5	7.94 (1.34)	32
				5.2. The ICU nurse educator must be a critical care master's degree-prepared RN with an education qualification and must be an ICU nurse education specialist.	3–9	8	7.38 (1.67)	32
				5.3. To optimise their contribution to ICU nursing practice, ICU nurse educators will be based in the ICU as part of its workforce as opposed to a generic nurse education unit. The nurse educator should report to the ICU nurse manager.	1–9	9	7.22 (2.53)	32
				5.4. All new nursing staff will undergo an ICU-specific orientation and induction program.	6–9	9	8.78 (.65)	32
				5.5.1. ICU nurse education staff specialists will provide ICU orientation, induction, and mandatory ICU competency programs.	1–9	9	7.81 (2.05)	32
				5.5.2. ICU nurse education staff specialists will provide transition programs for novice RNs (e.g. in the first year following graduation) and should provide educational support to RNs that are new to the ICU environment.	1–9	9	8.09 (1.93)	32
				5.5.3. ICU nurse education staff specialists will provide support to RNs that are postgraduate intensive care or critical care nursing students. This will be in partnership with the relevant university.	3–9	9	8.28 (1.46)	32
				5.5.4. ICU nurse education staff specialists will provide continuing educational opportunities in collaboration with senior experienced intensive care nurses.	2–9	9	8.47 (1.46)	32
[a]6. A predetermined number of ACCESS nurses (formula-based) must be rostered to maximise ICU bed utility and optimise safety.	59.4	34.4	6.2	6.1. A predetermined number of ACCESS nurses should be rostered to provide 'on-the-floor' support to nurses so that ICU bed utility is maximised and safety is optimised.	3–9	9	8.19 (1.45)	32
				6.2. ACCESS nurses are in addition to nurses providing direct patient care as defined in standard one (2.3 above), and other staff identified in standards 3–5.	3–9	9	7.91 (1.65)	32
				6.3.1. In ICUs with more than 50% qualified ICU nurses and/or where 80% or more of the ICU beds are in single rooms, one ACCESS nurse is required per four patients per shift.	1–9	6.5	6.41 (2.33)	32
				6.3.2. In ICUs with between 50–75% qualified ICU nurses and less than 80% of the ICU beds are in single rooms, one ACCESS nurse is required per six patients per shift	1–9	7	6.50 (2.26)	32
				6.3.3. In ICUs with greater than 75% of qualified ICU nurses and less than 80% of the ICU beds are in single rooms, one ACCESS nurse is required per eight patients per shift.	1–9	7	6.53 (2.41)	32

(*continued on next page*)

Table 2 (*continued*)

Standard	Overall agreement (%)			Section	Score			*n*
	Yes	Yes, with modification	No		Range	Median	Mean (SD)	
[a]7. Life-support equipment for specialised diagnostic or therapeutic procedures is managed by a suitably skilled and qualified registered nurse.	50.0	37.5	12.5	7.1. The ICU equipment nurse should be a master's degree-prepared RN who is an ICU equipment and technology specialist.	1–9	7	6.13 (2.60)	32
				7.2. Large units i.e. greater than ten beds should have a dedicated equipment nurse to manage the complex array of equipment used in the intensive care environment e.g. ventilators, renal replacement therapy equipment, and oversee an appropriate quality control program in regards to the equipment.	1–9	9	7.34 (2.44)	32
				7.3. Smaller units may have the equipment nurse role as part of a senior portfolio.	1–9	8	7.41 (2.22)	32
8. A liaison nurse service, managed by a suitably skilled and qualified registered nurse, must be provided to coordinate and facilitate the intensive care liaison team.	50.0	43.8	6.2	8.1. ICU liaison nurses must be critical care master's degree-prepared RNs.	1–9	7	6.56 (2.24)	32
				8.2. ICU liaison nurses are part of the ICU staff and on the ICU roster, but are additional to the ICU staffing needs articulated in Standards 2–7.	1–9	9	7.81 (1.86)	32
				8.3. One ICU liaison nurse must be provided per ten ICU beds.	1–9	6	6.06 (2.28)	32
				8.4. The ICU liaison nurse role includes clinical services delivery and consultancy with and between hospital wards. The role is inclusive of quality improvement activities, education, leadership and research in the liaison service.	2–9	8	7.59 (1.80)	32
[a]9. Intensive care nursing practice must be supported by a suitably skilled and qualified registered nurse researcher.	56.3	37.5	6.2	9.1. In large ICUs i.e. greater than ten beds, there will be a nominated lead nurse researcher who is a critical care specialist RN. The minimum qualification for this role is a research master's degree, but possession of a PhD is preferable. Partnerships will be linked with a tertiary institution, for example via a joint appointment arrangement. The nurse researcher will initiate and coordinate nurse-oriented research and is considered part of the ICU nursing workforce. This position is supernumerary to direct patient care needs.	1–9	7	6.59 (2.19)	32
				9.2. Smaller units should consider a fractional appointment to support nursing research in the unit.	2–9	7	6.97 (2.05)	32
				9.3. Smaller units should link with larger units to facilitate nursing research.	1–9	8.5	7.50 (2.0)	32
10. Non-nursing staff, such as administrative, clerical, cleaning, and equipment-support staff that are based in the ICU, must be provided to support service delivery and ensure that the nursing staff is able to focus on the delivery of patient-centred care for critically ill patients.	71.9	28.1	0	10.1. A dedicated ward clerk (or equivalent), whose role includes managing telephone enquiries, clerical duties and responding to visitors' requests to enter the ICU will be rostered seven days per week between the hours 08.00 to 20.00.	5–9	9	8.63 (.93)	
				10.2. Dedicated non-nursing staff must be on hand to ensure that ICU cleanliness is maintained, that bed areas are available for use for new patients, consumables are restocked, and samples etc. are collected and delivered as required, in a timely manner.	6–9	9	8.72 (.76)	
				10.3. The value and cost of using RNs for administrative or cleaning purposes is not justifiable unless the work requires specialised and professional knowledge or skill.	5–9	9	8.72 (.80)	

[a] Extra section(s) subsequently added to final draft of standards.

Table 3
Consumers' agreement with draft standards (n = 15).

Standard	Overall agreement (%)			*n*
	Yes	Yes, with modification	No	
1	92.9	7.1	0	14
2	86.7	13.3	0	15
3	66.7	33.3	0	15
4	80.0	13.3	6.7	15
5	66.6	26.7	6.7	15
6	71.4	14.3	14.3	14
7	78.6	21.4	0	14
8	71.4	28.6	0	14
9	57.1	28.6	14.3	14
10	78.6	14.3	7.1	14

improve nursing workforce centred outcomes such as a sustainable and highly educated intensive care nursing workforce due to the comprehensive detail and application in Standard 3, 4 and 5. All of the Standards will help to improve long term organisation efficiency and continuity of patient centred care. Though there are many similarities to the statements to the original position statement, these are the first intensive care nursing workforce Standards to be developed using a robust and evidence-based process. When the original position statement was developed there was a paucity of research evidence available whereas the current Standards are informed by a significant body of evidence, albeit mainly observational in nature. Similar to many other standards, the published evidence continues to grow in regard to the impact of the intensive care nursing workforce on outcomes.[26,27,3] Recently, preliminary work in large and complex longitudinal data sets[11,32] also supports this premise and strengthens the quality of evidence.

It is recognised that intensive care nursing is a demanding and highly skilled role. The importance of an appropriately skilled and educated workforce is well recognised by commissioners, providers and users of healthcare.[7] The Standards have been designed as a complete collective approach to workforce sustainability and planning. Using one point in isolation places at risk the context of the evidence, the variation of care in application and the synergistic relationship of the standards. These Standards are to be interpreted in the context of, and work synonymously with the ACCCN Practice Standards for Specialist Critical Care Nurses.[10] The requirements of the Practice Standards cannot be achieved if all the conditions of the Workforce Standards are not implemented. To achieve a professional level of practice with critical thinking, problem solving and delivery of safe patient centred care, the minimum requirements as stated in these Standards is considered essential.

Nursing surveillance is one of the key mechanisms linking nursing numbers and ratios to patient outcomes, in particular in the prevention of adverse medical events.[28] Surveillance is the process nurses use to acquire, process, and synthesise vast amounts of information in the course of a patient encounter. Intensive and critical care nurses have reported use of surveillance as a safety strategy to identify and prevent and recover medical errors.[28–30] By reason of continuous nurses' surveillance and ratios of one nurse to one patient, Australian intensive care units have lower rates of patient restraint and monitor and comparably reduce sedation levels in critically ill patient, thus improving patient outcome.[30] Workforce issues such as the number and ratios of nurses and providers, working hours and fatigue, are some of the highlighted issues related to increased adverse events. Further, the most common stressor for intensive and critical care nurses is the unpredictable workload that is presented with emergency admissions and unforeseen and adverse events.[31] The contribution of these standards to ongoing work of adverse event prevention is an important milestone and one that will invite further work.

Table 4
AGREE II results.

	Domain (items n)	Domain score range	Obtained score	Scaled domain score (%)
Domain 1	Scope and purpose (3)	24–168	136	78
Domain 2	Stakeholder involvement (4)	32–224	150	61
Domain 3	Rigour of development (7)	56–392	311.5	76
Domain 4	Clarity of presentation (4)	32–224	158	66
Domain 5	Applicability (3)	24–168	89	45
Domain 6	Editorial independence (2)	16–112	78	65

The World Health Organisation's extensive work on patient safety underpins the ten key actions that are likely to have the most impact on improving safety.[32] Of these, key action point 8; "Strengthen workforce capacity and capability to improve safety"[3333, p 221] is already a priority on the world health agenda and supports the premise and philosophical underpinning of these Standards. Notwithstanding is the contemporary focus of the intensive care nursing workforce on retention with issues of burnout, compassion fatigue and satisfaction of providing safe patient centred care.[34] These Standards are commensurate with these important concerns and provide a benchmark for preliminary work in relation to intensive and critical care nurses' wellbeing. Underresourcing is a prime area that contributes to workplace stress and burnout and is a major factor in experienced, educated intensive and critical care nurses choosing to leave a clinical role.[35]

Elements of these Standards are not unique. They align with the College of Intensive Care Medicine *Minimum Standards for Intensive Care Units*[8] and the National Safety and Quality Health Service Standards, especially Standard 1: *Governance for Safety and Quality in Health Service Organisations*.[36] The British Association of Critical Care Nurses *Standards for Nurse Staffing in Critical Care*[4] which support the one nurse to one ventilated patient ratio and defend safe patient care, are focused upon quality, and desirable patient outcomes. Also, based on a report from the American Association of Critical-Care Nurses,[37] six standards were developed in view of establishing and sustaining a healthy work environment: including skilled communication, true collaboration, effective decision-making, appropriate staffing, meaningful recognition, and authentic leadership. They also emphasise that inappropriate staffing is one of the most harmful threats to patient safety and to the well-being of nurses; as emphasised with these Standards.

However, unique to these Standards, is the inclusion of the whole intensive and critical care nursing workforce. In addition to the direct patient care role, there are standards for intensive care nursing management and education, equipment nurses, nurse researchers, liaison nurses, ACCESS nurse role extension and non-nursing support staff. In conjunction with medical and allied health personnel, the intensive care unit is a team environment and specification and acknowledgement of each nursing role will assist with the implementation of these Standards. For larger units, multiple individuals will take on these roles; in smaller units, one individual may take on more than one role. There was good evidence for each of the roles in their contribution to positive patient care outcomes.

Due to the state-by-state segregation of the industrial relation processes in Australia, there are many variations as well as differences between rural, regional and metropolitan intensive and critical care workforce structure and practice profiles. This has been an outcome of ad hoc service planning and staffing over time, lack of standardisation across industrial jurisdictions and creation of nursing titles according to performance of clinical procedures.[38] Since the launch, the Standards have been used in the nursing and midwifery enterprise agreement negotiated between the Australian Nursing and Midwifery Foundation, the Office for the Public Sector and the Department for Health and Ageing in accordance with the Fair Work Act 1994 (SA).[39] Adoption of the

Standards by governments referencing them in legislation, mandates their use, and confirms the importance of the Standards for the profession. As other states enter future enterprise agreements, the Standards will contribute to a national consistency in laws and regulations for the intensive care nursing workforce.

4.1. Limitations

The complex nature of the intensive care unit, with variations in patient severity of illness, comorbidities, support structures, management styles and leadership makes the implementation of a randomised control trial to test the implementation of an intensive care workforce/staffing model very difficult both ethically and pragmatically. Thus, it is virtually impossible to obtain Level A evidence according to the NHMRC criteria (systematic review of RCTs, several RCTs). Notwithstanding this, there is a growing body of strong observational evidence that supports these Standards. The evidence in these Standards fulfils the other four requirements of the NHMRC matrix of evidence: it is consistent, demonstrates substantial clinical impact, is generalisable to the intensive care patient population and is applicable to the Australian healthcare context.

5. Conclusions

A set of ten evidence-based Intensive Care Nursing Workforce Standards were developed using NHMRC standard for clinical practice guidelines methodology. Peer and consumer review confirmed the ten Standards had strong applicability in the Australian intensive care workplace. These Standards continue to be adopted nationally to ensure a safe and sustainable intensive care nursing workforce that will result in the best outcomes for critically ill patients.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.aucc.2017.08.007.

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