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Research paper

Pressure injury prevention practice in Australian intensive care units: A national cross-sectional survey

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ABSTRACT

Introduction: Pressure injury (PI) is an ongoing problem for patients in intensive care units (ICUs). The aim of this study was to explore the nature and extent of PI prevention practices in Australian adult ICUs.
Materials and methods: An Australian multicentre, cross-sectional study was conducted via telephone interview using a structured survey instrument comprising six categories: workplace demographics, patient assessment, PI prevention strategies, medical devices, skin hygiene, and other health service strategies. Publicly funded adult ICUs, accredited with the College of Intensive Care Medicine, were surveyed. Data were analysed using descriptive statistics and chi-square tests for independence to explore associations according to geographical location.
Results: Of the 75 eligible ICUs, 70 responded (93% response rate). PI was considered problematic in two-thirds (68%) of all ICUs. Common PI prevention strategies included risk assessment and visual skin assessment conducted within at least 6 h of admission (70% and 73%, respectively), a structured repositioning regimen (90%), use of barrier products to protect the skin (94%), sacrum or heel prophylactic multilayered silicone foam dressings (88%), regular PI chart audits (96%), and PI quality improvement projects (90%). PI prevention rounding and safety huddles were used in 37% of ICUs, and 31% undertook PI research. Although most ICUs were supported by a facility-wide skin integrity service, it was more common in metropolitan ICUs than in rural and regional ICUs ($p < 0.001$). Conversely, there was greater involvement of occupational therapists in PI prevention in rural or regional ICUs than in metropolitan ICUs ($p = 0.026$).
Discussion and conclusion: This is the first study to provide a comprehensive description of PI prevention practices in Australian ICUs. Findings demonstrate that PI prevention practices, although nuanced in some areas to geographical location, are used in multiple and varied ways across ICUs.
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1. Introduction

Pressure injury (PI) is a common hospital-acquired adverse event.[1] Also termed pressure ulcer, it is a localised injury to the skin, mucosa, or underlying tissue typically over a bony prominence caused by pressure, or pressure in combination with shear, friction, and microclimate changes.[1] PIs occurring on the skin are classified by a staging system that has six stages where stage 1 indicates beginning injury and stage 4 indicates full-thickness tissue loss. There are two other stages: 'unstageable' representing full-thickness tissue loss where the base of the injury is covered by slough or eschar, and 'suspected deep-tissue PI' indicating a localised area of discoloured skin due to damage of underlying soft tissue. PIs occurring on mucous membranes are not staged but are categorised as mucosal PI.[1]

PIs cause considerable harm to patients, hinder recovery, cause pain and emotional distress, precipitate serious infection, and increase morbidity and mortality.[2] Internationally, the cost burden associated with PI is high. In the United States, treatment costs are estimated at USD$10,708 per PI and up to USD$26.8 billion annually.[3] In the United Kingdom, PI accounts for 9% of all wounds and treatment costs the National Health Service an estimated GBP £530 million per year.[4] In Australia, treatment costs are estimated to be AU$1.8 billion per annum, representing approximately 1.9% of all public health expenditure.[5]

Patients in intensive care units (ICUs) have high rates of PI. A secondary data analysis of state-wide PI audit data from one state in Australia demonstrated that ICU patients in a tertiary facility were nearly four times more likely to develop a PI than non-ICU patients.[6] Internationally, PI rates in ICU patients have been reported to vary from 4.3% (106/2459) in China[7] and 5.1% (81/1587 patients) in the United States[8] to 12.5% (153/1228 patients, 95% confidence interval [CI] = 16.6–21.0) in France.[9] A systematic review found the cumulative incidence of PI development in the ICU ranged from 6.6% to 36.8%, whereas prevalence ranged from 12.2% to 25%.[10] Global PI prevalence was reported from an international 1-day point prevalence study 26.6% (6747/13254, 95% CI = 25.9–27.3), representing 1117 ICUs in 90 countries. Of the 6747 PIs reported, 59.2% (n = 3997) were ICU-acquired.[11]

It is recognised that prevention of PI is paramount and research has been reported addressing this problem. Reported PI prevention interventions range from single patient-focused interventions such as the application of prophylactic dressing to anatomical areas at risk of pressure[12,13] and patient repositioning frequency[14–16] to bundled approaches consisting of a group of PI prevention interventions administered together,[17–19] targeted state-wide translational programs,[20] and quality improvement programs aimed at PI prevention.[21,22] Furthermore, approaches to address PI prevention from a healthcare delivery perspective have been explored including peer-to-peer rounds,[23] wound team rounding,[24] safety huddles,[21] and regular PI prevalence audits.[22,25]

A systematic review and meta-analysis of interventions to prevent PI in the ICU revealed a dearth of high-quality evidence.[26] Although some studies have demonstrated the effectiveness of PI prevention strategies for PI reduction in the ICU context, PI rates in the ICU continue to be unacceptably high. This may in part be due to variability in clinical practice, the availability of facility-specific equipment and resource, and variation in clinical processes of care such as skin assessment and repositioning. Although internationally supported guidelines[1] for PI prevention are available, high-quality evidence for many commonly practised interventions is unavailable.[27]

Against this background, the aim of this study was to explore the nature and extent of PI prevention practices in Australian ICUs.

2. Materials and methods

2.1. Design

This study used a cross-sectional survey design, using structured telephone interviews, to gather information. The study adhered to the Strengthening Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observation studies.[28] Exemption for full ethical review was granted from the lead facility's human research ethics committee (ref: LNR/2020/QRBW/64401) on the grounds that the study met the Australian National Health Medical Research Council (NHMRC) definition of a quality assurance and evaluation activity.[29]

2.2. Setting

Data were collected from July to November 2020. In Australia, there are 191 ICUs, with 119 units in public hospitals and 72 units in the private setting.[30] This study used the College of Intensive Care Medicine (CICM) website to identify 97 public ICUs that were registered and met CICM accreditation and specialist medical training requirements which focus on staffing (e.g., at least one intensive care specialist who is a CICM Fellow; appropriate numbers of experienced nursing staff where the majority will have undertaken or are undertaking postgraduate training in intensive care), operational aspects (e.g., a minimum case load of 250 admissions annually), ICU structure (e.g., a minimum of five beds), equipment, and monitoring (e.g., regular use of invasive haemodynamic monitoring; invasive and noninvasive ventilation).[31]

2.3. Sample

The inclusion criteria for this study were that ICUs were based in Australian public healthcare facilities providing care to critically ill adults and were registered with the CICM. Paediatric and neonatal ICUs were excluded.

2.4. Instrument

A structured survey using selections of prespecified answers or categories with an accompanying data dictionary was developed by the research team. Key recommendations and good practice statements from recognised international guidelines[1] informed the survey questions. Through a process of discussion amongst the research team and review of multiple iterations, the final survey was developed (Supplemental file 1). It comprised six key categories: workplace demographics, patient assessment, PI prevention strategies, medical device securement and inspection, skin hygiene, and other health service strategies. Pilot testing of the survey and data dictionary was completed by interviewing five intensive care nurses. Testing was conducted to determine clarity and understandability of the interview tool and its structure and flow and to estimate the time required for completion. After pilot testing, no changes were required.

2.5. Procedure

The general enquiry telephone number of each hospital site was called to determine the name and work email address of the nurse unit manager (NUM) for each site. Eligible sites were then divided, according to availability, between the research team members. One respondent per site, who was a senior registered nurse (RN), NUM, clinical nurse consultant, or an appropriate delegate who was aware of the ICU-specific PI prevention practices, was invited to

participate. Potential respondents were contacted initially via their designated work email address. Introductory contact, using a standardised email template, provided the participant information form including and outlining the expected length of the interview which was approximately 15 min. This email was followed up with a telephone call to reiterate key components of involvement in the study, ascertain their willingness to participate, and organise a mutually agreeable date and time for the telephone interview to occur. To protect confidentiality, a unique identification code was assigned to each participating ICU, which was kept in a separate password-protected computer-based master log. On the day of the telephone interview, voluntary consent of the respondent was confirmed verbally and recorded via the online data collection form. Survey responses were entered directly into the Research Electronic Data Capture (REDCap)[32] hosted by the Queensland University of Technology. All data were entered using the unique study identifier, and no respondent or site was entered. At the request of some respondents, the survey was emailed to them and returned via paper copy with follow-up email communication to confirm responses if required.

2.6. Data analysis

Data analysis was performed using IBM SPSS Statistics for Windows, version 27.0 (Armonk, NY: IBM Corp). Descriptive statistics were used to summarise data, with counts and percentages used to describe nominal variables and median and interquartile range (IQR) for continuous variables. Potential differences in PI prevention health service variables between metropolitan and rural/regional ICUs were evaluated. The significance of PI prevention health service variables between metropolitan and rural/regional ICUs was evaluated with simple associations using chi-square tests for categorical variables. For all tests, significance was set at $p < 0.05$.

3. Results

3.1. Sample

At the time of the study, there were 97 ICUs registered with the CICM. Of these, 75 ICUs met all inclusion criteria; 22 ICUs were excluded because they were either located overseas ($n = 15$) or were mixed adult and paediatric units ($n = 7$). Respondents from 70 ICUs completed the survey, giving a response rate of 93.3%. The survey respondent was most often the NUM, assistant/associate NUM, or other nurse manager ($n = 40$, 57.1%). Of the ICUs surveyed, most were in metropolitan districts ($n = 44$, 62.8%). The median ICU capacity was 12 beds (IQR = 8–21) serviced by a median of 59 (IQR = 38–124) full-time equivalent (FTE) nursing staff members. Further sample characteristics are summarised in Table 1.

3.2. PI risk and skin assessment

PIs were considered to be a problem in most ICUs ($n = 47$, 67.1%), and half ($n = 37$, 52.9%) had dedicated guidelines for PI prevention and management in their ICU. PI risk assessment (Table 2) was conducted in all ICUs, except for one ICU where all critically ill patients were deemed to be at high risk. The Braden Scale was the most used tool for PI risk assessment ($n = 38$, 54.3%). Most respondents ($n = 49$, 70.0%) identified that the patient's initial PI risk assessment was conducted within the first 6 h of admission, and most respondents ($n = 61$, 87.1%) stated their practice was to reassess their patients' PI risk at least daily. In all ICUs, a comprehensive visual inspection of patients' skin was performed by the bedside nurse. In nearly half of the ICUs ($n = 34$, 48.6%), a comprehensive patient visual skin inspection was completed within 2 h of admission and was within 6 h in the majority of ICUs ($n = 51$, 72.9%). Most respondents reported that skin inspection was performed subsequently on every shift (Table 2).

3.3. PI prevention strategies

PI prevention strategies identified in the survey are described in Table 3. Most ICUs ($n = 63$, 90.0%) had a structured patient repositioning schedule, with the majority ($n = 45$, 64.3%) turning patients every 2–3 h (Table 3). Several methods were used to prompt patient repositioning, including timed turn rounds ($n = 32$, 45.7%), clinical nurse consultant reminders ($n = 10$, 14.3%), and clock reminders ($n = 8$, 11.4%). In all but four ICUs, devices to assist with patient repositioning, such as slide sheets or slings, were used.

Most respondents noted the ICU used some device to relieve pressure on heels (heel wedges, pillows under heels, and heel boots) and other body locations (head cushions and fluidised cushions) as shown in Table 3. Almost all ICUs had measures in place to prevent PI by protecting the underlying skin with barrier protectant products ($n = 66$, 94.3%) and multilayered silicone foam dressings ($n = 61$, 87.1%).

3.4. Device-related PI prevention strategies

Devices such as endotracheal attachment devices to secure endotracheal tubes (ETTs) were used in nearly all ICUs ($n = 66$, 94.3%) (Table 3). Nasogastric tubes (NGTs) were often secured with nasal bridles or stabilisation devices ($n = 35$, 50.0%). Skin under medical devices was protected, where appropriate, with preventative foam dressings ($n = 53$, 75.7%), protective barrier films ($n = 52$, 74.3%), and preventative hydrocolloid dressings ($n = 43$, 61.4%).

Table 1
Characteristics of ICUs ($n = 70$).

ICU	Counts	Percentage
1) State located		
Queensland	18	25.7%
New South Wales and Australian Capital Territory	28	40.0%
Victoria and Tasmania	13	18.6%
Western Australia	5	7.1%
South Australia and Northern Territory	6	8.6%
2) Hospital classification		
Metropolitan or urban district	44	62.8%
Rural or regional	26	37.1%
3) Specialty services provided *(more than one response possible)*		
Cardiac	17	24.3%
Neurological/neurosurgical	17	24.3%
Respiratory	12	17.1%
Trauma	11	15.7%
Obstetrics	10	14.3%
Transplant	9	12.9%
Renal	9	12.9%
Spinal	7	10.0%
Burns	6	8.6%
Cancer	4	5.7%
Paediatrics	2	2.9%
Other	10	14.3%
Nil (no specialist units)	45	64.3%
4) Nursing shift length		
8 h	2	2.9%
10 h	1	1.4%
12 h	9	12.9%
Combination	58	82.9%
5) Nursing staff FTE (missing $n = 6$) (median, IQR)	59, (38–124)	
6) Number of funded beds in the ICU (median, IQR)	12 (8–21)	

FTE = full-time equivalent; ICU = intensive care unit; IQR = interquartile range.

Table 2
Patient assessment for pressure injuries ($n = 70$).

PI assessment	Counts	Percentage
1) PI risk assessment		
1.1) Methods used to assess patient risk of pressure injury (PI) *(more than one response possible)*		
Braden Scale	38	54.3%
Waterlow Score (including modified versions)	26	37.1%
Electronic medical record assessment	3	4.3%
Clinical judgement	5	7.1%
Risk assessment not performed	1	1.4%
1.2) Timing of initial PI risk assessment		
On arrival into the ICU	24	34.3%
Within 2 h of arrival	8	11.4%
Within 4 h of arrival	13	18.6%
Within 6 h of arrival	4	5.7%
Within 8 h of arrival	17	24.3%
Within 24 h of admission	3	4.3%
Not performed	1	1.4%
1.3) Frequency of reassessment of PI risk		
Once per shift	43	61.4%
Daily	18	25.7%
Weekly	3	4.3%
Not performed/no regular time for reassessment	6	8.6%
2) Patient visual skin inspection (performed by the bedside nurse)		
2.1) Timing of initial comprehensive visual skin inspection of patients		
On arrival into the ICU	25	35.7%
Within 2 h of arrival	9	12.9%
Within 4 h of arrival	13	18.6%
Within 6 h of arrival	4	5.7%
Within 8 h of arrival	13	18.6%
At beginning of the next shift	2	2.9%
Other	4	5.7%
2.2) Frequency of visual reinspection of the patient's skin		
Start shift	38	54.3%
End shift	3	4.3%
2 hourly	10	14.3%
4 hourly	5	7.1%
6 hourly	2	2.9%
8 hourly	4	5.7%
10 hourly	0	0.0%
12 hourly	1	1.4%
Every 24 hourly	3	4.3%
No regular time for reassessment	4	5.7%
2.3) Tools used for PI skin inspection		
Electronic charts	17	24.3%
Paper charts	18	25.7%
Other	3	4.3%
No tools used	30	42.9%
Not reported	2	2.9%

ICU = intensive care unit.

3.5. Skin hygiene

The patient bed bath method used in nearly half ($n = 32$, 45.7%) of the ICUs was a basin of water with soap and dry wipes (Fig. 1). Most bed bathing occurred in the early morning ($n = 23$, 32.9%); however, in a third of ICUs, no regular time for bed bathing was reported.

3.6. Health service PI prevention strategies

PI prevention rounds were conducted in around a third of ICUs ($n = 26/70$, 37.1%) (Table 4). These rounds were conducted at least weekly in 17 ICUs, and some ICUs ($n = 11/70$, 15.7%) included multidisciplinary team members (physiotherapists, occupational therapists, and dieticians). Safety huddles around PI prevention were conducted in 37.1% ($n = 26/70$) of the surveyed ICUs. Most ICUs conducted in-service training and education on PI prevention

Table 3
Pressure injury prevention strategies, $n = 70$.

PI prevention	Counts	Percentage
1) Supporting bed surfaces		
1.1) Supporting bed surfaces used in intensive care units *(more than one response possible)*		
Foam mattress	15	21.4%
Foam mattress overlay	2	2.9%
Reactive supporting surface	16	22.9%
Active supporting surface	59	84.3%
Other	5	7.1%
1.2) ICU bariatric bed support (yes)	64	91.4%
1.3) Bariatric bed support types		
Foam mattress	4	5.7%
Reactive supporting surface	9	12.9%
Active supporting surface	44	62.9%
Other	6	8.6%
No bariatric bed support used/missing ($n = 1$)	7	10.0%
2) Patient repositioning		
2.1) Patient turning schedule		
2 hourly	22	31.4%
3 hourly	23	32.9%
4 hourly	18	25.7%
No regular schedule	7	10.0%
2.2) Method for patient prompting *(more than one response possible)*		
Turn rounds	32	45.7%
CNC reminder	10	14.3%
Clock reminders	8	11.4%
Other	6	8.6%
Nil/no prompting	24	34.3%
2.3) Staff members routinely involved in patient repositioning *(more than one response possible)*		
Bedside nurse	48	68.6%
Patient support officer	47	67.1%
Float nurse	28	40.0%
Assigned airway nurse	16	22.9%
CN co-ordinators	12	17.1%
Other	5	7.1%
None mentioned	19	27.1%
2.4) Devices used for assisting with patient repositioning *(more than one response possible)*		
Nylon sailcloth	55	78.6%
Matt with air	47	67.1%
Commercial	32	45.7%
Hoists	14	20.0%
Jordon frames	6	8.6%
Slides	4	5.7%
Nil	4	5.7%
3) Pressure injury (PI) prevention strategies used		
3.1) PI prevention products used *(more than one response possible)*		
Head cushion	32	45.7%
Silicone dressings	61	87.1%
Heel wedges	34	48.6%
Pillows under heels	51	72.9%
Heel boots	47	67.1%
Fluidised cushions	31	44.3%
Barrier products	66	94.3%
4) Device-related PI (DRPI)		
4.1) Securement strategies for the prevention of DRPI *(more than one response possible)*		
Devices for securing ETT (e.g., ETAD)	66	94.3%
Preventative foam dressings	53	75.7%
Barrier film, spray, or wipes	52	74.3%
Preventative hydrocolloid dressing	43	61.4%
Use of devices for securing NGT	35	50.0%
Other	5	7.1%
4.2) Timing of skin inspection surrounding medical devices		
Two hourly	16	22.9%
Three hourly	5	7.1%
Four hourly	14	20.0%
Six hourly	2	2.9%
Eight hourly	9	12.9%
Twelve hourly	8	11.4%
No regular timing	16	22.9%

CNC = clinical nurse consultant; CN = clinical nurse; ETAD = endotracheal attachment device; ETT = endotracheal tube; NGT = nasogastric tube.

and skin integrity ($n = 58/70$, 82.9%) and had skin integrity portfolios ($n = 52/70$, 74.3%). Metropolitan ICUs were more likely to have skin integrity portfolios ($n = 39/44$, 88.6%) than those ICUs in rural and regional areas ($n = 13/26$, 50.0%, $p < 0.001$). In addition, metropolitan hospitals were more likely to have a hospital-wide skin integrity service ($n = 38/44$, 86.4%) than rural and regional ICUs ($n = 17/26$, 65.4%, $p = 0.039$). The prompt for a skin integrity service review for the ICUs which had this service (n = 55) was mostly subject to nurses' clinical judgement ($n = 36/55$, 65.5%). However, more severe PIs also triggered a review in many ICUs: ≥ Stage 3 ($n = 30/55$, 54.5%) or unstageable PI ($n = 22/55$, 40.0%).

Occupational therapists were available to review ICU patients and assist in PI prevention in 60.0% ($n = 42/70$) of ICUs; however, there were significantly fewer ICUs with access to an occupational therapist in metropolitan hospitals than regional/rural hospitals ($n = 22/44$, 50.0% versus $n = 20/26$, 76.9%, $p = 0.026$). Nearly all ICUs ($n = 67/70$, 95.7%) had access to the services of dieticians, of whom the majority ($n = 44/70$, 62.9%) visited the ICU daily or every weekday.

3.7. PI prevention audit and research

Almost all respondents ($n = 67/70$, 95.7%) identified that chart audits of patients who developed PI were conducted in the ICU, most commonly monthly (34.3%, $n = 24/70$). Most ICUs ($n = 63/70$, 90.0%) conducted quality assurance projects every 6–12 months (41.3% n = 26/63) or on an *ad hoc* basis (28.6% n = 18/63) (Table 4). Around a third ($n = 22/70$, 31.4%) of ICUs reported that they undertook formal research around PI prevention, although the proportion was notably greater in metropolitan ICUs ($n = 17/44$, 38.6%) than in rural or regional ICUs ($n = 5/26$, 19.2%).

4. Discussion

This is the first study to report the nature and extent of PI prevention practices in Australian ICUs. Optimal PI prevention practice requires appropriate healthcare system and organisational resources, infrastructure, and policies. PI is an acknowledged healthcare problem.[10,19] This is reflected in our findings, where

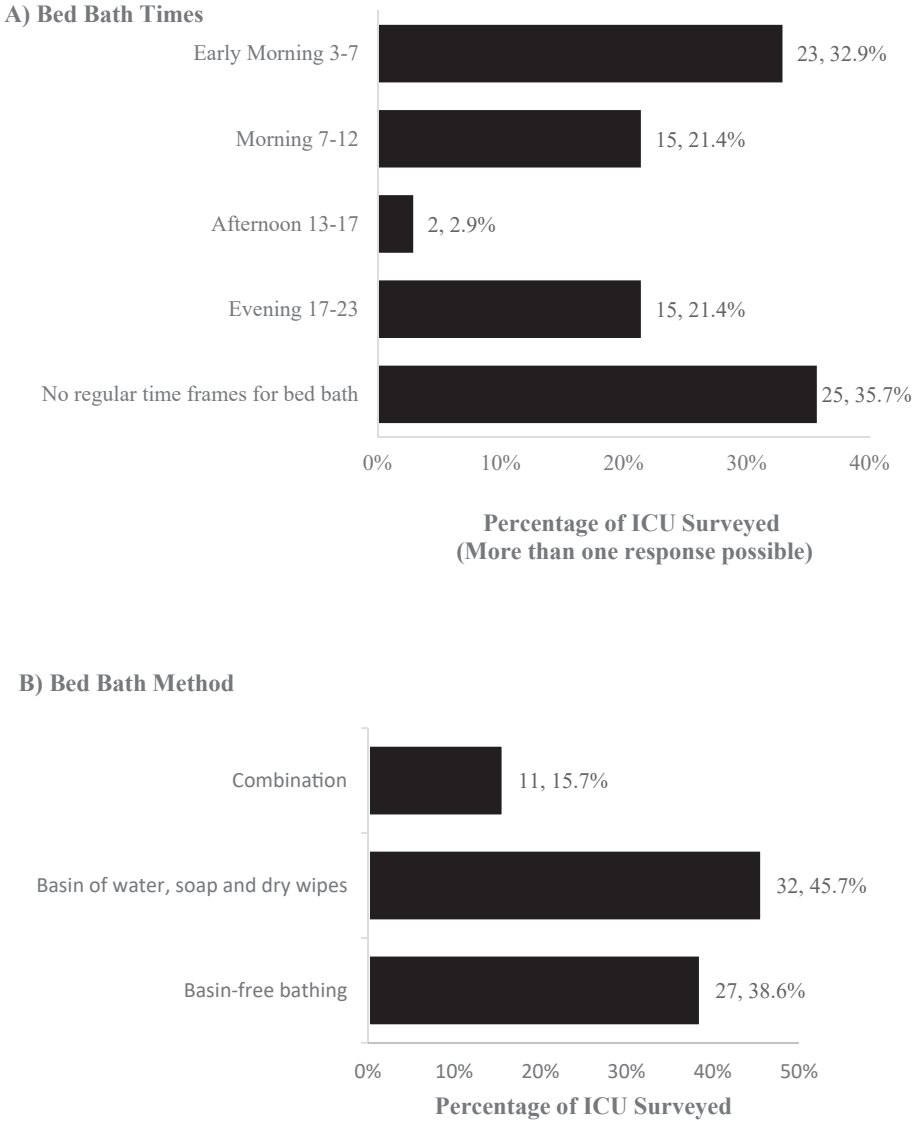


Fig. 1. Skin hygiene: Bed bath times (A) and method (B). ICU = intensive care unit.

Table 4
Skin integrity and health services: comparing Australian metropolitan ICUs with those in regional and rural locations, $n = 70$.

PI prevention focus	All ICUs, $n = 70$		Metropolitan ICUs, $n = 44$		Regional and Rural ICUs, $n = 26$		χ^2	Significance p
	Counts	Percentage	Counts	Percentage	Counts	Percentage		
ICU conducts PI prevention rounds (yes)	26	37.1%	17	38.6%	9	34.6%	0.113	0.737
ICU conducts safety huddles specific to PI prevention (yes)	26	37.1%	16	36.4%	10	38.5%	0.031	0.861
ICU conducts regular in-service education on PI prevention and skin integrity (yes)	58	82.9%	39	88.6%	19	73.1%	2.785	0.095
ICU has a skin integrity portfolio (yes)	52	74.3%	39	88.6%	13	50.0%	12.771	<0.001
Hospital has a designated hospital-wide skin integrity service (yes)	55	78.6%	38	86.4%	17	65.4%	4.272	0.039
ICU has pressure injury prevention champions (yes)	58	82.9%	37	84.1%	21	80.8%	0.127	0.722
Occupational therapist to review ICU patients (yes)	42	60.0%	22	50.0%	20	76.9%	4.936	0.026
Dietician to review ICU patients (yes)	67	95.7%	43	97.7%	24	92.3%	1.17	0.279
ICU chart audits of PIs (yes)	67	95.7%	41	93.2%	26	100.0%	1.852	0.174
ICU quality assurance projects conducted on PIs (yes)	63	90.0%	41	93.2%	22	84.6%	1.333	0.248
PI research conducted in the ICU (yes)	22	31.4%	17	38.6%	5	19.2%	2.856	0.091

ICU = intensive care unit; PI = pressure injury.

two-thirds of respondents identified that PI was a problem in their ICU. Yet, more than half (53%) of the ICUs in this study had dedicated organisational guidelines for PI prevention and management in their ICU. The reasons for this were not investigated; however, many organisations may have relied upon the international PI guideline,[1] and there is a state-wide ICU guideline available.[33]

A cornerstone of PI prevention is assessment of risk, which was conducted in all but one ICU in this study. We found the Braden Scale score and the Waterlow Score were the most commonly used tools to assess PI risk in the ICUs in our study; however, neither of these tools was developed for use in critically ill patients. More recently, an ICU-specific risk assessment tool, Consciousness, Mobility, Haemodynamics, Oxygenation Nutrition Index (the COMHON Index), has been developed in Spain and tested in Australia, demonstrating high inter-rater reliability compared with the Braden and Waterlow tools;[34] however, none of the ICUs in our survey reported its use. Hyun et al. analysed longitudinal data from the electronic health records of 7790 ICU patients to evaluate the predictive ability of the Braden Scale.[35] Of the six subscales in the Braden Scale, only those of skin moisture, mobility, friction, and shear and sensory perception were shown to be associated with PI development in ICU patients. A systematic review concluded that the Braden Scale, one of the most frequently used risk assessment scales, was not the most appropriate risk assessment tool for ICU patients.[36] It was argued that the ICU patient population is too heterogenous in terms of case mix, illness severity, and treatment interventions for one risk assessment model to be capable of characterising the whole ICU population.[37] Use of the Braden Scale score in combination with ICU patient risk factors, such as vascular disease and mechanical ventilation, has been recommended to potentially increase its utility in the ICU context.[35] However, this recommendation was based on the poor predictive validity of the Braden Scale found in that study. It has been contended that predictive validity associated with PI risk assessment is a flawed concept, as it does not take into consideration the effect of preventative interventions which may or may not have been implemented following risk assessment.[31,38] Given this, and the lack of evidence supporting the superiority of PI risk assessment tools over clinical judgement,[39,40] it is interesting to note that only five respondents in our study reported the use of clinical judgement to determine risk of PI development for patients in their ICU. Clinical judgement is a key component of assessment of the patient's risk for PI development.[1]

Our study findings highlight that a 2- to 3-hour patient repositioning regimen was used in most ICUs. Although there is limited evidence to support a single dedicated timeframe for patient repositioning, it is acknowledged that immobility and unrelieved pressure from body forces are significant contributors to PI development.[1] Lovegrove et al.[41] undertook a Delphi survey of an international expert panel to determine PI prevention strategies for critically ill patients based on low, medium, or high level of risk for PI development established in the COMHON Index risk assessment scale. Their findings determined that critically ill patients at low risk should be repositioned a minimum of 4-hourly but increased to 2- to 3-hourly for those at a moderate to high risk of PI development. However, as concluded by the authors, further higher-level research is needed.[41] Large prospective, multicentre studies are required to test the effectiveness of bundled interventions according to risk level, before they can be recommended as standard practice.

The application of prophylactic protective dressings to the sacrum or heels has received considerable recent attention as a novel strategy to alleviate PI development risk factors. In a systematic review, moderate evidence was found to support the effectiveness of prophylactic sacral protective dressings with an overall relative risk indicating the dressings decreased PI risk by 83% in ICU patients.[12] This finding was supported in a more recent meta-analysis of randomised controlled trials in intensive care, which demonstrated the effectiveness of both sacral (risk ratio = 0.22) and heel (risk ratio = 0.31) prophylactic dressings.[26] Interestingly, 87% of respondents in our study reported use of prophylactic multilayered silicone foam dressings to the sacrum and/or heels to assist in localised PI prevention, indicating that these particular interventions have been broadly incorporated into ICU clinical practice.

An international consensus document[42] recommends the implementation of a skin care regimen that includes keeping the skin clean and appropriately hydrated, cleansing the skin promptly after episodes of incontinence, avoiding the use of alkaline soaps and cleansers, and protecting the skin from moisture with a barrier product. A nonrinse washcloth providing pH-balanced cleansing, moisturisation, and deodorant capabilities is also recommended.[1] In contrast to these recommendations, our study showed variation in practice between ICUs with regards to products used and the timing of the patient bed bath, with nearly half (46%) of all ICUs using soap and water for bed bathing and performing the bed bath in the early morning (33%), potentially interrupting sleep. Although patient bathing is considered an 'everyday' nursing activity, there is potential to cause patient harm if inappropriate products are used. For example, the use of soap stresses the stratum corneum by altering skin pH (acid mantle) to a more alkaline environment, disrupts transepidermal water loss, strips lipids, and removes

natural moisturising factor, a chemical protective coat of the epidermis responsible for maintaining adequate hydration of the stratum corneum.[43]

Device-related PI (DRPI) can account for a large proportion ICU-acquired PI; however, prospective longitudinal data for DRPI in the ICU are limited. Apold and Rydrych[44] found that nearly a third (29%) of reported PI were caused by medical devices. Mehta et al reported an overall point prevalence rate of 19.2% (28/146) DRPI for patients in an ICU and that these PIs are frequently associated with ETTs and NGTs.[45] Data from an Australian and New Zealand point prevalence study reported DRPI prevalence of 4.3%, with ETTs and NGTs most commonly attributed to skin injury;[46] thus, their prevention is important. In our study, securement of ETTs and NGTs was achieved largely using commercial products; however, most respondents reported that in the ICU, securement was supplemented with barrier protective products or dressings applied to the skin. We acknowledge that we did not obtain information on the brand or type of commercial products used.

Staff-focused strategies to prevent PI that were reported in our study included safety huddles, which were usually brief (<5 min) exchanges of information about potential or existing risks, and multidisciplinary team rounding to discuss PI prevention strategies for patients. These findings are consistent with previous literature reporting the success of peer-to-peer nursing rounds,[23] whole of team approach to patient rounds,[24] and safety huddles[21] as strategies to assist in PI prevention. However, these strategies were not used by most ICUs in our study, and there may be a variety of organisational factors that affected their uptake, such as staffing levels. Uptake of different organisational strategies is dependent on the various barriers and enablers at each site, and what works well for staff members in one ICU may not be as effective for another; however, their investigation was beyond the scope of our study. Coyer et al. identified the acknowledgement that PI prevention as a priority of care coupled with a good level of PI knowledge serve to enable the uptake of PI prevention practices.[47] However, in that study, patient acuity was shown to be a significant barrier to the implementation of PI prevention practices.

The importance of an interprofessional team approach to PI prevention has been emphasised,[40] and in our study there was good evidence of interdisciplinary collaboration, with most ICUs having access to occupational therapists and physiotherapists (although there were variations between metropolitan/urban and regional/rural hospitals). There is limited evidence to support the association between nutritional goals and PI development; however, Wenzel and Whitaker[48] reported that patients who started enteral nutrition after 48 h showed a higher PI rate than those who commenced enteral nutrition within 48 h of admission (44.7% vs, 26.9%). Our study did not collect data on the nature and extent of the multidisciplinary team's involvement in PI prevention. However, further investigation is required to understand the true extent of interdisciplinary involvement with PI prevention. Many ICUs were supported by hospital-wide skin integrity teams, which may have been multidisciplinary in some cases; however, this was not investigated. The prevention, management, and treatment of PIs, and indeed wound care best practices, are ideally delivered by an interprofessional team (e.g., nurse, physician, dietician, physical therapist, occupational therapist) as no one profession has all the requisite skills.[49,50]

In terms of monitoring and investigating PI, our results indicated nearly all ICUs conducted audits of patients who had developed PI, and quality assurance projects were conducted regularly. It was encouraging that around a third of ICUs reported involvement in research around PI prevention, although more often it was conducted in metropolitan ICUs. This may have been related to factors such as staff resources and established collaborations with local universities. Although this study did not examine the nature of quality improvement projects or formal research in each ICU, the proportional involvement is encouraging. The importance of research into strategies to prevent PI has been highlighted,[51] and this is emphasised following a systematic review and meta-analysis, which revealed a lack of high-quality research evidence to support the effectiveness of PI interventions in the ICU.[26]

4.1. Limitations

The Australian context of this study limits its generalisability to international settings. However, the study does provide useful benchmark information for ICUs in Australia and overseas. Around two-thirds of the ICUs were based in metropolitan or urban settings, which may have affected some of the results, particularly where resource and personnel may have been factors. Furthermore, for similar reasons, our results may not reflect PI prevention practices in privately funded ICUs, as they were not included in our sample. There is also the potential that some respondents may have provided more favourably perceived responses to present their ICU positively. Lastly, cross-sectional surveys capture data from a specific time point and practice change is dynamic, so trends in PI prevention can and will change.

5. Conclusion

This is the first national study exploring Australian ICU PI prevention practices. Perceived as a problem for most ICUs, only half had dedicated guidelines for PI prevention and management. Findings from this study revealed that in the Australian ICU context, clinicians integrate several approaches to mitigate PI. Skin protection strategies were common in combination with structured repositioning schedules and PI prevention portfolios. Variability existed in practice-based approaches to skin hygiene, safety structures, and the composition of multidisciplinary PI prevention teams, between ICUs. Although quality assurance audits were common, relatively few sites engaged in research focused on PI prevention.

Nurses lead risk assessment for PI prevention in the ICU setting but continue to rely on instruments that lack validation in this specific context. A single ICU setting chose to classify all patients as high risk, rendering risk assessment and screening redundant. Tools for risk assessment, and existing evidence-based guidelines, stem from research undertaken in non-ICU settings, using prevention and management approaches developed and tested in select populations. Given the prevalence of PI in the ICU, the paucity of evidence for best practice, and the variability in evidence implementation in the clinical context, robust multicentre implementation studies tailored for the ICU patient population are vital. A structured, systematic approach to ICU practice improvement is required to establish relevant evidence for preventative practice. Incorporation of an ICU-specific risk screening tool should be prioritised as a foundation from which targeted intervention studies for prevention and management can be launched.

Conflict of Interest

None.

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CRediT authorship contribution statement

Annabel Levido: Conceptualisation, Methodology, Investigation, Data curation, Writing – original draft. **Paul Fulbrook**: Methodology, Investigation, Writing – review & editing. **Michelle Barakat-Johnson**: Methodology, Investigation, Writing – review & editing. **Jill Campbell**: Methodology, Investigation, Writing – review & editing. **Lori Delaney**: Methodology, Investigation, Writing – review & editing. **Sharon Latimer**: Methodology, Investigation, Writing – review & editing. **Rachel M Walker**: Methodology, Investigation, Writing – review & editing. **Rochelle Wynne**: Methodology, Investigation, Writing – review & editing. **Anna Doubrovsky**: Conceptualisation, Investigation, Writing – original draft, Data curation, Formal analysis. **Fiona Coyer**: Conceptualisation, Methodology, Investigation, Data curation, Writing – original draft.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aucc.2021.11.004.

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