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State-wide prevalence of pressure injury in intensive care versus acute general patients: A five-year analysis

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Abstract

Aim: The aim of this study was to analyse prevalence of pressure injury in intensive care versus non-intensive care patients.

Background: Hospital-acquired pressure injury is an enduring problem. Intensive care patients are more susceptible due to multiple risk factors. Several studies have indicated that intensive care patients are more likely than general patients to develop pressure injuries.

Design: Secondary data analysis.

Methods: Eighteen general hospitals with intensive care units were included. The sample included all consenting patients. Logistic regression modelling was used to derive prevalence and effect estimates. STROBE reporting guidelines were followed.

Results: The sample comprised 15,678 patients; 611 were in intensive care. The crude prevalence estimate of hospital-acquired pressure injury was 9.6% in intensive care and 2.1% in non-intensive care patients. The ≥Stage II hospital-acquired prevalence estimate in was 8.6% intensive care and 1.2% in non-intensive care patients. Intensive care patients were at markedly increased risk of hospital-acquired pressure injury compared with non-intensive care patients, with risk persisting after adjusting for pressure injury risk score. Risk of ≥ Stage II hospital-acquired pressure injury was further elevated. Intensive care patients had a higher pressure injury risk level and developed a greater proportion of severe hospital-acquired pressure injuries than non-intensive care patients. In intensive care, most hospital-acquired pressure injuries were found on the sacrum/coccyx and heels.

Conclusions: There were significant differences between the hospital-acquired pressure injury prevalence of intensive care versus non-intensive care patients, which is consistent with previous studies. Overall, the prevalence of hospital-acquired pressure injury in intensive care is relatively high, indicating that their prevention should remain a high priority within the intensive care setting.

Relevance to Clinical Practice: These results may be used for benchmarking and provide a focus for future education and practice improvement efforts.

Patient or Public Contribution: Neither patients nor the public were directly involved in the project.

KEYWORDS
acute care, benchmarking, critical care, hospital-acquired, intensive care, pressure injury, prevalence

1 | INTRODUCTION

Pressure injury is a common complication of hospital admission (Fernando-Canavan et al., 2021), associated with adverse patient impacts including pain (Kim et al., 2019) and mortality (Labeau et al., 2021; Verdú-Soriano et al., 2021), as well as increased healthcare costs and length of stay (Nghiem et al., 2022). Pressure injury occurring on the skin is classified by an international system into six categories (National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, & Pan Pacific Pressure Injury Alliance, 2014): Stages I to IV, Unstageable and Suspected deep tissue injury. Pressure injuries that occur on the mucous membranes differ and subsequently should not be staged using skin classification systems (European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, & Pan Pacific Pressure Injury Alliance, 2019) and should be reported separately as mucosal pressure injury. Whilst many hospital-acquired pressure injuries are avoidable using appropriate preventative interventions (Pittman et al., 2019; Schmitt et al., 2017), they remain a significant clinical challenge. A systematic review of prevalence and incidence (2008–2018) in hospitalised adults reported a global pooled hospital-acquired pressure injury rate of 8.4% (Li et al., 2020), similar to the hospital-acquired pressure injury pooled prevalence of 7.9% found in an Australasian systematic review (1997–2018) (Rodgers et al., 2020).

Within-hospital settings, patients in intensive care represent a subgroup that is inherently different to, and at greater risk of, hospital-acquired pressure injury than the general acute population (Coyer et al., 2017; Lovegrove et al., 2022). A retrospective analysis of data from acute care hospitals in the United States between 2011 and 2016 reported that patients admitted to intensive care were significantly more likely to develop severe pressure injuries (Kayser et al., 2019). Their vulnerability is related to multiple risk factors associated with critical illness (Cox & Schallom, 2021), and several studies have reported higher hospital-acquired pressure injury rates in intensive care than acute ward settings (e.g. Bredesen et al., 2015; Coyer et al., 2017; Lahmann et al., 2012; VanGilder et al., 2021).

An intensive care-specific systematic review of pressure injury in adult patients (2002–2017) reported 95% confidence intervals (CI) around cumulative incidence and prevalence of 10.0%–25.9% and 16.9%–23.8%, respectively (Chaboyer et al., 2018); however, the study did not distinguish between hospital-acquired pressure injury and community-acquired pressure injury rates. More recently, a 90-country international point-prevalence study reported an intensive care-acquired pressure injury prevalence of 16.2%, although by continent prevalence ranged from 9.1% to 22.8% (Labeau et al., 2021). Furthermore, of all pressure injuries identified globally, 59.2% were intensive care-acquired. Internationally, single country studies also indicate that pressure injury occurrence is high in intensive care, although sample sizes are variable, Stage I injuries are not always included, and it is not always clear what proportion of reported pressure injuries are hospital-acquired.

What does this paper contribute to the wider global community?

- A rigorous analysis of pressure injury prevalence was undertaken, taking into account confounding variables. The results demonstrate that the odds (adjusted for risk) of developing any hospital-acquired pressure injury (OR 2.9) or any ≥Stage II pressure injury (OR 4.3) in intensive care are significantly greater than in acute wards.
- Severe hospital-acquired pressure injuries occur in significantly greater proportions in intensive care patients compared with others in acute wards.
- Whilst hospital-acquired mucosal pressure injury prevalence is low in intensive care (1.6%), it is 16 times greater than that of acute wards (.1%). As a proportion of all hospital-acquired pressure injuries in intensive care, they represent around one in 10 pressure injuries.

In Australia and New Zealand, a prevalence study undertaken in 2016, across 47 intensive care units and 671 patients, reported pressure injury point prevalence of 10.4% (Yarad et al., 2021). Of the 107 pressure injuries recorded in 70 intensive care patients, over half (57%, $n = 61$) was present on admission to intensive care. In the United States, in a much larger analysis of critically ill patients included in the 2018–2019 International Pressure Ulcer Survey™ ($n = 41{,}866$), hospital-acquired pressure injury prevalence in intensive care was reported as 5.9% (Cox et al., 2022). Of 2451 patients in whom injuries were reported, 12.8% were Stage 1. Also in the United States, a retrospective cohort study found that 6.5% of 5101 patients admitted to surgical and cardiovascular intensive care units between 2014 and 2018 developed a hospital-acquired pressure injury, although Stage 1 injuries were excluded (Alderden et al., 2021). In a point-prevalence study ($n = 1228$) undertaken in In France in

2017, across 86 participating intensive care units, overall prevalence of 18.7% (95% CI 16.6–21.0) was reported (Jacq et al., 2021), although it is not clear whether all of these injuries were hospital-acquired. However, when patients with pressure injuries on admission to intensive care were excluded, the prevalence of intensive care-acquired pressure injury was 12.5% (95% CI 10.6–14.3). In 2015, in a Spanish prospective cohort study (*n* = 335) an intensive care-acquired pressure injury incidence of 8.1%, with a rate of 11.7 per 1000 days of stay (95% CI 7.9–16.8) was reported (González-Méndez et al., 2018). However, patients with an intensive care stay of less than 24 hours were excluded. Similarly, a Brazilian study of pressure injury in intensive care between the years 2010 and 2014 reported a mean pressure injury incidence of 10.8% (Ali et al., 2020) but pressure injury categories were not reported, and it is unclear whether Stage I injuries were included. In another Brazilian study, a notably higher incidence of 20.0% was reported in a small sample (*n* = 40) (Rodrigues et al., 2021). Nine injuries were reported of which three were Stage I. Most injuries (*n* = 7) were in the sacral area. Again, patients with intensive care stays of less than 24 hours were excluded. A much higher intensive care-acquired pressure injury incidence of 33.7% of 145 patients admitted between December 2014 and June 2017 was reported in a retrospective chart review of a Lebanese medical-surgical intensive care unit (El-Marsi et al., 2018). Most injuries were Stage II, although there were some anomalies in the data reported in this study. A recent systematic review and meta-analysis of pressure prevalence in Iranian intensive care units, which included nine studies in their meta-analysis, reported a pressure injury pooled prevalence of 19.6% (95% CI 13.2%–26.0%) (Akhkand et al., 2020), but intensive care-acquired pressure injury per se was not reported.

In Australia, an annual *Queensland Bedside Audit* was undertaken from 2011 until 2019, across all Queensland public health facilities (Queensland Health, 2019, 2020). Data were collected related to key components of Australian health and safety standards (Australian Commission on Safety and Quality in Health Care, 2012, 2017) and various other aspects of patient safety and quality. Facilitated by Queensland's *Patient Safety and Quality Improvement Service*, the annual audits enabled hospitals and health services to use the results to evidence Australia's *National Safety and Quality Health Service Standards* (Australian Commission on Safety and Quality in Health Care, 2017) and to identify actions that could be implemented to improve patient outcomes.

A secondary analysis of Queensland Bedside Audit data (2012–2014) of adults (≥16 years) admitted to 18 hospitals with intensive care units, reported higher hospital-acquired pressure injury prevalence (excluding Stage I) in intensive care (11.5%) versus non-intensive care patients (3%), with intensive care patients 3.8 times more likely to develop a hospital-acquired pressure injury (Coyer et al., 2017). Another secondary data analysis (2006–2015) examined hospital-acquired pressure injury in a tertiary hospital, reporting 4.5% intensive care incidence and .4% in others, indicating that intensive care patients had a 10-fold higher hospital-acquired pressure injury incidence (Nowicki et al., 2018). In both studies, results demonstrated increased hospital-acquired pressure injury rates over time in intensive care compared with decreased rates in non-intensive care patients. These two studies offer valuable insights into the scope of hospital-acquired pressure injury in Queensland, providing intensive care benchmark data; however, the data were not adjusted for potentially confounding variables such as pressure injury risk level, which take account of factors such as age, body mass index and mobility.

The hospital-acquired pressure injury rates in these studies, and internationally (Lahmann et al., 2012; VanGilder et al., 2021), emphasise the need for intensive care patients to be analysed as a subgroup of the broader hospital population. Although previous studies have demonstrated higher rates of pressure injury in intensive care patients compared with those in other ward settings, few have adjusted outcomes for potential confounders such as pressure injury risk level. Also, there has been a lack of consistency regarding the inclusion/exclusion of community-acquired pressure injuries and Stage I pressure injuries, which make institutional, national and international comparisons difficult. Furthermore, a recent systematic review found a significant lack of reporting of mucosal pressure injury, limiting benchmarking (Fulbrook, Lovegrove, Miles, & Isaqi, 2022). This is particularly relevant, given mucosal pressure injuries are primarily associated with medical device use at the injury site (European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel, & Pan Pacific Pressure Injury Alliance, 2019) and device use is greater in intensive care (Coyer et al., 2017; Fulbrook, Lovegrove, Miles, & Isaqi, 2022). These factors influenced the aims of this study.

2 | METHODS

2.1 | Design

A secondary analysis of audit data was undertaken. The dataset for this study included all consenting patients surveyed in the Queensland Bedside Audit (2015–2019) in acute hospitals with an intensive care unit (*n* = 18). Verbal consent for visual skin inspections was obtained from patients or their proxy and recorded on the audit form at the time of the audit. Ethics approval was granted by the relevant Human Research Ethics Committee (ref: HREC/2021/QPCH/78247). Data custodian and Public Health Act approval (ref: PHA 78247) were also granted for access and use of de-identified data. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for reporting observational studies (Von Elm et al., 2008) were followed (File S1).

2.2 | Aims

Within acute hospitals with intensive care units, the primary aims of this study were to identify:

- Five-year (2015–2019) overall prevalence of hospital-acquired pressure injury in intensive care and non-intensive care patients

- Five-year prevalence of hospital-acquired pressure injury by category (including and excluding Stage I) in intensive care and non-intensive care patients
- Five-year prevalence of hospital-acquired mucosal pressure injury in intensive care and non-intensive care patients
- Compare differences in pressure injury risk level, prevalence and characteristics (category and site) in intensive care and non-intensive care patients; and
- Compare pressure injury prevalence between hospitals using direct standardisation.

A secondary aim was to compare pressure injury prevalence by ward type (intensive care versus non-intensive care). Potential (measured) confounders of interest were age, pressure injury risk level, year and hospital.

2.3 | Setting and sample

All acute general adult (≥18 years) inpatients were included, excluding outpatients and those within day procedure units, mental health units, residential aged care, palliative care and maternity care settings. Across the 5 years of audit, most hospitals ($n = 12$) participated every year. Of the remainder, two hospitals participated for 4 years, two participated for 3 years, and 4 participated for 2 years. Fourteen hospitals participated in 2015 with 17, 16, 14 and 11 hospitals participating in the following years (2016–2019), respectively.

2.4 | Data collection

Patient-level data were collected in October annually, although the day varied by site. Local auditors collected data and received standardised training on how to complete the audit form (available from authors on request). Those conducting visual skin inspections completed pressure injury interrater reliability testing. Patient-level data detailing the patient's age, presence and risk of pressure injury were collected. Throughout Queensland, the most commonly used pressure injury risk assessment tool is the Waterlow score (Waterlow, 2005); however, the use of a particular pressure injury risk assessment tool was not recorded in the audit form, but the patient's most recent documented level of risk was reported (not at risk; at risk; high risk; and very high risk). The number, body site and category (Stage I–IV; Unstageable; Suspected deep tissue injury; and Mucosal) of pressure injuries per patient were recorded, with injuries also classified as hospital-acquired or community-acquired.

2.5 | Data analysis

The de-identified dataset was provided in Microsoft Excel™ and then imported into IBM SPSS™ version 28 (IBM Corp., 2021) and Stata™ statistical software package version 17.0 (StataCorp, 2021) for statistical analyses. The primary outcome measure was hospital-acquired pressure injury (yes/no), and the main exposure of interest was intensive care (yes/no). Other exposures and confounders of interest were pressure injury risk level, patient age and year of audit. Patients were clustered within wards within hospitals.

Continuous variables were summarised as means (M) with standard deviation (SD) or medians (Md) with interquartile range (IQR) as appropriate. Categorical variables were summarised as frequency (%). Prevalence was calculated as: (numerator ÷ denominator) × 100%, where: the numerator = number of eligible consenting hospital inpatients at the time of audit who had at least one pressure injury; the denominator = total number of eligible hospital inpatients at the time of the audit consenting to a visual skin inspection. In many countries, Stage I pressure injuries are not reportable, making benchmarking comparisons difficult for those that do. Therefore, to facilitate benchmarking across countries, prevalence estimates were calculated to both include and exclude Stage I pressure injuries.

Pressure injury risk level was collapsed into three categories for analysis where appropriate (not at risk, at risk and unknown). Patient age at the time of audit was recorded. Crude and adjusted prevalence estimates and population-averaged effect estimates comparing intensive care to non-intensive care patients were derived from logistic regression modelling with standard errors adjusted for clustering of patients within wards.

Mixed effects logistic regression modelling was used to explore clustering of hospital-acquired pressure injury within wards and hospitals and variation in adjusted hospital-acquired pressure injury prevalence between hospitals. Null models were fitted to obtain intraclass correlation coefficients (ICC). The best-fitting final model contained fixed effects for ward type and pressure injury risk status and random intercepts for hospital and random slopes for ward type within hospital. The final model was refitted using Bayesian methods. The posterior distribution comprised 150,000 iterations, obtained after a burn-in of 10,000 from three independent MCMC chains, each of length 50,000 and thinned by a factor of 10. Non-informative normal priors for coefficients and inverse gamma priors for random effects were used. Convergence was assessed by inspecting diagnostic plots.

Patient-level predicted probabilities of hospital-acquired pressure injury were derived. Directly standardised hospital-acquired pressure injury prevalence estimates were obtained by aggregating over covariate pattern and hospital estimates with highest posterior density 95% credible intervals (CrI) derived as centiles of the distribution (50 (2.5–97.5)) and presented graphically.

3 | RESULTS

3.1 | Sample characteristics

The sample comprised 15,678 patients (age M 64.5 years, SD 18.3). The 611 (3.9%) intensive care patients (age M 58.0 years, SD 16.9) were on average younger than non-intensive care patients (M

64.8 years, SD 18.3; $p < .001$). Nearly one-third (32.7%, $n = 4251$) of all patients whose risk level was recorded ($n = 12,981$) were found to be 'not at risk' of pressure injury. Within intensive care, the risk level (Md 2 = high risk, $n = 533$) was higher than non-intensive care patients (Md 1 = at risk, $n = 12,448$; $p < .001$). Most intensive care patients (95.3%, $n = 508$) were at some level of risk of pressure injury compared with a smaller proportion of non-intensive care patients (66.1%, $n = 8222$; $p < .001$).

3.2 | Pressure injury prevalence

Of 15,678 patients, 742 (4.7%) had at least one pressure injury (range 1–10, median 1 (IQR 1–2)). Of these, 370 (49.9%) had at least one hospital-acquired pressure injury, 360 (48.5%) had at least one community-acquired pressure injury (inclusive of 26 patients with both) and the source was unknown for 39 (5.3%). Overall, 611/15678 (3.9%) patients were in intensive care, ranging from 2.8%– to 4.9% across all hospitals. Patients with pressure injuries were on average older (M 70.4 years, SD 15.8) than those without (M 64.3 years, SD 18.4). Of patients in intensive care, 13.1% had at least one pressure injury compared with 4.4% of non-intensive care patients. The distributions of variables of interest and crude hospital-acquired pressure injury prevalence estimates with 95% CIs are shown in Table 1, and crude prevalence estimates for outcome measures by ward type are shown in Table 2. Risk of hospital-acquired pressure injury was strongly associated with ward type and pressure injury risk category and there was evidence of variation in crude prevalence by age group and hospital but no evidence for variation by year. With the exception of community-acquired pressure injury and any Stage IV hospital-acquired pressure injury (insufficient observations), all other prevalence estimates were significantly higher in intensive care units compared with non-intensive care wards (Table 2).

The overall crude prevalence of hospital-acquired pressure injury was 2.4% (95% CI 2.0–2.8); in non-intensive care wards, it was 2.1% (95% CI 1.8–2.4) compared with 9.6% (95% CI 4.3%–14.8%) in intensive care units (odds ratio [OR] 5.0, 95% CI 2.7–9.4: $p < .001$). The effect was attenuated after adjusting for pressure injury risk level (OR 2.9, 95% CI 1.7–4.9) (see Table 3). Similarly, for Stage II or higher hospital-acquired pressure injury, the crude association (OR 7.7, 95% CI 3.9–14.9) was attenuated (OR 4.3, 95% CI 2.4–7.7) after adjusting for pressure injury risk level. Whilst the crude prevalence of hospital-acquired mucosal pressure injury was very low (1.6%, 95% CI 0–3.3) in intensive care, it was 16 times greater than that found in non-intensive care wards (.1%, 95% CI 0–.1) (see Table 2).

Based on two-level null models, the ICC for wards was .17 (95% CI .12–.24) compared with .10 (95% CI .04–.22) for clustering within hospitals. The average hospital-specific estimates derived from mixed effects models comparing intensive care units to non-intensive care wards within hospitals were generally consistent with the population-averaged estimates. However, the contrast between intensive care units and non-intensive care wards varied across hospitals. Directly standardised estimates by hospital, ward type and pressure injury risk level, derived as posterior predicted median probabilities with 95% CrI obtained after fitting the equivalent mixed effects Bayesian model are presented graphically in Figure 1. For some hospitals, at-risk patients in intensive care units had markedly higher predicted prevalence, whilst for other hospitals, there was little variation in risk. Adjusted directly standardised overall prevalence estimates by hospital are compared with the overall sample average (2.2%) in Figure 2. There are four hospitals with rates above the upper 95% exact binomial confidence limits.

3.3 | Characteristics of hospital-acquired pressure injury in intensive care

Across all years, 1026 pressure injuries were recorded in 742 patients, of which 116 (11.3%) were in 80 intensive care patients. The number of pressure injuries per patient ranged from 1 to 10, with no more than five recorded in single intensive care patients. The mean number of pressure injuries per intensive care patient was slightly higher (M 1.45) than non-intensive care patients (M 1.37; $p = .438$). In most cases (96.2%, $n = 987$), the source of the pressure injury (community- or hospital-acquired) was recorded. Just under half was hospital-acquired (49.6%, $n = 490$), with a greater proportion in intensive care (76.8%; $n = 86/112$) than in non-intensive care patients (46.2%; $n = 404/875$).

The distribution of hospital-acquired pressure injury cases by category and ward type is shown in Table 4. Of 490 hospital-acquired pressure injuries, 86 (17.6%) were reported in 58 intensive care patients. In intensive care, the greatest proportion was Stage II hospital-acquired pressure injuries (29.1%), which was similar to non-intensive care patients (31.2%). However, in non-intensive care patients the greatest proportion was Stage I (41.6%), which was much greater than in intensive care (20.9%). Overall, intensive care patients had a much greater proportion of ≥ Stage 2 hospital-acquired pressure injuries (79.1%, $n = 68$) than non-intensive care patients (54.0%, $n = 218$). The proportion of 'severe' hospital-acquired pressure injuries, that is Stages III-IV and Suspected deep tissue injuries (after Nowicki et al., 2018), in intensive care (27.9%) was greater than non-intensive care patients (14.4%). Intensive care patients' risk category and hospital-acquired pressure injury category were recorded for 79 hospital-acquired pressure injuries. Of these, none were categorised as 'not at risk' and, for all categories, three quarters (75.9%) were at 'very high risk' (see Table 5). In intensive care, the largest proportions of hospital-acquired pressure injury were found on the sacrum/coccyx (20.9%), heel (16.3%) or lip/mouth (15.1%) (see Table 6). In both ward types, the largest proportion of hospital-acquired pressure injury was on the sacrum/coccyx; however, it was greater in non-intensive care patients. The main sites of hospital-acquired pressure injury by category are shown in Table 7.

TABLE 1 Distribution of variables of interest by pressure injury status.

Variable	Overall N (%)	Any PI n (%)	Any HAPI N (n)	Any HAPI Prevalence[a] % (95% CI)	Significance *p*[a]
Hospital ID					.019
A	755 (4.8)	47 (6.3)	754 (16)	2.1 (.8–3.4)	.001
B	782 (5.0)	52 (7.0)	780 (29)	3.7 (2.1–5.4)	<.001
C	1476 (9.4)	82 (11.1)	1474 (50)	3.4 (1.6–5.2)	<.001
D	434 (2.8)	22 (3.0)	428 (8)	1.9 (.8–3.0)	.001
E	2496 (15.9)	129 (17.4)	2484 (71)	2.9 (2.1–3.6)	Reference
F	1881 (12.0)	118 (15.9)	1878 (66)	3.5 (1.2–5.8)	.003
G	510 (3.3)	11 (1.5)	510 (3)	.6 (0–1.4)	.17
H	1189 (7.6)	0	1189 (0)	—	—
I	645 (4.1)	19 (2.6)	643 (10)	1.6 (.7–2.4)	<.001
J	417 (2.7)	16 (2.2)	416 (8)	1.9 (.8–3.0)	.001
K	1473 (9.4)	52 (7.0)	1471 (24)	1.6 (.8–2.4)	<.001
L	285 (1.8)	17 (2.3)	282 (9)	3.2 (1.4–4.9)	<.001
M	395 (2.5)	19 (2.6)	392 (9)	2.3 (.8–3.8)	.003
N	497 (3.2)	17 (2.3)	497 (8)	1.6 (.9–2.3)	<.001
O	550 (3.5)	36 (4.9)	548 (13)	2.4 (.8–4.0)	.004
P	852 (5.4)	57 (7.7)	852 (30)	3.5 (2.1–5.0)	<.001
Q	632 (4.0)	30 (4.0)	632 (9)	1.4 (.3–2.5)	.01
R	409 (2.6)	18 (2.4)	409 (6)	1.5 (.5–2.4)	.003
Ward type					
Non-ICU	15,067 (96.1)	662 (89.2)	15,032 (311)	2.1 (1.8–2.4)	
ICU	611 (3.9)	80 (10.8)	607 (58)	9.6 (4.3–14.8)	<.001
Year					.11
2015	2646 (16.9)	141 (19.0)	2635 (75)	2.8 (1.9–3.8)	Ref
2016	3920 (25.0)	186 (25.1)	3892 (92)	2.4 (1.7–3.0)	.359
2017	3618 (23.1)	140 (18.9)	3618 (65)	1.8 (1.3–2.3)	.022
2018	3112 (19.8)	157 (21.2)	3112 (84)	2.7 (2–3.4)	.776
2019	2382 (15.2)	118 (15.9)	2382 (53)	2.2 (1.5–2.9)	.197
PI risk category					<.001
Not at risk	4251 (27.1%)	39 (5.3)	4249 (25)	.6 (.4–.8)	Ref
At risk	4312 (27.5%)	153 (20.6)	4302 (73)	1.7 (1.3–2.1)	<.001
High risk	2430 (15.5%)	163 (22.0)	2425 (79)	3.3 (2.5–4.0)	<.001
Very high risk	1988 (12.7%)	282 (38.0)	1977 (133)	6.7 (4.8–8.6)	<.001
Unknown risk	2697 (17.2%)	105 (14.2)	2686 (59)	2.2 (1.7–2.7)	<.001
Age (years)					.014
18 to <60	5423 (34.6%)	154 (20.8)	5414 (90)	1.7 (1.0–2.3)	Ref
60–75	4923 (31.4%)	259 (34.9)	4910 (122)	2.5 (2.0–3.0)	.009
≥75	5332 (34.0%)	329 (44.3)	5315 (157)	3.0 (2.4–3.5)	.198
Overall	15,678 (100)	742 (100)	15,639 (369)	2.4 (1.9–2.8)	

Abbreviations: HAPI, hospital-acquired pressure injury; PI, pressure injury.
[a]HAPI prevalence and *p*-values derived from logistic regression models adjusted for clustering of patients within 272 wards.

4 | DISCUSSION

This study has provided a comprehensive analysis of pressure injury prevalence in acute hospital settings and has enabled a systematic comparison of intensive care and non-intensive care pressure injuries. Whilst, for completeness, community-acquired pressure injuries were included in the analysis, the main focus is on hospital-acquired pressure injury. In this study, the

TABLE 2 Distribution and crude prevalence estimates for outcomes of interest by ward type.

	Overall		Non-ICU		ICU		
	N (*n*)	Prevalence % (95% CI)	*N* (*n*)	Prevalence % (95% CI)	*N* (*n*)	Prevalence (95% CI)	Significance *p*[a]
Any PI	15,678 (742)	4.7 (4.2–5.3)	15,067 (662)	4.4 (3.9–4.9)	611 (80)	13.1 (8.0–18.2)	<.001
At least one Stage II PI[b]	15,639 (502)	3.2 (2.8–3.7)	15,032 (432)	2.9 (2.5–3.3)	607 (70)	11.5 (6.6–16.4)	<.001
Any CAPI	15,639 (360)	2.3 (2.0–2.6)	15,032 (341)	2.3 (1.9–2.6)	607 (19)	3.1 (1.9–4.3)	.12
At least one ≥ Stage II CAPI	15,639 (280)	1.8 (1.5–2.1)	15,032 (30)	1.7 (1.4–2)	607 (16)	3.1 (1.9–4.3)	.005
Any HAPI	15,639 (369)	2.4 (2.0–2.8)	15,032 (312)	2.1 (1.8–2.4)	607 (58)	9.6 (4.3–14.8)	< .001
At least one ≥ Stage II HAPI[b]	15,639 (234)	1.5 (1.2–1.9)	15,032 (194)	1.2 (1.0–1.5)	607 (52)	8.6 (3.6–13.5)	<.001
Any Stage I HAPI	15,639 (163)	1.0 (.9–1.3)	15,032 (149)	1.0 (.8–1.2)	607 (14)	2.3 (.7–3.9)	.024
Any Stage II HAPI	15,639 (137)	.9 (.7–1.1)	15,032 (113)	.8 (.6–.9)	607 (24)	4.0 (2.0–5.9)	<.001
Any Stage III HAPI	15,639 (20)	.1 (.1–.2)	15,032 (16)	.1 (0–.2)	607 (4)	.7 (0–1.5)	.008
Any Stage IV HAPI	15,639 (4)	.03 (.01–.07)	15,032 (4)	.03 (.01–.07)	607 (0)	—	—
Any SDTI HAPI	15,639 (46)	.3 (.2–.5)	15,032 (341)	.2 (.1–.3)	607 (19)	2.6 (.1–5.1)	<.001
Any Unstageable HAPI	15,639 (33)	.2 (.1–.3)	15,032 (25)	.2 (.1–.2)	607 (8)	1.3 (.3–2.4)	<.001
Any Mucosal HAPI	15,639 (18)	.1 (.1–.3)	15,032 (7)	.1 (.0–.1)	607 (11)	1.6 (.0–3.3)	<.001

Abbreviations: CAPI, community-acquired pressure injury; HAPI, hospital-acquired pressure injury; ICU, intensive care unit; PI, pressure injury; SDTI, Suspected deep tissue injury.

[a]*p* values for contrasts between ICU and non-ICU wards derived from logistic regression models with standard errors adjusted for clustering of patients within wards.

[b]Comprised Stage II, III or IV PI or any Unstageable or mucosal PI or SDTI.

overall prevalence estimate of hospital-acquired pressure injury was 2.4%, which is lower than found in Australasia (7.9%) (Rodgers et al., 2020) and globally (8.4%) (Li et al., 2020). This finding may be indicative of a strong focus on pressure injury prevention within Queensland; however, it is important to note that only hospitals with intensive care units were included in our analyses, so our results may not be representative of all Queensland hospitals. However, within Queensland Health (public health service) there has been a state-wide multidisciplinary *Pressure Injury Prevention Collaborative* in operation for several years, whose aim is to disseminate evidence-based guidance about prevention and management strategies, which may have influenced the overall low prevalence of pressure injury.

Within intensive care, the hospital-acquired pressure injury crude prevalence estimate of 9.6% was higher than that in non-intensive care patients (2.1%). Although the hospital-acquired pressure injury prevalence in intensive care found in this study is relatively high, it is lower than reported global point-prevalence (16.2%) (Labeau et al., 2021). In a sub-set sample of 288 intensive care patients in 16 adult intensive care units across four Australian states, point prevalence was similar (9.7%) (Coyer, Chaboyer, Lin, Doubrovsky, et al., 2022). Forty intensive care-acquired pressure injuries were found in 28 patients, which were deemed intensive care-acquired if they were not recorded as being present-on-admission to intensive care. Notably, in our study, intensive care pressure injuries were included if they were recorded as being hospital-acquired, indicating that some may have been present before intensive care admission, in which case the true intensive care-acquired pressure injury prevalence may be lower than 9.6%. In the previous state-wide prevalence study (2012–2014), intensive care hospital-acquired pressure injury prevalence was 11.5%, compared with 3.0% in non-intensive care patients (Coyer et al., 2017). However, Stage I pressure injuries were excluded from this analysis, indicating that all-category pressure injury prevalence would have been higher. By comparison, the Queensland single-site study of hospital-acquired pressure injury (2006 to 2015), intensive care incidence was calculated at 4.5% (Nowicki et al., 2018). The lower incidence in this study may be reflective of the strong emphasis on hospital-acquired pressure injury prevention and education within that study hospital (Miles et al., 2013). In many previous studies, Stage I pressure injuries were either not collected in the first instance or were not reported in the results, making prevalence and incidence comparisons difficult, especially for facilities wishing to benchmark. In our study, intensive care ≥ Stage II hospital-acquired pressure injury prevalence was 8.6%, which is three quarters of that recorded in the previous state-wide study (Coyer et al., 2017) although much higher than that of non-intensive care patients (1.2%). Furthermore, after adjusting for pressure injury risk, the odds of ≥ Stage II hospital-acquired pressure injury in intensive care patients were 4.3 times higher than non-intensive care patients.

In the global *DecubICUs* intensive care prevalence study, prevalence of severe intensive care-acquired pressure injury, that is Stage

TABLE 3 Effects estimates for associations between ward type and any hospital-acquired pressure injury and Stage II or above hospital-acquired pressure injury ($n = 15{,}639$).

Outcome (method)	Variable	Category	Any HAPI OR (95% CI)	Significance *p*	Adjusted prevalence % (95% CI)[c]	≥ stage II HAPI OR (95% CI)	Significance *p*	Adjusted prevalence % (95% CI)[c]
HAPI					2.4 (2.0–2.7)			1.5 (1.2–1.8)
Logistic regression[a]	Ward type	Non-ICU	Reference		2.1 (1.8–2.4)	Reference		1.2 (1.0–1.5)
		ICU	2.9 (1.7–4.9)	<.001	5.8 (3.0–8.5)	4.3 (2.4–7.7)	<.001	5.0 (2.5–7.5)
	PI risk category			<.001			<.001	
		Not at risk	Reference			Reference		
		At risk	2.8 (1.8–4.4)	<.001		4.7 (2.3–9.5)	<.001	
		High risk	5.2 (3.4–8)	<.001		9.0 (4.5–17.9)	<.001	
		Very high risk	10.1 (6.5–15.7)	<.001		16.7 (8.2–33.9)	<.001	
		Unknown	3.6 (2.4–5.6)	<.001		6.1 (3.1–12.4)	<.001	
HAPI		Overall			2.2 (1.5–2.9)	Overall		1.2 (.7–1.7)
Mixed effects models[b]	Ward type	Non-ICU	Reference		2.1 (1.4–2.7)	Reference		1.1 (.6–1.5)
		ICU	2.4 (1.1–4.9)	.021	4.7 (1.4–8.0)	4.3 (2.2–8.2)	<.001	4.2 (1.4–7.0)
	PI risk category			<.001			<.001	
		Not at risk	Reference			Reference		
		At risk (any)	5.0 (3.3–7.6)	<.001		8.5 (4.3–16.7)	<.001	
		Unknown	3.1 (1.9–5.1)	<.001		4.7 (2.3–10.0)	<.001	
			Estimate (95% CI)			Estimate (95% CI)		
Variance	Ward type	(within hospital)	.78 (.15–3.98)			.40 (.05–3.12)		
	Hospital-level		.36 (.13–.97)			.55 (.20–1.50)		

Abbreviations: HAPI, hospital-acquired pressure injury; ICU, intensive care unit; PI, pressure injury.

[a]Logistic regression models were adjusted for clustering of patients within 272 wards.

[b]Mixed effects logistic regression models were fitted with a random intercept for hospital and random slope for ward type within hospital; estimates are ‘subject specific’ and represent the within-hospital contrasts for an ‘average’ hospital (with random effects set to 0).

[c]Adjusted for pressure injury risk category and age.

III, IV and Suspected deep tissue injuries, was reported as 3.3%, 1.7% and 2.0%, respectively (Labeau et al., 2021). In contrast, in our study, the prevalence of these injuries in intensive care was relatively lower: .7%, 0% and 2.6%, respectively. In terms of hospital-acquired pressure injury category counts, we found a much smaller proportion of Stage 1 pressure injuries in intensive care (20.9%) than in non-intensive care wards (46.0%) and a much larger proportion (27.9%) of severe pressure injuries in intensive care compared with non-intensive care patients (14.4%). In the United States, prevalence data from 2451 intensive care patients with hospital-acquired pressure injuries revealed a large proportion was Deep tissue injuries (33.6%), with a further 4.1% and 1.4% of Stage III and IV injuries respectively (Cox et al., 2022). A large proportion (40.8%) of severe pressure injuries (Stages III and IV) was also reported in the French intensive care prevalence study (Jacq et al., 2021), although this may have included non-intensive care-acquired pressure injuries, and a small Brazilian study in which a third were Stages III and IV (Rodrigues et al., 2021). In contrast, in the previous state-wide study (Coyer et al., 2017), the proportion of severe hospital-acquired pressure injury in intensive care patients was much lower (10.2%, $n = 5/49$), of which most were Suspected deep tissue injury. However, had Stage I pressure injuries been included, the proportion would have been lower still. Similarly, the proportion of severe pressure injuries (Stages III-IV and Suspected deep tissue injuries) reported in an Australian and New Zealand prevalence study was 11.2% (12/107) (Yarad et al., 2021) but around half of these were not intensive care-acquired injuries. In the Australian point-prevalence study of Coyer, Chaboyer, Lin, Doubrovsky, et al. (2022), the proportion of severe hospital-acquired pressure injury in intensive care patients was 22.5%. There were no Stage IV pressure injuries, and the majority of severe pressure injuries were Suspected deep tissue injuries, similar to our current study; however, most injuries (65.0%) were reported as Stage I or II, which was higher than found in our study (50.0%). In contrast, in Nowicki et al.'s (2018) study, the proportion of severe hospital-acquired pressure injury was 6.1% ($n = 44/726$) in intensive care and 1.6% (73/4554) in non-intensive care patients. The reason for these differences in severity is unclear. Nowicki et al. (2018) examined the characteristics of 13 intensive care patients with Stage III and IV hospital-acquired pressure injuries, concluding that severe hospital-acquired pressure injury may be a manifestation of skin failure due to hypoperfusion associated with severity of illness. Further research is warranted in this area, as many of the skin injuries categorised as pressure injury in intensive care may in fact be caused primarily by hypoperfusion rather than pressure or shear. This is of further significance, given that in some countries, healthcare facilities incur financial penalties when hospital-acquired and severe pressure injuries occur (Centres for Medicare and Medicaid Services, 2022; Independent Health and Aged Care Pricing Authority, 2022; Jackson et al., 2016; Padula et al., 2020). The inclusion of *Suspected* deep

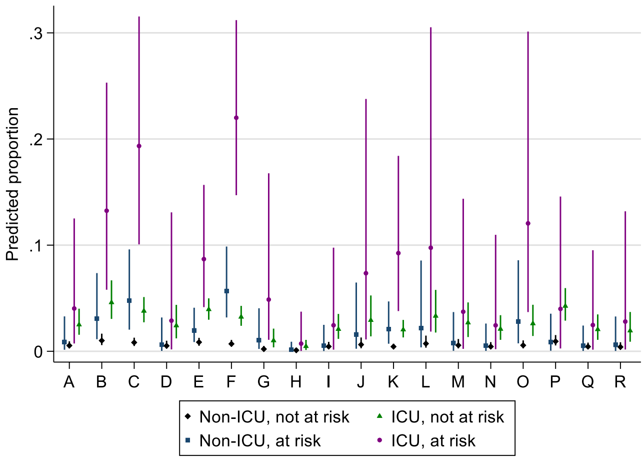
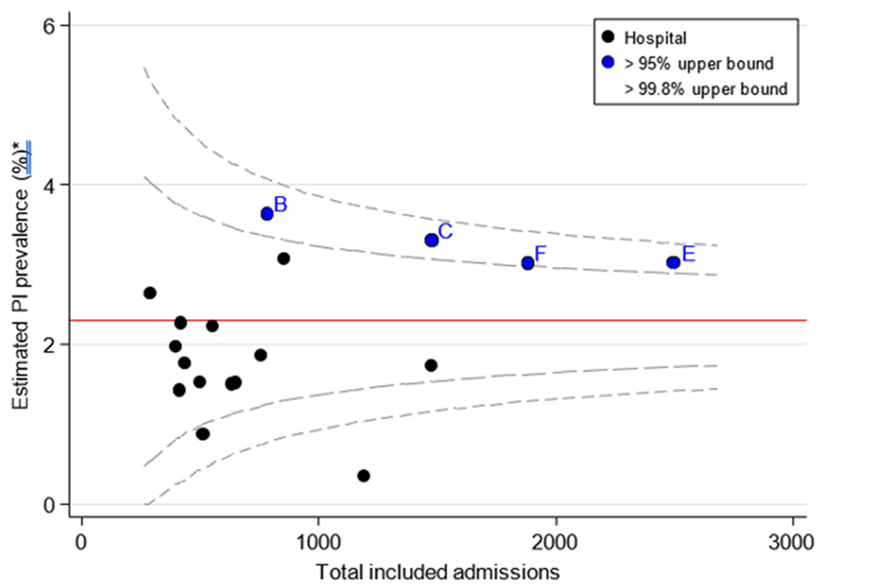


FIGURE 1 Predicted proportion of patients with hospital-acquired pressure injury (95% CrI) by hospital, ward type and pressure injury risk; derived from mixed effects logistic regression modelling.



*95% and 99.8% exact binomial confidence intervals shown around the estimated mean (2.2%)

FIGURE 2 Funnel plot of directly standardised hospital-acquired pressure injury prevalence by hospital, derived from mixed effects logistic regression modelling.

TABLE 4 Number of hospital-acquired pressure injuries by ward type[a] and pressure injury category.

Pressure injury category	ICU *n* (%)	Non-ICU *n* (%)	Total *n* (%)
Stage I	18 (20.9)	186 (46.0)	204 (41.6)
Stage II	25 (29.1)	126 (31.2)	151 (30.8)
Stage III	7 (8.1)	17 (4.2)	24 (4.9)
Stage IV	0 (0)	4 (1.0)	4 (.8)
Suspected deep tissue injury	17 (19.8)	37 (9.2)	54 (11.0)
Unstageable	9 (10.5)	26 (6.4)	35 (7.1)
Mucosal	10 (11.6)	8 (2.0)	18 (3.7)
Total	86 (100)	404 (100)	490 (100)

[a]Hospital-acquired pressure injuries were present in 370 patients (58 in intensive care and 312 in non-intensive care wards).

TABLE 5 Number of hospital-acquired pressure injury in intensive care patients[a] by pressure injury risk level and category.

	Pressure injury risk level *n* (%)			
Pressure injury category	At risk	High risk	Very high risk	Total
Stage I	0 (0)	3 (3.8)	12 (20.0)	15 (19.0)
Stage II	1 (25.0)	7 (46.7)	15 (25.0)	23 (29.1)
Stage III	0 (0)	1 (6.7)	6 (10.0)	7 (8.9)
Stage IV	0 (0)	0 (0)	0 (0)	0 (0)
Suspected deep tissue injury	1 (25.0)	2 (13.3)	13 (21.7)	16 (11.0)
Unstageable	0 (0)	1 (6.7)	8 (13.3)	9 (11.4)
Mucosal	2 (50.0)	1 (6.7)	6 (10.0)	9 (11.4)
Total	4 (100)	15 (100)	60 (100)	79 (100)

[a]79 hospital-acquired pressure injuries were present in 52 intensive care patients; missing pressure injury risk status $n = 6$.

tissue injuries within epidemiological studies has been challenged as it is unclear how many of these will convert to actual pressure injuries (Labeau et al., 2021), a point that is also relevant to the collection of clinical audit data.

Consistent with previous studies, in our results the most common sites of hospital-acquired pressure injury in intensive care were the sacrum/coccyx and heels (37.2% of hospital-acquired pressure injuries), accounting for the greatest proportion of severe pressure injuries. A further third (33.7%) was found on the lip, mouth, nose or ear; over half were mucosal injuries on the lips, mouth and nose. Whilst the presence of medical devices was not audited in our study, there is a high likelihood that most of these were device-related pressure injuries, as found in other studies reported in a recent systematic review (Fulbrook, Lovegrove, Miles, & Isaqi, 2022). In the French prevalence study (Jacq et al., 2021), the proportion of pressure injuries that was reported as device-related was 11.8%; however, the sample denominator was smaller ($n = 186$) than the main intensive care sample ($n = 230$). How this proportion was derived is unclear, as the total number of intensive care-acquired pressure injuries was not reported. This is an area that requires further investigation, as device-related pressure injury in intensive care is under-reported, especially its association with mucosal pressure injury (Fulbrook, Lovegrove, Miles, & Isaqi, 2022). In our study, the Queensland Bedside Audit form did not allow for urogenital sites to be recorded specifically and, in our intensive care data, the site of 10.5% of hospital-acquired pressure injuries was recorded as 'other'. However, this is a relatively large proportion, and some of these may have been related to indwelling urinary catheters. Fulbrook, Lovegrove, Miles, and Isaqi (2022) found no studies that reported mucosal pressure injury as a primary outcome measure, and prevalence or incidence was able to be calculated from only four studies (Alves et al., 2017, 2017); all reporting intensive care samples. In two studies, the prevalence of mucosal pressure injury was low (1.7%: Coyer et al., 2014; 3.7%: Coyer et al., 2017), which is consistent with that in our current study (1.6%) but was higher than the incidence (.8%) reported in a Portuguese study (Alves et al., 2017). More recently, Cox et al. (2022) reported that 2.4% ($n = 59$) of all hospital-acquired pressure injuries in intensive care were mucosal. In a sample of 41,866 intensive care patients, this represents a prevalence of only .14%, which is very low. However, pressure injury counts were reported based on the most severe pressure injury recorded for each patient. The results from these studies are in contrast to the calculated incidence of 30.4% found in one study (Coyer et al., 2015). More recently, an Australian study of mucosal pressure injury incidence reported a very low hospital-wide hospital-acquired incidence of .1% (Fulbrook, Lovegrove, & Butterworth, 2022). However, when intensive care versus non-intensive care subgroups were compared, intensive care incidence was 80 times greater (2.4%) than that of non-intensive care patients (.03%). The limited evidence available to date suggests a need to further investigate mucosal pressure injury rates. Since publication of the 2014 international guideline (National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel, & Pan Pacific Pressure Injury Alliance, 2014), it has been recommended that mucosal pressure injuries are included in prevalence and incidence studies. Whilst we were unable to report device-related pressure injury prevalence, we recommend that this should be investigated in all future pressure injury prevalence or incidence studies in intensive care, especially given the fact that most intensive care patients require multiple devices, and a large proportion of intensive care-associated pressure injury is related to their use (Coyer et al., 2014; Coyer, Cook, Doubrovsky, Campbell, et al., 2022; Coyer, Cook, Doubrovsky, Vann, & McNamara, 2022; Fulbrook, Lovegrove, Miles, & Isaqi, 2022; Jacq et al., 2021; Mehta et al., 2019). An international consensus document offers a strategic approach to device-related pressure injury prevention (Gefen et al., 2022), but further research is needed to investigate effectiveness of interventions to reduce device-related pressure injury in intensive care.

Whilst the prevalence of hospital-acquired pressure injury amongst patients not at risk of pressure injury was consistently low, we observed considerable variability in pressure injury incidence across hospitals amongst patients at risk of pressure injury, particularly in intensive care units. The funnel plot method facilitates

TABLE 6 Number of hospital-acquired pressure injuries by ward type[a] and body site.

Body site	Intensive care *n* (%)	Non-intensive care *n* (%)	Total *n* (%)
Sacrum/coccyx	18 (20.9)	135 (33.4)	153 (31.2)
Heel	14 (16.3)	98 (24.3)	112 (22.9)
Lip/mouth	13 (15.1)	0 (0)	13 (2.7)
Ear	8 (9.3)	32 (7.9)	40 (8.2)
Nose	8 (9.3)	10 (2.5)	18 (3.7)
Knee	3 (3.5)	1 (.2)	4 (.8)
Occiput	3 (3.5)	2 (.5)	5 (1.0)
Elbow	2 (2.3)	13 (3.2)	15 (3.1)
Trochanter/hip	2 (2.3)	2 (.5)	4 (.8)
Finger	2 (2.3)	0 (0)	2 (.4)
Scapula	1 (1.2)	2 (.5)	3 (.6)
Lower leg	1 (1.2)	6 (1.5)	7 (1.4)
Toe	1 (1.2)	26 (6.4)	27 (5.5)
Upper arm	1 (1.2)	1 (.2)	2 (.4)
Ankle	0 (0)	16 (4.0)	16 (3.3)
Foot	0 (0)	19 (4.7)	19 (3.9)
Ischium	0 (0)	5 (1.2)	5 (1.0)
Spine	0 (0)	5 (1.2)	5 (1.0)
Upper leg	0 (0)	2 (.5)	2 (.4)
Lower arm/hand	0 (0)	2 (.5)	2 (.4)
Other	9 (10.5)	27 (6.7)	36 (7.3)
Total	86 (100)	404 (100)	490 (100)

[a]Hospital-acquired pressure injuries were present in 370 patients (58 in intensive care and 312 in non-intensive care wards).

comparison of standardised hospital-acquired pressure injury prevalence estimates to an external benchmark or between hospitals; assuming all patients were hypothetically treated at each hospital (Jones & Spiegelhalter, 2011). Whilst point estimates were above the 95% exact binomial confidence interval for four hospitals in our study, we acknowledge that this may be due to uncontrolled confounding due to unmeasured differences in patient mix. Future audits should aim to collect further relevant data.

A final point of discussion relating to our results, is the finding that less than 5% of intensive care patients that were risk-assessed were not at risk of pressure injury, and of those who had a hospital-acquired pressure injury, none were assessed to be not at risk. Based on the adjusted estimate found in our study, patients at risk of pressure injury were much more likely to develop a hospital-acquired pressure injury compared with those not at risk (OR 8.5). Combined with the markedly increased risk for intensive care patients compared with non-intensive care patients, this supports the view, held by many, that all critically ill patients are at high risk of pressure injury development. In this context, it is recommended that risk assessment of intensive care patients should be conducted using intensive care-specific tools, such as the COMHON Index which was developed in Spain (Cobos Vargas et al., 2013) and tested further in Australia (Fulbrook & Anderson, 2016), which accounts for intensive care-specific factors and does not have a 'not at risk' category.

Results from our study indicate that hospital-acquired pressure injury is an enduring adverse event in intensive care, in terms of both prevalence and severity compared with non-intensive care patients and emphasise the need for effective strategies to mitigate the risk of hospital-acquired pressure injury in intensive care. In this context, the use of preventative evidence-based interventions is vital. However, further high-quality research is needed, as a recent systematic review and meta-analysis found only two interventions that demonstrated effectiveness to prevent pressure injury within ICU (Lovegrove et al., 2022). Importantly, these interventions (prophylactic use of sacral and heel dressings) apply to the two sites in which most intensive care hospital-acquired pressure injuries were found in our study (sacrum/coccyx and heels). The results from the systematic review (Lovegrove et al., 2022) were used in an international Delphi study using the COMHON Index to determine which interventions supported by high-level evidence (randomised controlled trials) were appropriate to implement in relation to the pressure injury risk level of intensive care patients (Lovegrove et al., 2020). The authors argued that a tailored approach should be used to determine the appropriateness of interventions to mitigate risk, rather than implementing all interventions to all intensive care patients, which would not be cost-effective. Of note, whilst patient repositioning to relieve pressure is the widely accepted cornerstone of pressure injury prevention practice, the evidence to support its frequency is inconclusive (Gillespie et al., 2021) but may be more effective two to three-hourly compared with four to six-hourly (Avsar et al., 2020). In the Delphi study (Lovegrove et al., 2020), international consensus was that repositioning should occur at least four-hourly for low-risk intensive care patients and at least two-hourly those at higher risk. In a recent observational study, in a Spanish intensive care unit in which the COMHON Index was used, there was poor compliance with four- and two-hourly repositioning for low and moderate-risk patients (22.7% and 20.0%, respectively), although compliance with two-hourly repositioning was greater (58.8%) for high-risk patients (Cobos-Vargas et al., 2022). Based on their results, the authors suggested that further work was indicated to investigate the association between the mobility subscale of the COMHON Index and repositioning frequency.

4.1 | Limitations

In this study, only patients who provided consent were included. This could have resulted in some bias, especially as some patients with pressure injury may have been too ill to consent or may have been cognitively impaired. On the contrary, consent to a full visual skin inspection helped to ensure that all pressure injuries were rigorously accounted for. As with all studies where there are multiple sites and data collectors, there is potential for inconsistent data collection processes. However, the use of a standardised audit tool across all sites, as well as standardised training for auditors, helped to ensure

TABLE 7 Hospital-acquired pressure injury by ward type, pressure injury category and body site.

	Hospital-acquired pressure injuries					
	Intensive care			Non-intensive care		
Pressure injury category	*n*	Main sites % (*n*)		*n*	Main sites % (*n*)	
Stage I	18	Heel	27.8 (5)	186	Sacrum/coccyx	32.3 (60)
		Ear	16.7 (3)		Heel	29.6 (55)
		Elbow	11.1 (2)		Ear	8.6 (16)
		Other	44.4 (8)		Toe	5.9 (11)
					Foot	4.3 (8)
					Other	19.4 (30)
Stage II	25	Sacrum/coccyx	20.0 (5)	126	Sacrum/coccyx	45.2 (57)
		Ear	16.0 (4)		Heel	12.7 (16)
		Lip/mouth	16.0 (4)		Ear	10.3 (13)
		Other	48.0 (12)		Toe	7.1 (9)
					Elbow	4.0 (5)
					Other	20.6 (26)
Stage III	7	Sacrum/coccyx	57.1 (4)	17	Sacrum/coccyx	41.2 (7)
		Trochanter	28.6 (2)		Ankle	17.6 (3)
		Other	14.3 (1)		Ear	11.8 (2)
					Heel	11.8 (2)
					Other	17.6 (3)
Stage IV	0			4	Sacrum/coccyx	75.0 (3)
					Heel	25.0 (1)
Suspected deep tissue injury	17	Heel	35.3 (6)	37	Heel	43.2 (16)
		Sacrum/coccyx	29.4 (5)		Foot	8.9 (7)
		Other	35.3 (6)		Toe	16.2 (6)
					Sacrum/coccyx	8.1 (3)
					Other	13.5 (5)
Unstageable	9	Sacrum/coccyx	33.3 (3)	26	Heel	30.8 (8)
		Heel	22.2 (2)		Sacrum/coccyx	19.2 (5)
		Other	44.4 (4)		Ankle	19.2 (5)
					Ischium	11.5 (3)
					Other	19.2 (5)
Mucosal	10	Lip/mouth	70.0 (7)	8	Nose	50.0 (4)
		Nose	30.0 (3)		Other	50.0 (4)
Total	89			404		

rigorous processes. Overall prevalence was low and with fewer intensive care patients within hospitals, hospital-level estimates in intensive care units are imprecise. In future audits, it may be useful to incorporate further details about ward type and patient mix. Finally, it is important to acknowledge that our results are historical and may not reflect current rates of pressure injury.

5 | CONCLUSION

This study provides a comprehensive analysis of state-wide pressure injury prevalence, with detailed analysis of intensive care patients that may be used for national and international benchmarking. The results contribute to the evidence that intensive care patients are much more likely than those in other acute settings to develop a hospital-acquired pressure injury. They also add to a growing body of evidence from Australia, that intensive care pressure injury rates are lower than reported in many other countries. Nevertheless, the rate remains relatively high, signalling that sustained effort and greater vigilance may be required to continue to reduce pressure injury in intensive care, including the development of a stronger evidence base to support the effectiveness of preventative interventions. We recommend further prevalence and incidence studies should be undertaken, especially within the intensive care setting, to enable local, national and international benchmarking. Such studies should report outcomes that both include and exclude Stage I pressure injuries, ensure that mucosal pressure injury rates are captured and clearly identify whether pressure injuries were hospital- or community-acquired. In intensive care-specific studies, it should be clarified whether or not the hospital-acquired pressure injury occurred whilst the patient was in intensive care, as opposed to whilst the patient was in hospital (i.e. hospital-acquired). Furthermore, future studies should investigate other potential differences in pressure injury rates in intensive care patients such as disease diagnoses or different types of intensive care unit. This will help to deliver a clearer understanding of intensive care-acquired pressure injury rates. Although device association with pressure injury data were not collected in our study, we recommend that this should be collected in future studies, especially considering that the majority of device-related pressure injuries occur in intensive care settings.

6 | RELEVANCE TO CLINICAL PRACTICE

The results of this study may be used for national and international benchmarking and emphasise the clinical importance of pressure injury prevention in intensive care. Furthermore, greater proportions of severe pressure injuries and mucosal pressure injuries occur in intensive care, indicating focus areas for targeted clinical improvement initiatives.

AUTHOR CONTRIBUTIONS

Paul Fulbrook contributed to the conceptualisation, data curation, formal analysis, investigation, methodology, project administration, validation, writing—original draft and writing—review and editing. Josephine Lovegrove contributed to the conceptualisation, data curation, investigation, methodology, writing—original draft, writing—review and editing. Karen Hay contributed to the formal analysis, methodology, writing—original draft and writing—review and editing. Fiona Coyer contributed to the conceptualisation and writing—review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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