Research paper

Prevalence of pressure injury in adults presenting to the emergency department by ambulance

Paul Fulbrook, RN, PhD [a, b, c, *]
Sandra Miles, RN, PhD [a, b]
Fiona Coyer, RN, PhD [d, e, f]

[a] School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Brisbane, Australia
[b] Nursing Research and Practice Development Centre, The Prince Charles Hospital, Brisbane, Australia
[c] Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa
[d] School of Nursing, Queensland University of Technology, Brisbane, Australia
[e] Intensive Care Services, Royal Brisbane and Women's Hospital, Brisbane, Australia
[f] Institute for Skin Integrity and Infection Prevention, University of Huddersfield, UK

ARTICLE INFORMATION

ABSTRACT

Introduction: Pressure injuries are harmful, painful, and potentially preventable. Although hospital-acquired pressure injury prevalence is decreasing, it is unclear if some pressure injuries develop before hospital admission. The objective of this study was to investigate the prevalence of pressure injury in adults on arrival by ambulance to the emergency department (ED).
Methods: An observational, cross-sectional descriptive study design was used. Participants ($n = 212$) were recruited from the EDs of two Australian tertiary hospitals. Full skin inspection and pressure injury risk assessment, using Braden and Waterlow scores, were undertaken within 1 h of presentation.
Results: Pressure injuries were identified in 11 of 212 participants, giving a prevalence of 5.2% at presentation. Nearly all were admitted to hospital, giving a prevalence of 7.8% at this entry point. Participants with pressure injury and those at high risk of injury were found to have spent longer in the ambulance and within the ED. During ambulance transport and in the first hour of presentation to the ED, it was rare that pressure-relieving interventions were implemented, even for those with an identified pressure injury and those at high risk.
Conclusions: The results indicate that early pressure injury surveillance and risk assessment are merited at the point of presentation to the ED, so that prevention and treatment can be implemented at the earliest possible opportunity. Although it is more challenging to manage pressure injuries within the ambulance and ED, the use of pressure-relieving devices should be considered for those at greatest risk. Further research is recommended.

1. Introduction

Internationally, hospital-acquired pressure injuries (PIs) are regarded as adverse hospital events that cause significant patient pain, impact on quality of life,[1] and may be associated with increased mortality.[2] Considered to be largely preventable, these injuries increase hospital length of stay (LOS) and healthcare costs.[3,4] Consequently, hospital-acquired PIs can incur funding penalties or reimbursement adjustments,[5] based on the additional costs of treating patients with more severe injury.[6] PI prevalence data have been investigated worldwide and used to drive implementation of PI preventative strategies in hospital settings. Although prevalence has decreased greatly over the last 10 years,[7,8] maintenance of low prevalence levels is proving to be both a challenge and an economic burden,[9] despite evidence that prevention is effective. It has thus become important to focus attention on areas where PI may be generated, such as during transfer to hospital and within the emergency department (ED),

* Corresponding author at: School of Nursing, Midwifery and Paramedicine, Australian Catholic University, Brisbane, Australia.
E-mail addresses: paul.fulbrook@acu.edu.au (P. Fulbrook), sandra.miles@acu.edu.au (S. Miles), f.coyer@qut.edu.au (F. Coyer).

so that early intervention may be implemented. To date, there is little specific research in this area.

About 75% of patients admitted to hospital present via the ED,[10,11] and many arrive by ambulance.[12] The demographics of patients attending the ED have changed, with less life-threatening conditions requiring emergent treatment and more acute and chronic illness presentations, with a high proportion of older patients, including aged care residents, presenting to the ED.[13] These factors pose an associated high risk of PI development before ED presentation.[13]

Patients presenting to the ED via ambulance may have a higher prevalence of PI than others, due to several risk factors. They are likely to be more acutely ill,[14] which may contribute to circulatory impairment, and tend to be older and more frail, so their skin integrity may be at greater risk.[14] Others may have spent relatively long periods of time in an immobile state before arrival of an ambulance, such as those presenting after a fall.[15] A factor that may predispose to the development of PI is the relatively hard and narrow surface of the ambulance trolley[14] on which a patient may have to lie, during the journey and on arrival at the ED, until a bed space becomes available. Once in the ED, there may be a delay while assessments and diagnostic investigations take place[14] before an at-risk patient is provided with an appropriate pressure-relieving support surface or device. At-risk patients who remain on non-pressure-relieving surfaces in the ED are at increased risk of PI development.[16] All these factors could contribute to development or progression of PI for an ED patient.

Parnham[17] studied interface pressure during ambulance transport, demonstrating significantly increased pressures, especially during braking and turning, which were likely to cause capillary occlusion and tissue distortion and increase shear forces. Because a PI can develop in as little as 2 h,[18] it can be postulated that long periods in an ambulance, for example *en route,* in addition to waiting at the ED entry, could result in prolonged immobility and pressures sufficient to generate a PI. It is not known to what degree pressure-relieving support surfaces would reduce this interface pressure, but it is known that these surfaces are critical for PI prevention.[15]

Current PI prevention guidelines recommend undertaking skin inspection within 8 h of admission to hospital.[15] PIs found within this time are classified as present on admission. If all PIs are not identified at hospital point of entry, a delay in implementing prevention and treatment strategies may occur. Thus, skin inspection as soon as possible on presentation to the ED[18] and during transport contexts is advisable,[5] rather than waiting until entry point of ward admission.[8] As well as treatment delay, PI found later may inadvertently be categorised as hospital-acquired, incurring a possible financial penalty in some jurisdictions.[5]

Although PI prevalence on presentation to the ED has not been studied, within-ED PI prevalence has been reported. In a Swedish multicentre randomised controlled trial,[19] a within-ED heel PI prevalence of 8.8% (n = 15) was found for older patients brought to hospital by ambulance, with all patients nursed on a standard trolley. A single-centre non-randomised trial of a preventative sacral dressing recruiting ED patients[20] reported a sacral PI incidence for older (≥65 years) at-risk patients as 1.9% (n = 1/51) and 10.3% (n = 6/58) in the intervention and comparison groups, respectively. A single Australian state point prevalence study reported an ED PI prevalence of 7.8% (n = 10/128).[21] At least five participants (with a total of eight PI) were identified as having PI present on admission, indicating an ED-acquired point prevalence of at least 3.1% (n = 4/128; accounting for six PI). In a small Brazilian point prevalence study of a single hospital,[22] the PI prevalence of patients in the ED was 18% (n = 3/17).

In relation to studies of PI prevalence on hospital admission, findings are inconclusive or misleading. One study[23] found a PI prevalence of 26% present on admission of nursing home residents admitted to a hospital; however, auditing was undertaken on average three days after admission. Other studies have investigated the effect of emergency department length of stay (ED LOS) on hospital admission, mortality, and adverse events[11,12] or the effect of ED LOS and poor PI prevention practices on the prevalence or incidence of PI.[24] It is unclear whether some PIs may be generated before hospital admission or during the process of admission to hospital from home via ambulance and the ED, and this is the area on which this research focused attention.

2. Aim

The aim of this study was to determine the prevalence of PI in adult patients presenting to the ED by ambulance. Secondary aims were to describe PI prevalence on admission to hospital wards of adults presenting to the ED via ambulance and to examine the association between various factors (e.g., triage category, length of ambulance journey, and stretcher surface) and the presence of PI on presentation to the ED.

3. Methods

An observational, cross-sectional descriptive study was conducted at two tertiary hospital sites in south east Queensland, Australia. Both hospitals follow current international guidelines[15] for skin inspection and PI prevention and management. The multisite study was approved by the relevant hospital research ethics committees (ref: HREC/14/QPCH/255), and Public Health Act approval (ref: RD005556; RD006370) was granted for a consent waiver to recruit incapacitated participants. All other participants provided written consent, and to protect confidentiality, all data were de-identified.

3.1. Sample

A randomised sample of patients presenting to the ED via ambulance was surveyed to determine the presence of PI. Inclusion criteria were all adult patients presenting to the ED via ambulance who were able to have a full-body skin inspection within 1 h of triage. It was estimated that during the funded data collection period, it was feasible to recruit around 200 participants. This was a preliminary study, with no previous ambulance PI prevalence studies available to guide sample size calculation. However, to facilitate sample size comparison, a post hoc analysis, using the pooled PI incidence of 12% reported in prospective within-ED studies,[25] with conventional values applied to estimate sample size (z = 1.96, P = .12, d = .05),[26] a minimum sample size of 162 would be required. As this preliminary study was limited by resources, it was not possible to recruit a consecutive cohort; thus, participants were recruited on convenience days, Monday to Friday. To reduce the potential for sampling bias, one in every two potential participants was sampled randomly on presentation, using a computer-generated random numbers table.

3.2. Data collection

Skin inspections were undertaken by two experienced ED nurse research assistants on weekday shifts during September to December 2016. Before data collection, both research assistants received standardised hospital-based training on PI risk assessment and how to conduct a skin inspection. Each hospital's usual PI risk assessment form was used to record the results of skin inspection,

including the presence, location, and staging of any PI and risk assessment using the Braden[27,28] and Waterlow[29,30] risk assessment scores. Both scores were used to gather additional information about the relationship between each risk score and PI prevalence to inform future practice decisions about the use of risk assessment scores in this setting.

The Braden scale consists of six items (mobility, activity, sensory perception, skin moisture, nutritional status, and friction), with a sum score range from 6 to 23. Each item is rated from 1 (least favourable) to 3 or 4 (most favourable), with participants scoring 16 or less seen as 'at risk'. The original Waterlow score was revised in 2005. It consists of 11 items (gender, age, body mass index, mobility, continence, medication, skin condition, tissue malnutrition, neurological deficit, major surgery/trauma, and nutrition). The possible lowest score is 2, with scores greater than 10 categorised as 'at risk'.

3.3. Data analysis

Data were entered into SPSS™ (version 23) for analysis. PI prevalence is expressed as a percentage using the formula (numerator/denominator) × 100%, where numerator = the number of consenting patients with one or more PI (all stages) and denominator = the total number of consenting patients inspected. As the data were abnormally distributed, central tendency is described using median and interquartile range (IQR) values, with nonparametric tests used to examine sample differences and associations regarding PI occurrence, PI risk category, ambulance transfer time, on-stretcher time, and ED LOS, with significance set at p < .05.

4. Results

4.1. Sample

A total of 212 adult participants who presented to the ED by ambulance were included in the study. Initially, 214 participants were recruited. However, before analysis, one participant was excluded because they arrived via aircraft, and a second was excluded because their skin assessment occurred more than 1 h after triage. There was a similar proportion from each hospital site (49.1%, n = 104 vs 50.9%, n = 108). Although there was potential for participants to present to the ED on more than one occasion, this did not occur in the sample that was recruited.

4.1.1. Sample characteristics

The median age of the sample was 56.5 years (IQR, 36–75), but was abnormally distributed, with relatively large numbers of younger and older participants (Kolmogorov–Smirnov p = .001). Most participants were in triage category 3 (59.9%, n = 127), 4 (18.9%, n = 40), or 2 (18.4%, n = 39), with few in categories 1 (1.4%, n = 3) or 5 (1.4%, n = 3). In terms of case mix, the largest groups of participants in the sample were classified within the World Health Organization International Classification of Disease[31] (ICD-10) codes R00-R99 (symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified; 26.0%, n = 53), followed by ICD codes I00-I99 (diseases of the circulatory system; 19.6%, n = 40), ICD codes S00-S99 (injuries; 15.2%, n = 31), and ICD codes T00-T99 (multiple injuries, burns, poisoning and other causes; 5.9%, n = 12) and accounted for two-thirds of all participants (66.7%, n = 136).

4.2. Pressure injury

4.2.1. Prevalence

Eleven participants were identified as having a PI, giving a prevalence of 5.2% (95% confidence interval, 2.6–9.1, n = 212) on

presentation to the ED. Their median age was 64 years, which was somewhat older than those without PI (median age, 56 years), and most were male (n = 7). Most had only 1 PI (n = 10), but one participant had 4, giving a total of 14 PIs identified. Ten of the participants with PI were admitted to hospital, giving a PI prevalence at the point of ward admission of 7.8% (95% confidence interval, 3.8–13.9, n = 128) (Table 1). The site and stage of PI are shown in Table 2; most (n = 6) were Stage 1.

4.2.2. Risk assessment

Using the Braden and Waterlow scores to derive risk categories, 9 (4.3%) and 35 (16.7%) participants, respectively, were categorised as being at high risk or above. Although the Waterlow score categorised more participants as being at higher risk, when the risk category correlation between the two tools was examined for all participants, using Spearman's Rank Order Correlation, a strong positive correlation was found (rho = .70, p < .01, n = 209). The risk categories of those identified with PIs (n = 11) are shown in Table 3.

4.2.3. Ambulance transfer

The majority of all participants (90.1%, n = 191) were transferred to hospital on a Mercedes stretcher, including all those with an identified PI. A small proportion was transferred using a Mercedes chair (8.5%, n = 18) or a Subaru stretcher (1.4%, n = 3). The differences in total ambulance time (ambulance arrival time to patient off stretcher time) and time spent on stretcher by participants with and without PI were investigated using the Mann–Whitney U test. The median ambulance time for participants with PI was significantly longer (71 min) than others (59 min) (U = 703, z = −2.00, p = .046, n = 210), but the effect size was small (r = .14). Participants with PI spent longer (median 44 min) on the ambulance stretcher than others (median, 37 min); however, the difference was not statistically significant (p = .121).

Based on Waterlow scoring, ambulance transfer time (median, 65; IQR, 48–73 min) and on-stretcher time (median, 41; IQR, 27–48 min) of high-/very-high-risk participants were longer than those of lower risk participants (median, 59; IQR, 49–72 and median, 37; IQR, 28–47 min, respectively), but the differences were not statistically significant (p = .368 and .547, respectively). Applying Braden scoring similarly, the total ambulance transfer time (median, 65; IQR, 52–78 min) and on-stretcher time (median, 43; IQR, 28–51 min) of higher risk participants were notably greater than those of lower risk participants (median, 59; IQR, 48–72 and median, 37; IQR, 28–47 min, respectively) but was not statistically significant (p = .375 and .507, respectively). However, when on-stretcher time and ED LOS were added together and compared by the same two risk groups, the median lengths of time were significantly longer for higher risk participants than those of lower risk participants for both the Waterlow and Braden categorisations (median, 367; IQR, 293–491 vs median, 258; IQR, 200–377 min; U = 1802, z = −3.74, p < .001; and median, 491; IQR, 332–898 vs median, 276; IQR, 203–395 min, U = 378, z = −2.91, p = .004; respectively).

4.2.4. Within ED

Within the ED, the majority of participants were cared for on a standard trolley (86.3%, n = 183), whereas some were seated in a chair (13.2%, n = 28), and 1 (with an identified PI) was provided with a pressure-relieving mattress. Of the remaining 10 participants with PI, 9 were cared for on a standard trolley, and 1 was seated in a chair.

The Waterlow score categorised a total of 35 participants as being at 'high' or 'very high' risk of PI. The majority were cared for on a standard trolley (91%, n = 32) or a chair (6%, n = 2). Of these, 26 (84%) did not have an identified PI. Of the 11 participants with PI, 9

Table 1
Sample characteristics.

Variable	PI present	
	Yes	No
Gender, male: female % (n)	64:36 (7:4)	50:50 (100:101)
Median age, years (IQR)	64 (59–75)	56 (36–75)
Median ATS category, n (IQR)	3 (2–4)	3 (3–3)
Median Waterlow score (IQR)	22 (17–27)	7 (4–12)
Median Waterlow risk category	High risk	Not at risk
Median Braden score (IQR)	16 (10–18)	23 (21–23)
Median Braden risk category	Medium risk	Low risk
Median total ambulance time, min (IQR)	71 (57–78)	59 (48–72)
Median time on ambulance stretcher, min (IQR)	44 (40–53)	37 (28–47)
Median POST, min (IQR)	14 (7–22)	12 (8–18)
Median triage to skin assessment time, min (IQR)	42 (32–48)	42 (30–51)
Median ED LOS, min (IQR)	368 (286–609)	228 (167–359)
NEAT met % (n)	9.1 (1)	51.7 (104)
Access blocked % (n)	27.3 (3)	10.9 (22)
Admitted to hospital % (n)	90.9 (10)	58.7 (118)

ATS, Australasian Triage Scale; ED LOS, Emergency department length of stay; IQR, interquartile range; NEAT, National Emergency Access Target (met = ED discharge within 4 h); PI, pressure injury; POST, patient off stretcher time.

were categorised as 'high' or 'very high' risk, 1 was categorised as 'at risk', and 1 as 'not at risk'. Using the two categories of risk (high/very high vs at risk/not at risk), this represented a sensitivity of 81.8% with a specificity of 86.9%. The Braden score categorised significantly fewer participants as being at 'high' or 'very high' risk of PI (n = 9), of whom 5 (56%) had a PI. All but one (noted above) were cared for on a standard trolley. Of the 11 participants with an identified PI, 5 were categorised as being at 'high' or 'very high' risk, with the remainder categorised as being at 'medium' risk. Using the two categories of risk (high/very high vs low/medium), this represented a sensitivity of 45.5% and specificity of 98.0%.

The median ED LOS of participants with PI was significantly longer (386 min) than others (228 min) (U = 378, z = −2.91, p = .002) with a small to medium effect size (r = .021). Nearly all (n = 10) participants with PI exceeded the National Emergency

Table 2
Stage and site of pressure injuries.

Site	Pressure injury stage						Total
	1	2	3	4	DTI	Unstageable	
Buttock	1	1	1				3
Coccyx		1					1
Ear	3						3
Malleolus				1			1
Penis	1						1
Sacrum					1	3	4
Trochanter	1						1
TOTAL	6	2	2	0	1	3	14

DTI = deep tissue injury.

Table 3
Risk categories of subjects with identified PI (n = 11).

Braden risk category	Waterlow risk category				
	Not at risk	At risk	High risk	Very high risk	TOTAL
Low	0	0	0	0	0
Medium	1	0	2	3	6
High	0	1	0	1	2
Very high	0	0	1	2	3
TOTAL	1	1	3	6	11

PI, pressure injury.

Access Target time (Chi-square with Yates Continuity Correction: χ^2 (1, n = 212) = 5.98, p = .014), with phi (−.189) indicating a small to medium effect size.

5. Discussion

Our study is the first worldwide to report PI prevalence in ambulance patients on presentation to the ED. The prevalence of 5.2% in this relatively small sample size is considered clinically relevant, given a 4% prevalence of PI present on admission to hospital for Queensland statewide and 2% for one of our study hospitals in 2017.[32] The majority of our sample (60.4%) was admitted to hospital, with an associated PI prevalence at this entry point of 7.8%, which is the same found statewide in Victoria in 2016.[21] This highlights the need for accuracy when reporting either present on admission or hospital-acquired PI prevalence. The proportions of our sample in each triage category are similar to those reported in Queensland and nationally,[10] suggesting that ours is a fairly representative sample of this population. As this was a preliminary study to estimate PI prevalence, we did not gather extensive demographic information about participants, so it is difficult to generalise about the possible contributing factors to the development of PI in ambulance patients. Thus, we recommend future research using larger samples and regression analysis to identify predictors of PI on ED presentation.

Median ambulance transfer time in our study for all participants was 59.5 min, with a median on-stretcher time of 38 min. Although ambulance transfer and on-stretcher times were longer for high-risk participants and those identified with a PI, the relatively small sample sizes will have affected statistical significance. Nevertheless, the absolute differences in these times are clinically relevant, especially when total length of time within the ambulance and ED of higher risk participants is considered, and especially if pressure-relieving support surfaces/devices are not used.

In our study, between 4.3% (Braden) and 16.7% (Waterlow) of ED participants arriving by ambulance were categorised as being at high to very high risk of developing a PI. Despite this, with the exception of a single case, no participants were initially cared for on a pressure-relieving surface, and half of the sample had an ED LOS of greater than 4 h. While participants in triage categories 1 and 2 (19.8% of sample) may have first required critical treatment before being provided with pressure-relieving support, this support was lacking early on for other high-risk patients. In a study of risk assessment relative to PI prevention for general ward patients,[33] we noted preventative interventions planned were suboptimal in relation to PI risk level; therefore, we suggest this is an area that merits further research attention.

While current clinical practice guidelines require a skin inspection within 8 h of admission to hospital,[15] a PI can develop in as little as 2 h.[18] As ED LOS of patients subsequently admitted to hospital is rarely less than 2 h, it is important to conduct skin inspection early. Because patients may already have a PI on presentation to the ED, consideration should be given to revising the guidelines to reduce this time frame. Non-identification of an existing PI may lead to its deterioration while in the ED, especially if pressure-relieving strategies are not implemented, and it may subsequently be incorrectly identified as hospital-acquired. Our results provide evidence that use of pressure-relieving devices in the ambulance and ED was rare, including for those most at risk of PI and even those with an identified PI. A reported ED audit[34] found evidence of PI in waiting patients, with old, poorly maintained trolleys and equipment. Patients expressed discomfort in the ED and, despite limited pressure-relieving devices and patient support surfaces being available, these were not used for those patients in most discomfort or most at risk of PI development.[34] Mixed results

were found regarding average LOS in the ED (mean, 6 h; range, 1–15), although 70% of patients waited less than 6 h before hospital admission, while nurses' awareness of PI prevention was found to be limited.[34]

It is critical to identify a PI, or high PI risk, early in an admission to institute appropriate PI prevention and management strategies. Especially for more vulnerable patients, the risk of developing a PI between ambulance pick up and ED discharge may increase significantly. In our study, more participants with PI were identified as high risk using the Waterlow score than the Braden scale, but the latter is quicker to use. In the time-pressured environment of the ED, it may be useful to use a risk assessment scale to identify those at greatest risk of developing a PI, so that pressure-relieving devices can be used discriminately; however, further research is needed in this area. Use of a shorter version of a risk assessment tool for screening at triage has been previously studied in the USA[16] and found to improve reporting quality and raising of ED staff awareness of the importance of PI prevention[16]; this may be useful for prehospital and ED contexts and is recommended for further research. Supportive education has previously been found to improve identification and correct classification of PI in the ED setting,[35] which may improve efficiency of ED risk assessment.

Within the prehospital transfer and ED contexts, there is potential for several improvements to PI preventative care and protocols. A 2013 Cochrane review[36] and 2014 systematic review[37] present low-level evidence that prophylactic application of soft silicone foam dressings may reduce PI incidence. One randomised controlled trial,[38] funded by industry but deemed to be of high quality by the authors who conducted the initial study and subsequent systematic review,[37] found that these dressings reduced PI incidence in the intensive care unit setting. A non-randomised experimental study showed reduced PI incidence after their use for higher PI risk medical patients, if applied in the ED,[20] whereas two economic analyses show the dressings to be highly cost-effective in acute care settings.[39,40] Padula and Pronovost[2] posit that it would take little effort to place a prophylactic dressing on a patient's sacrum or occiput to reduce the impact of pressure, shear, and friction during transportation. The use of such dressings also offers a tangible presence as a reminder to healthcare professionals of the need for PI prevention.[39] With these dressings increasingly being used in clinical practice,[8,41,42] further high-quality studies are needed.

In the ambulance setting, pressure interface monitoring devices show promise for patient transport contexts, although their cost may be a limitation.[2] A systematic review and meta-analysis of pressure-monitoring devices concluded that they were strongly associated with PI reduction.[43] Compared to standard care, the use of pressure-monitoring devices was associated with a statistically significant reduction (88%) in the risk of developing a PI, with a relatively low number needed to treat of between 21 and 26.[44] In our study, all ambulance transfers were made using standard support surfaces, and most participants were initially cared for in the ED on a standard trolley. A 2013 Cochrane systematic review[44] of support surfaces for PI prevention found low-level evidence that high-specification foam mattresses are effective and should be considered standard, with these found, in an economic analysis of older ED patients,[24] to be cost-effective when used on stretchers and beds. It may be timely for such surfaces and pressure-monitoring devices to be provided as standard care in the pre-hospital transfer and ED contexts, especially for older and at-risk patients. For inpatients, a 2018 network meta-analysis[45] found moderate-certainty evidence for the use of powered active and powered hybrid air surfaces for PI prevention, although these provide slightly less patient comfort. Other innovations, such as the use of ultrasound to detect the presence of evolving PI or deep tissue injury,[46] have potential for selective use in the ED setting.

5.1. Limitations

This study is limited by its relatively small sample size and data collection from only two EDs in an Australian public health setting. However, post hoc sample size calculation, using the formula cited by Naing et al.,[26] and the 5.2% prevalence reported in our study indicate that future studies would require a sample size of $n = 280$. Although the baseline characteristics of our sample suggest that it is similar to that of the Australian general population presenting to the ED by ambulance, significant differences in patient profile and case mix may be present in other settings, particularly internationally, so caution should be used in terms of generalisation. There is a lack of national benchmark data available for comparison.[47] Data were collected within the first hour of presentation to the ED; therefore, any subsequent PI interventions implemented have not been accounted for. Also, participants were recruited on weekdays only and may not be a true reflection of weekly prevalence.[47] Because of this, future research is recommended with a larger sample drawn from ED presentations on all weekdays.

6. Conclusions

This study has shown the prevalence of PI of patients presenting to hospital by ambulance to be 5.2%, with the majority of those identified with PI subsequently admitted to hospital. If such PIs are not identified at the hospital point of entry, there is potential that a delay in prevention and treatment interventions will occur and such injuries may be incorrectly classified as hospital-acquired. Our results provide support for re-evaluation of the recommended time frame to initial skin inspection in the international PI prevention guidelines. Results also demonstrate that patients at higher risk of PI have longer on-stretcher times and ED LOS which are likely to further increase their susceptibility to PI. Increased use of early pressure-relieving interventions in the ED should be considered. Given that this is the first study of its kind in this area, and in consideration of our relatively small sample, further research is recommended.

CRediT authorship contribution statement

Paul Fulbrook: Design, Data collection, Data analysis, Manuscript preparation, Critical review, Manuscript amendment. **Sandra Miles**: Design, Data collection, Manuscript preparation, Critical review, Manuscript amendment. **Fiona Coyer**: Data collection, Manuscript preparation, Critical review.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aucc.2018.10.002.

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