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# Pressure Injuries in Critical Care Patients in US Hospitals

## Results of the International Pressure Ulcer Prevalence Survey

Jill Cox ◆ Laura E. Edsberg ◆ Kimberly Koloms ◆ Catherine A. VanGilder

### ABSTRACT

**PURPOSE:** The purpose of this secondary analysis was to examine pressure injury (PI) prevalence, PI risk factors, and prevention practices among adult critically ill patients in critical care units in the United States using the International Pressure Ulcer Prevalence™ (IPUP) Survey database from 2018 to 2019.

**DESIGN:** Observational, cohort study with cross-sectional data collection and retrospective data analysis.

**SUBJECTS AND SETTING:** The sample comprised 41,866 critical care patients drawn from a sample of 296,014 patients in US acute care facilities who participated in the 2018 and/or 2019 IPUP surveys. The mean age among critical care patients was 63.5 years (16.3) and 55% were male. All geographic regions of the United States were represented in this sample, with the greatest percentages from the Southeast (47.5%) and Midwest (17.5%) regions.

**METHODS:** Overall critical care PI prevalence and hospital-acquired PI (HAPI) rates were obtained and analyzed using the 2018/2019 IPUP survey database. Critical care PI risk factors included in the database were analyzed using frequency distributions. Prevention practices among critically ill patients were analyzed to evaluate differences in practices between patients with no PIs, superficial PIs (stage 1, stage 2), and severe PIs (stage 3, stage 4, unstageable, deep tissue pressure injury).

**RESULTS:** The overall PI prevalence for critical care patients was 14.3% (n = 5995) and the overall HAPI prevalence was 5.85% (n = 2451). In patients with severe HAPIs, the most common risk factors were diabetes mellitus (29.5%), mechanical ventilation (27.6%), and vasopressor agents (18.9%). Significant differences between patients with no PIs as compared to those with superficial or severe HAPIs (P = .000) for all prevention practices were found.

**CONCLUSIONS:** Study findings support the gaps elucidated in previous critical care studies on PI development in this population. The 2 most persistent gaps currently challenging critical care practitioners are (1) accurate risk quantification in this population and (2) the potential for unavailability in PI development among critically ill patients.

**KEY WORDS:** critical care, intensive care, pressure injury, prevalence.

### INTRODUCTION

Approximately 5 million patients enter critical care units in the United States annually, facing a myriad of life-threatening illnesses and conditions.<sup>1</sup> While advances in medical technology and the management of critical illness have lowered mortality rates in this population, survival may come with unintended sequelae, such as development of a pressure injury (PI). Pressure injury prevalence in critical care

exhibits wide variability ranging from 12% to 32.7% and is cited as the highest among all healthcare settings.<sup>2,3</sup> For patients admitted into a critical care unit, chances of developing a more severe PI (stage 3, stage 4, deep tissue pressure injury [DTPI], unstageable) during their admission are reported as 4 times more likely as compared to superficial PIs (stage 1 or stage 2).<sup>4</sup>

A notable downward trend in hospital-acquired pressure injuries (HAPIs) has been reported from 2006 to 2013, with rates decreasing from 6.6% to 3.6%.<sup>5</sup> Van Gilder's group<sup>5</sup> found that this downward trend has plateaued since 2013, with rates between 2013 and 2019 hovering in a tight range between 2.5% and 3.2%. This trend was also found in critical care patients; HAPI rates from 2015 to 2019 varied from 5.6% to 6.4% (Figure 1). Therefore, healthcare experts are concerned at ongoing HAPI occurrences despite the widespread national adoption of evidence-based PI prevention programs.<sup>6-8</sup>

Because critically ill patients are a unique subset of hospitalized patients with the highest reported rates of PI occurrence, a closer examination of PI prevalence, PI risk factors, and PI prevention practices is warranted. The purpose of this study was to examine PI prevalence in a large sample of critically ill patients and to identify PI risk factors and prevention practices among adult patients in critical care units in the United States using the International Pressure Ulcer Prevalence™ (IPUP)

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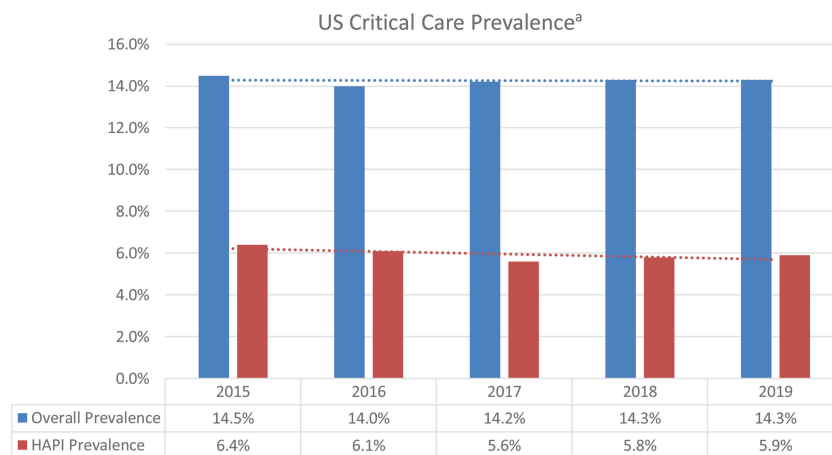
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**Figure 1.** Critical care pressure injury prevalence: 2015-2019. HAPI indicates hospital-acquired pressure injury. <sup>a</sup>Based on data from the International Pressure Injury Prevalence surveys.

survey database from 2018 to 2019. The following research questions guided this analysis:

1. What is the overall PI and HAPI prevalence in critical care units in the United States in 2018/2019?
2. What PI risk factors are associated with more severe HAPIs in critically ill patients?
3. Is there a difference in prevention practices in critically ill patients with no HAPIs as compared to patients who develop superficial PIs (stage 1 and stage 2) or severe PIs (stage 3, stage 4, DTPI, or unstageable)?

## METHODS

We completed a secondary analysis of critical care patients in US hospitals drawn from the IPUP survey in 2018/2019. The IPUP is facilitated by Hillrom, Inc (Batesville, Indiana), with participation open to any and all healthcare facilities. The current study employed an observational, cross-sectional cohort design for data collection. Study procedures were reviewed by the institutional review board of Rutgers University and received exempt status.

Data used in this analysis were drawn from a sample of 296,014 patients cared for in US acute care facilities; data were collected in the 2018 and/or 2019 IPUP surveys. Types of critical care units, also called intensive care units (ICUs), included in the analysis were as follows: general ICU, general cardiac care unit (CCU), medical ICU, surgical ICU, cardiac ICU, neuro ICU, trauma ICU, and burn ICU. All patients admitted to any of the aforementioned ICU settings during the IPUP survey date in 2018 and/or 2019 were considered for study inclusion. The sample consisted of critical care patients from 5 geographic regions of the United States (Northeast, Southeast, Southwest, West, and Midwest).

### Data Collection

Prior to the IPUP survey date, hospital-based clinical teams were trained on the data collection procedure and proper completion of data abstraction records. The data abstraction record contains no patient identifiers. We analyzed the following demographic variables: age, gender, type of critical care unit, length of hospital stay prior to the IPUP survey date, and Braden Scale score on the day of the survey. In addition, we analyzed the following PI characteristics: PI prevalence (overall

and hospital acquired), stage, and anatomic location. Critical care risk factors included in the IPUP survey were the following: diabetes, peripheral vascular disease, mechanical ventilation, vasopressors, ventricular assist device (VAD), extracorporeal membrane oxygenation (ECMO), intra-aortic balloon pump (IABP), and continuous veno-venous hemofiltration (CVVH). Questions on critical care risk factors were only completed when the patient was receiving care in a critical care unit on the day of data collection.

Prevention practices examined in the IPUP aligned with the National Database of National Quality Indicators (NDNQI) prevalence survey questions on PI prevention. The prevention practices we analyzed were as follows: skin assessment, repositioning, use of a pressure redistribution (support) surface, moisture management, and nutrition support. Responses to the questions were based on care rendered in the 24 hours preceding the IPUP data collection date. Analysis was limited to patients with a Braden Scale score of 18 or less within this same 24-hour assessment time frame. Compliance to prevention is determined based on documented and observed implementation of each of these prevention practices.

### Data Analysis

Descriptive statistics, including frequency distributions, mean, and standard deviation, for study variables were analyzed using R version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria). Differences in prevention practices among patients with no PIs, superficial PIs (stage 1, stage 2), or severe PIs (stage 3, stage 4, DTPI, unstageable) were analyzed using  $\chi^2$  analysis.

## RESULTS

Demographic variables are summarized in Table 1. The total number of hospitals participating in the survey years 2018 and 2019 combined was 1801; cumulatively, these facilities cared for 296,014 patients. Approximately 14% of these patients ( $n = 41,866$ ) were cared for in an ICU. Slightly more than half ( $n = 23,065$ ; 55%) were male, and 44.3% ( $n = 18,547$ ) were female. No gender was identified for 254 patients. The mean age for critical care patients was 63.5 years ( $SD = 16.3$ ). The largest geographic regions represented in the sample included the Southeast ( $n = 19,890$ ; 47.5%), followed by the Midwest ( $n = 7341$ ; 17.5%). The top 3 types of ICUs included in our analysis were general ICU ( $n = 13,822$ ), medical ICU

**TABLE 1.**  
Description of the Sample (n = 41,866)

Variable	Mean (SD) or n (%)
Age, y	63.5 (16.3)
Gender	
Male	23,065 (55.1%)
Female	18,547 (44.3%)
Critical care unit types	
General ICU	13,822 (33.0%)
Medical ICU	8,833 (21.2%)
Cardiac ICU	5,385 (12.9%)
Surgical ICU	5,367 (12.8%)
General CCU	4,858 (11.6%)
Neuro ICU	3,083 (7.4%)
Trauma ICU	375 (0.9%)
Burn ICU	143 (0.3%)
Length of hospitalization prior to survey date	8.4 (48.4)
Braden Scale score (last risk score—entire sample)	18.3 (3.1)
No pressure injury (n = 35,871)	16.2 (3.0)
Superficial pressure injury <sup>a</sup> (n = 1,001)	13.4 (3.1)
Severe pressure injury <sup>b</sup> (n = 1,351)	12.5 (2.9)
Overall critical care PI prevalence	5,995 (14.3%)
Hospital-acquired PI prevalence	2,451 (5.9%)

Abbreviations: ICU, intensive care unit; PI, pressure injury.  
<sup>a</sup>Stage 1, stage 2.  
<sup>b</sup>Stage 3, stage 4, deep tissue pressure injury, unstageable.

(n = 8833), and cardiac ICU (n = 5385). The mean length of hospital admission for critical care patients prior to the day of the IPUP survey was 8.4 days (SD = 48). The mean Braden Scale score reported for all critical care patients was 18.3 (SD = 3.1). When stratified by HAPI severity, for patients with no PI, the mean Braden Scale score was 16.2 (SD = 3.0); for superficial HAPIs, the mean Braden Scale score was 13.4 (SD = 3.1) while for patients with severe HAPIs, the mean score was 12.5 (SD = 2.9). We used the Braden Scale score recorded on the day of the data collection for our analysis.

**Pressure Injury Characteristics**

The overall PI prevalence for critical care patients was 14.3% (n = 5995). This includes both patients admitted with PIs and those who developed PIs during the critical care admission. The HAPI prevalence in critical care units was 5.85% (n = 2451). Further analysis of HAPIs by worst stage in critical care patients revealed the following distribution: stage 1 (12.8%; n = 313); stage 2 (28.1%; n = 688); stage 3 (4.1%; n = 101); stage 4 (1.4%; n = 35); DTPI (33.6%; n = 823); unstageable (16%; n = 392); mucosal membrane (2.4%; n = 59); not recorded (1.4%; n = 36); and indeterminable (0.16%; n = 4). If patients had more than 1 PI, only the worst stage reported was included in the prevalence analysis. We used the following ranking order for determining worst stage in patients with multiple PIs: stage 4, unstageable, DTPI, stage 3, stage 2, and stage 1. When stratified by severity of HAPIs among critical care patients, 2.39% (n = 1001) were categorized as

**TABLE 2.**  
Worst Stage Hospital-Acquired PI Stage Distribution: Critical Care (N = 2451)

PI Stage	n (%)
Stage 1	313 (12.8%)
Stage 2	688 (28.1%)
Stage 3	101 (4.1%)
Stage 4	35 (1.4%)
Unstageable	392 (16%)
DTPI	823 (33.6%)
Indeterminable	4 (0.16%)
Not reported	36 (1.5%)
Mucosal membrane	59 (2.4%)
Total	2451 (100%)

Abbreviations: DTPI, deep tissue pressure injury; PI, pressure injury.

**TABLE 3.**  
Hospital-Acquired Pressure Injury Anatomic Location Distribution: Critical Care (N = 3642)<sup>a</sup>

Location	n	%
Ankle	57	1.6%
Arm	18	0.5%
Back	95	2.6%
<b>Buttocks</b>	<b>540</b>	<b>14.8%</b>
Cheekbone	50	1.4%
Chin	16	0.44%
Ear	192	5.3%
Elbow	63	1.7%
Foot	90	2.5%
Forehead	22	0.60%
Hand	16	0.44%
<b>Heel</b>	<b>459</b>	<b>12.6%</b>
Ischium	52	1.4%
Knee/peri-knee	22	0.60%
Lower leg	67	1.8%
Neck	52	1.4%
Nose	163	4.5%
Not collected	1	0.03%
Occiput	43	1.2%
Other	231	6.3%
<b>Sacrum/coccyx</b>	<b>1208</b>	<b>33.2%</b>
Scapula	19	0.52%
Scrotum	26	0.71%
Thigh	69	1.9%
Toes	43	1.2%
Trochanter	28	0.77%
Total	3642	100%

<sup>a</sup>Patients may have more than 1 hospital-acquired pressure injury.

superficial HAPIs (stage 1 and stage 2) and 3.23% (n = 1351) were severe HAPIs (stage 3, stage 4, DTPI, and unstageable) (Table 2). The 3 most common anatomic locations for HAPI were sacrum/coccyx (33.17%; n = 1208), buttocks (14.83%; n = 540), and heel (12.6%; n = 459) (Table 3).

**Risk Factors for Pressure Injury in Critically Ill Patients**

The 2018/2019 IPUP survey contained 8 questions on PI risk factors in critical care patients. Of these risk factors, 6 represent treatment modalities unique to critical care (mechanical ventilation, vasopressors, VAD, ECMO, IABP, CVVH) and 2 represent common comorbid conditions found in hospitalized and critically ill patients (diabetes mellitus and peripheral vascular disease). The top 4 PI risk factors among the entire sample of critical care patient were as follows: diabetes mellitus (n = 6505; 17%); mechanical ventilation (n = 3184; 8%); peripheral vascular disease (n = 2764; 7%); and vasopressor agents (n = 2598; 6.7%).

We also analyzed HAPI severity and PI risk factors. The most common risk factors in patients with severe HAPIs were diabetes mellitus (n = 399; 29.5%), mechanical ventilation (n = 373; 27.6%), and vasopressor agents (n = 256; 18.9%) (Figure 2).

**Prevention Practices**

Prevention strategies were analyzed for patients deemed at risk for PIs (Braden Scale score ≤18). A total of 22,433 critical care patients were included in this analysis. Significant differences were found for all interventions in patients with no HAPIs as compared to those with superficial or severe HAPIs: skin assessment (P = .0000), repositioning (P = .0000), use of a

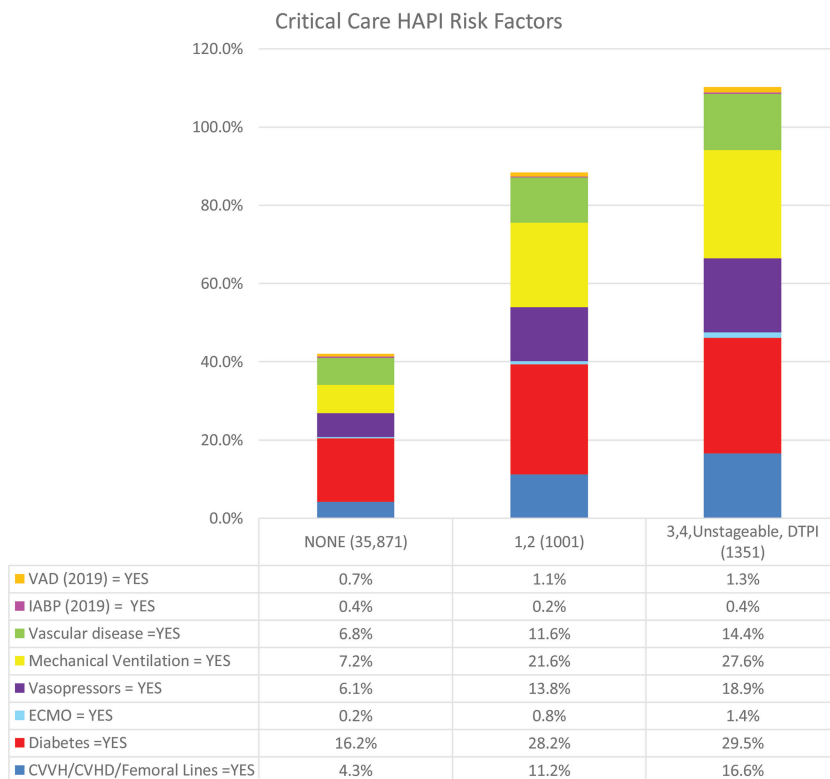
pressure redistribution surface (P = .0000), nutritional support (P = .0000), and moisture management (P = .0000) (Table 4).

**DISCUSSION**

Critically ill patients are at increased risk for PI development as a result of the complexities inherent to critical illness, as well as the multiplicity of advanced technologies used in their care. Analysis of the IPUP database from which this secondary analysis was conducted reveals an overall acute PI prevalence of 9.0% in the acute care setting, while the overall acute HAPI prevalence was 2.58%.<sup>5</sup> In contrast, critical care patients demonstrated higher rates, at 14.3% (overall prevalence) and 5.85% (HAPI prevalence) rates, respectively.

When compared to global critical care prevalence studies, the prevalence in this sample of US critical care patients was lower. Labeau and colleagues<sup>3</sup> reported on a global study on PI prevalence in 13,254 patients in 1117 ICUs based in 90 countries. The overall and acquired prevalence in ICUs was 26.6% and 16.2%, respectively.<sup>3</sup> Similarly, Chaboyer and colleagues<sup>2</sup> reported PI prevalence in a range from 12.2% to 24.5% in a systematic review and meta-analysis of 22 studies.

While the HAPI rate among critical care units in our study was lower than global reports, we assert that PI occurrences remain a concern. In a study of hospital-acquired conditions measured from the Medicare PSI-90 hospital penalty system, PIs increased 30% between the years 2013 and 2016. Pressure injuries were the only hospital-acquired condition to increase, affirming that PIs remain a threat in hospitalized patients.<sup>9</sup> In addition, HAPIs are associated with increased length of stay<sup>10-12</sup> and mortality risk,<sup>3,13</sup> and they are an additional comorbid condition in a critically ill patient. As a never event and ad-



**Figure 2.** Critical care pressure injury risk factors: Distribution by worst stage hospital-acquired pressure injury stage. HAPI indicates hospital-acquired pressure injury; DTPI, deep tissue pressure injury; VAD, ventricular assist device; IABP, intra-aortic balloon pump; ECMO, extracorporeal membrane oxygenation; CVVH, continuous veno-venous hemofiltration; CVHD, continuous veno-venous hemodialysis.

**TABLE 4.**  
**Prevention Practice in Critical Care: Distribution by Worst Stage Hospital-Acquired PI for At-Risk Patients Only**

Prevention Practice <sup>a</sup>	No PIs (n = 20,624)	Stage 1, 2 (n = 749)	Stage 3, 4, DTPI, Unstageable (n = 1060)	P
Daily skin assessment	19,142 (92.8%)	727 (97.1%)	1040 (98.1%)	.0000
Pressure redistribution surface	18,436 (89.4%)	685 (91.5%)	1020 (96.2%)	.0000
Routine repositioning	17,261 (83.7%)	673 (89.9%)	988 (93.2%)	.0000
Nutritional support	13,841 (67.1%)	599 (80.0%)	927 (87.5%)	.0000
Moisture management	17,206 (83.4%)	686 (91.6%)	990 (93.4%)	.0000

Abbreviations: DTPI, deep tissue pressure injury; PI, pressure injury.

<sup>a</sup>Must be at risk (Braden Scale score  $\leq 18$ ) to be included in count.

verse patient safety event, HAPI occurrence carries with it many negative connotations for facilities, from poor-quality measure reporting, increased exposure to litigation, as well as increases in attributable healthcare costs. Therefore, there is a need to advance our knowledge of the pathophysiologic and etiologic underpinnings that predispose critically ill patients to HAPI development.

Study findings revealed that the sacrococcygeal area was the most common location of HAPI occurrences (accounting for more than one-third of HAPIs), followed by the buttocks and heels. This anatomic distribution was identical across previous studies, with sacrococcygeal area being reported as the most common location.<sup>2,3,10,14</sup> With regard to stage, DTPI accounted for over one-third of all HAPIs, followed by stage 2 HAPIs. When compared to other recent studies, the HAPI stage distribution exhibits differences. Labeau and colleagues<sup>3</sup> reported stage 2 as the most common stage in ICU patients. However, in other studies of ICU patients in the United States, DTPI was the most common PI stage.<sup>4,15,16</sup> Cox and colleagues<sup>16</sup> in a descriptive analysis of 57 critical care patients who developed HAPIs during the ICU admission reported that 68% were DTPIs. In a study of 306 critically ill patients, DTPIs accounted for 39% of HAPIs.<sup>15</sup> The more recent findings of DTPIs as the most common stage may be the result of a change in PI coding. While DTPI has been recognized as a PI category since 2009, it was added to the US *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)* coding system in 2018. Therefore, large retrospective database studies conducted prior to this time period would not recognize or report DTPI as a distinct category.

We measured 8 PI risk factors. Diabetes mellitus emerged as the most common and frequent factor for any patient with a PI and for any stage of HAPI. In patients with severe HAPIs, 29.5% had diabetes mellitus. Mechanical ventilation was the most common iatrogenic factor evaluated; 27.6% of patients with severe HAPIs required mechanical ventilation. Vasopressor agents were the second most common iatrogenic factor, accounting for 18.9% of patients with HAPI. These findings suggest that impaired tissue oxygenation and perfusion are closely linked to PI development. Impaired tissue oxygenation and perfusion are recognized in the International Clinical Practice Guidelines as a PI risk factor.<sup>6</sup> The pathophysiologic mechanisms behind these links are not entirely understood; hypoxia is a common reason for cellular injury and is associated with both inflammation and ischemia. Respiratory failure requiring mechanical ventilation is the most common reason for admission to an ICU in the United States.<sup>1</sup> Hypotension, necessitating the use of vasopressor agents to achieve

hemodynamic stability, is also common among critically ill patients and potentiates the impact of both hypoxia and ischemia on the skin and deeper tissues.

Cox and Schallom<sup>17</sup> reported a conceptual schema for the development of PIs in the critical care population that included relationships between conditions that impair oxygenation and perfusion such as diabetes mellitus, cardiovascular disease, hypotension, mechanical ventilation, and vasopressor agents. The conundrum faced by clinicians is quantifying the magnitude of impaired tissue oxygenation and perfusion in an individual patient. Tissue oxygenation and perfusion are not part of the Braden Scale for Pressure Sore Risk. While the Cubbin-Jackson Scale does consider oxygenation in its risk scale, it is not widely used in the United States.<sup>18,19</sup>

Given the close links between impaired tissue oxygenation and perfusion, it is not surprising that we found DTPI was the most common PI stage in this population. Deep tissue injuries begin at the muscle-bone interface. Muscle is a highly vascularized tissue with high metabolic demands and low tolerance for sustained compression.<sup>20-23</sup> In acute conditions such as respiratory failure requiring mechanical ventilation or hypotension requiring the use of vasopressors to achieve hemodynamic stability, the potential for compromise of the skin and underlying tissues is elevated. Concomitant diabetes mellitus or peripheral vascular disease carry with them inherent deficits in the both microvasculature and macrovasculature, further potentiating the risk for PI development.

The Braden Scale for Pressure Sore Risk was the most common instrument used to determine PI risk. While significant differences in Braden Scale scores were found between the 3 groups ( $P = .000$ ), when examined more closely, the mean scores fell within the range from borderline “high risk” to “at risk” (12.5—severe PI group; 16.2—no PI group). This finding is not surprising, given the multiple comorbid conditions seen in critically ill patients, many of which are not incorporated in the Braden Scale.<sup>10-12</sup> Therefore, the need persists to more precisely identify objective risk factors for PI development in critically ill patients and develop an instrument that discriminates the unique blend of risk factors contributing to PI development in this population.

Whether all PIs are avoidable remains debatable, especially within the context of critical illness.<sup>24,25</sup> Findings from studies with a focus on the implementation of evidence-based PI prevention programs indicate these interventions do decrease HAPI development in the critical care population.<sup>25-28</sup> However, the authors of 2 recent systematic reviews of PI prevention practices among critically ill patients report a lack of high-quality studies in this area.<sup>29,30</sup> For example, Tayyib and Coyer<sup>29</sup> found

that the use of silicone foam dressings was the only strategy to significantly reduce PI incidence in their meta-analysis of PI prevention practices in the critical care setting.

We analyzed prevention practices using the NDNQI prevention measures queried within the IPUP data abstraction record. Five key PI prevention strategies were analyzed; they were skin assessment, support surface (pressure redistribution) use, repositioning, moisture management, and nutritional support. We compared these practices between critically ill patients who developed any stage HAPI (superficial or severe) and no HAPI and found statistically significant differences between these groups for all preventive practices. The clinical relevance of this finding is apparent. For example, adherence to the preventive intervention skin assessment was 92.8% to 98.1%; it was 89.4% to 96.2% for the use of a pressure redistribution surface, 83.7% to 93.2% for repositioning, 67.1% to 87.5% for nutrition, and 83.4% to 93.4% for moisture management. While the highest compliance rates to all preventive interventions occurred in the severe PI group, these findings suggest that regardless of HAPI status (no PI, superficial, or severe), adherence to PI prevention practices is evident within this sample. We also acknowledge that the statistical significance of these differences may be influenced by the large sample size, making the ability to find significance in data more likely.

According to the National Pressure Injury Advisory Panel, an unavoidable PI is the one that occurs despite the application of consistent and appropriate PI prevention strategies.<sup>24</sup> In order to truly evaluate unavoidability, an analysis of PI prevention practices must be undertaken as was done in this study. The occurrence of some PIs in this population may be the result of unavoidable factors. Clinical situations that predispose patients to unavoidable PIs have been described in the literature.<sup>25</sup> Situations such as hemodynamic instability manifesting as hypotension, hypoxemia in the setting of critical illnesses such as septic shock, or multiorgan failure can contribute to pathophysiologic events that may be insurmountable, creating the perfect scenario from the PI development. Likewise, the need for non-negotiable lifesaving treatment modalities such as mechanical ventilation or vasopressor agents further contributes to PI risk and their use may supersede PI prevention practices in certain circumstances. Recent studies in the critical population also support this premise that certain risk factors may predispose a patient to a potentially unavoidable PI.<sup>20,31-34</sup>

## IMPLICATIONS FOR CLINICAL PRACTICE

Results of our study support the gaps elucidated in previous studies on PI development in the critical care population.<sup>15,31,33-37</sup> The 2 most persistent gaps that continue to confront critical care clinicians are as follows: (1) accurate PI risk quantification in this population and (2) the potential for unavoidability in PI development among critically ill patients.

The development of a PI risk assessment tool tailored to the adult critical population is still needed to truly discern PI risk. While recent studies have examined PI risk in this population using currently available tools such as the Norton Scale<sup>38</sup> and the Jackson-Cubbin Scale,<sup>18,19,39</sup> others have examined PI risk using data available in the electronic health record.<sup>40-42</sup> With the widespread adoption of electronic medical records (EMRs) across US hospitals, the ability to automate this process has become a promising prospect. Use of sophisticated data analytic techniques can facilitate our ability to identify

and incorporate risk factors not currently found in PI risk assessment screening and has the potential to provide real-time warnings to clinicians of increasing PI risk. However, with automation comes risk. Spurious mathematical relationships and difficulty capturing appropriate clinical data from the EMR create opportunities for illogical or contrary results among predictor variables.<sup>43-45</sup> Therefore, even in this era of improved technological capabilities within EMRs, PI risk detection can never be devoid of the oversight and assessment that bedside clinicians can expertly provide.

The question of unavoidability of PIs, especially in the critical care population, has long been deliberated. At this time, there remains a lack of regulatory support for the phenomenon of unavoidable PIs in acute care institutions. This poses a clinical challenge for caregivers—that being trying to prevent PIs in patients with insurmountable risk factors even in the presence of prevention. Results from this study demonstrate that PI prevention strategies are consistent among critical care patients in the United States. While the prevention strategies studied were based on care delivered only in the preceding 24 hours to IPUP data collection, the data provide a large “real-time” snapshot of the care occurring in US hospitals.

## OPPORTUNITIES FOR FUTURE RESEARCH

Opportunities for future research are plentiful based on these study results. Investigations focused on risk detection methodologies, longitudinal and prospective studies of PI prevention practices, as well as additional work in the area of PI risk factors will improve our understanding as to why PIs continue to occur in this population despite our efforts at this time to prevent them. Additional prospective studies will also help strengthen the evidence base with regard to defining the enigma of the unavoidable PIs in critical care patients.

## STRENGTHS AND LIMITATIONS

We recognize various strengths associated with this study. While previous studies have focused on global PI prevalence,<sup>2,3</sup> this is the largest study known to the research team that has specifically examined PIs domestically using a very large data set of critically ill patients with representation from all geographic regions with the United States. Moreover, our study design allowed for cross-sectional observation of PI prevention practices occurring in ICUs in hospitals across the United States. Another recognized positive attribute of the IPUP study data collection process is that data collection efforts in most facilities are led by the institution's wound care expert, which increases the likelihood of accurate real-time PI identification and staging, as well as recognition of prevention practices.

We do recognize limitations. First, as data are collected by facility clinical teams, response bias and reporting errors can influence the results of this study. Second, since identification of prevention practices was limited to 24 hours, it is unknown if HAPI development may have been the result of inconsistent prevention practices prior to the 24-hour time frame required for data collection.

## CONCLUSIONS

Pressure injury development in critical care patients continues to be a topic of concern for healthcare providers and acute care

facilities alike. Large-scale prevalence data such as provided by this IPUP study are an asset to care providers and provide a benchmark for which to analyze one's institutional data. While critical care patients continue to develop PIs at higher rates than other hospitalized patients, the potential risk factors that confront these compromised patients are also greater. Deepening our understanding of the pathophysiology of PIs in critically ill patients will help address this threat. Despite consistent application of prevention practices, identifying those in critical care raises valuable question as to why PIs continue to occur. Ultimately, improving the evidence base surrounding PI development and prevention will provide frontline caregivers with much needed information to appropriately care for this vulnerable subset of hospitalized patients.

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### Call for Authors: Wound Care

- Continuous Quality Improvement projects, research reports, or institutional case studies focusing on innovative approaches to reduction of facility acquired pressure ulcers.
- Original research or literature review on causes and management of refractory wounds.
- Case studies, case series, review articles, or research reports on management of wound-related pain.
- Case studies, case series, review articles, or research reports on matrix dressings, human skin substitutes, growth factors, or other advanced wound therapies.
- Research reports or literature review on pathology, prevention, and management of biofilms.
- Literature review and current guidelines on skin and wound care in neonates and infants.