Using Pressure Mapping to Optimize Hospital-Acquired Pressure Injury Prevention in the Burn ICU

JOHNS HOPKINS MEDICINE

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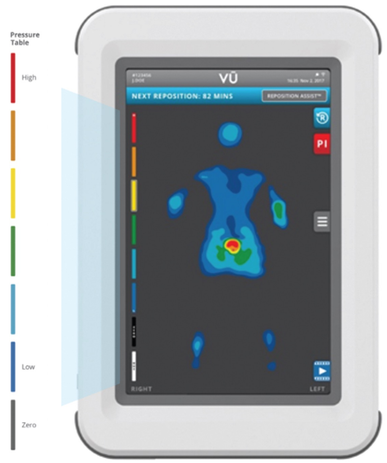
Problem Statement

Burn patients are highly vulnerable to hospital-acquired pressure injuries (HAPI) due to risk factors associated with the burn injury, pre-existing medical comorbidities, and concomitant injuries. Many of the treatments used for burn injuries increase the risks of HAPI. Understanding the impact of full-body, real time pressure monitoring through visual mapping and how it informed repositioning and offloading of pressure by patients and providers to reduce HAPI in a burn intensive care unit (BICU) was indicted to advance patient care standards.

AIM Statement

To understand the utility of real-time, full body pressure monitoring in preventing HAPI's on the BICU patient population.

To use pressure monitoring data to better understand the development of pressure injury in this vulnerable patient population.



The VŪ system controller unit and pressure grading color scale

Actions Taken

1. IRB approved, single institution, retrospective study of BICU patients.
2. Two patient cohorts were studied and defined:
   i. Those who were admitted before using pressure monitoring.
   ii. Those who were admitted after implementation of real-time pressure monitoring in the BICU.

Burn Injury Details

	Preimplementation (n = 57)	Postimplementation (n = 65)	*P*
Burn location, n (%)			
Head/neck	16 (28)	15 (23)	.53
Trunk	11 (19)	16 (25)	.48
Upper extremity	14 (25)	18 (28)	.69
Groin/buttocks	5 (9)	5 (8)	.83
Lower extremity	11 (19)	16 (25)	.48
Median %TBSA (IQR)	3.5 (6.5)	4.1 (8.2)	.66
Third-degree burn, n (%)	24 (42)	27 (42)	.95
Surgical treatment, n (%)	25 (44)	30 (46)	.80
Immobility, n (%)	13 (23)	13 (20)	.71
Mechanical ventilation, n (%)	7 (12)	9 (14)	.80
Median length of stay (IQR)	3 (8)	4 (7)	.14

TBSA, total body surface area; IQR, interquartile range.

Overall Results

Real-time pressure mapping reduced HAPI-related morbidity among BICU patients

	Pre-implementation	Post-implementation
122 Patients Included	57 (47%)	65 (53%)
HAPI (stage 3 & greater)	18%	8% (Chi square: P=.10)
Staging: 80% of HAPIs in sacral region	70% - Stage 2 or greater	60% - Stage 1

Additional Results

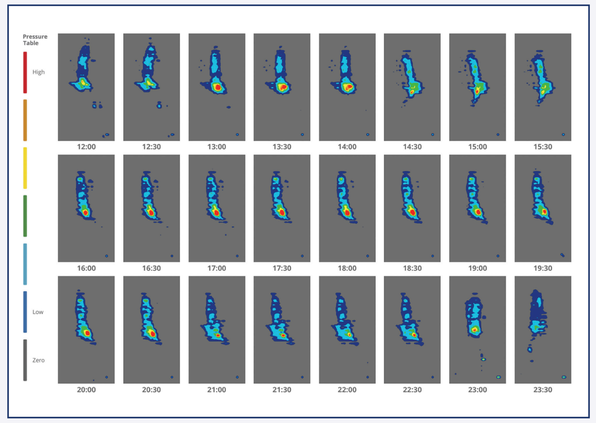
Known predictors of HAPIs in burn patients, having had at least 12 hours of sustained pressure loading in one area significantly increased odds of developing a pressure injury in that area. (odds ratio 1:3, 95% CI 1.0-1.5, P=.04)

Pressure Injury Details

	Preimplementation (n = 10)	Postimplementation (n = 5)	*P*
HAPI location, n (%)			1.0
Sacrum	8 (80)	4 (80)	
Occiput	1 (10)	1 (20)	
Elbows	0 (0)	0 (0)	
Heels	1 (10)	0 (0)	
Median Braden score (IQR)			
Admission	15 (6)	14 (7)	.45
Time of HAPI	16 (5)	14 (7)	.73
HAPI stage*, n (%)			**<.0001**
1	1 (10)	3 (60)	
2	7 (70)	2 (40)	
3 or worse (including deep tissue injuries)	2 (20)	0 (0)	
Mean cost, HAPI care (SD)	$6750 ($1008)	$3800 ($923)	**.008**
Median length of stay (IQR)	8 (2)	9 (1)	.87

HAPI, hospital-acquired pressure injury; SD, standard deviation; IQR, interquartile range.
Bold values are statistically significant (P < .05).
*Highest stage to which the wound progressed.

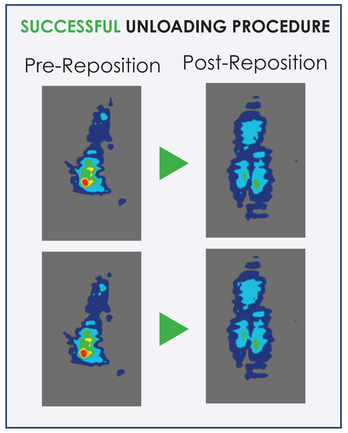
Patients who developed HAPIs were significantly more likely to have had unsuccessful repositioning efforts in comparison to those who did not (P=.02)

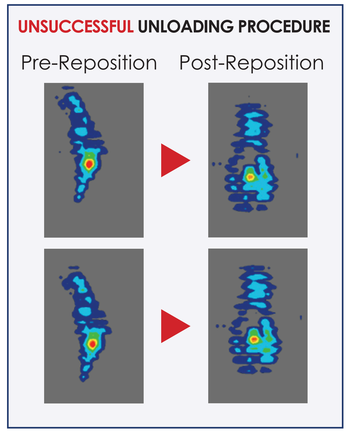


Example of 12 hours of continuous pressure loading in the sacral area

Actions Taken (continued)

3. Pre-implementation time-period only standard clinical HAPI prevention measures were used.
   i. Encouraging patients to shift in position at regular 15-minute intervals.
   ii. Turning of patient every 2 hours if incapable of shifting positions.
4. Post-implementation time-period, visual mapping and monitoring was used by patients and providers for targeted off-loading.
   i. Pressure visualization system visually mapped pressure recordings using a color-based system where red indicates high pressure (great than 75 mm Hg), yellow/green indicates medium pressure (10-75 mm Hg), and blue corresponds to low pressure (less than 10 mmHg).
   i. Patients and providers were given education to use the pressure mapping system to pinpoint specific focal areas for targeted pressure redistribution and determination of effectiveness.





Summary

I. Statistically significant reduction of stages 3 and 4 HAPIs were achieved in the BICU.

II. Among patients in our study who developed HAPIs, even after the implementation of real-time pressure monitoring, we found that repositioning efforts were significantly more likely to have been unsuccessful.
   - Pressure mapping demonstrated a change in position, patients continued to experience high loading pressures in the location where they eventually developed a pressure injury indicated greater limitations due to burn injuries and co-morbidities.
   - The fact that these patients continued to have sustained pressure loading in areas of risk despite repositioning efforts, may help providers to use such pressure mapping results to risk-stratify BICU patients even prior to HAPI development.

Further Learning's Beyond the Study

Patient engagement to self-manage off-loading of pressure through education of pressure monitoring system and indications of colors, created added benefit of patient involvement and awareness of reduction of pressure.