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“Turning” to technology:

Reducing pressure injury incidence in critical care with turn cueing

Content originally presented as a webinar on November 18, 2020
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Barrett Larson is a physician entrepreneur operating at the interface of clinical medicine, academics, and industry. Barrett did both medical school and residency training in anesthesiology at Stanford, where he continues to practice as an Assistant Professor. Barrett is the Director of the Stanford Anesthesia Innovation Lab (SAIL) and the recipient of numerous medical technology innovation awards. He started Leaf Healthcare after discovering an opportunity for wearables to transform the care of hospitalized patients. Barrett is passionate about developing new technologies that improve patient care and reduce health care costs.

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Robin Gasparini is a board-certified Clinical Nurse Specialist for Quality at Mayo Clinic in Jacksonville, Florida. In her 15-year career, she has held various nursing leadership roles throughout Duke University Health System and Mayo Clinic that have helped optimize system efficiencies and produce quality outcomes. Dr. Gasparini holds a Doctor of Nursing Practice degree from Duke University.

Introduction

The latest U.S. government research reports that rates of hospital-acquired pressure injuries (HAPIs) continue to increase while all other hospital-acquired conditions are declining.[1] HAPIs have also been shown to increase the length of hospital stay and the risk of hospital readmission, and these injuries are correlated with an increased risk for other hospital-acquired conditions such as falls, urinary tract infections, venous thrombolytic embolism, and ventilator-associated pneumonia.*[2]

Generally speaking, there are multiple risk factors related to the development of HAPIs, which are defined as localized injuries to the skin and/or underlying tissue that develop during inpatient hospital stays, often resulting from unrelieved pressure, friction, or shear. The most significant risk factors are age, mobility status, perfusion, and vasopressor infusion. Other risk factors include nutritional deficiencies, length of stay, and body mass index (BMI).[1] Critical care patients are at especially high risk for pressure injuries related to risk factors, especially their severity of the illness and prolonged immobility.[3,4]

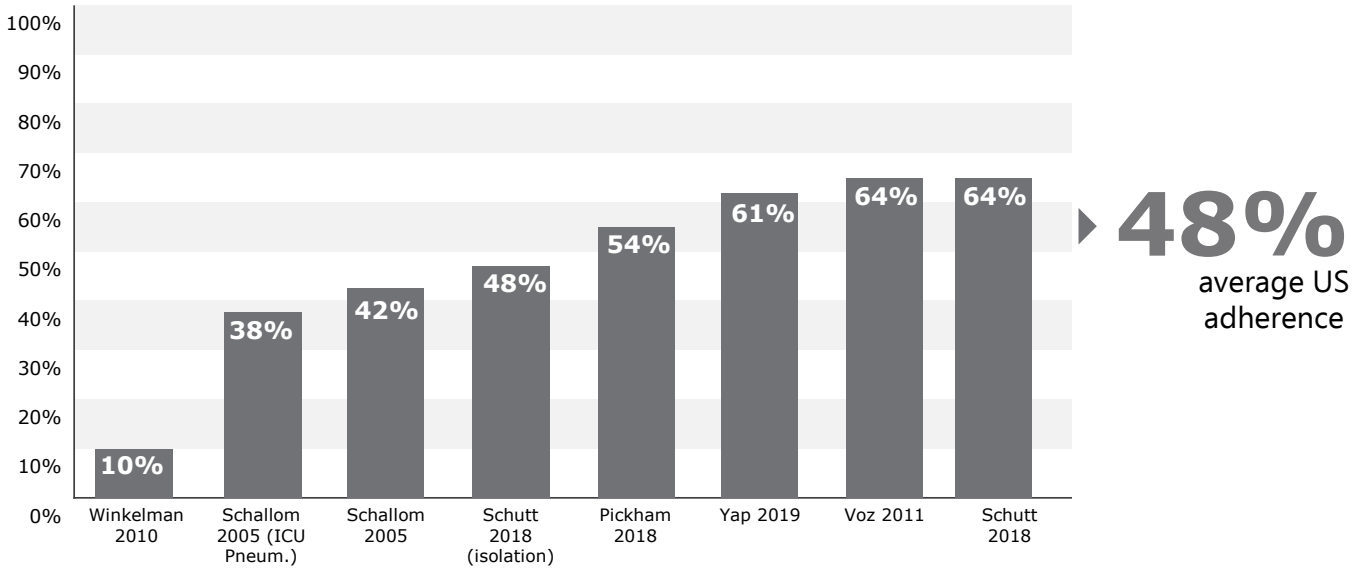
Although pressure injury rates continue to increase, many pressure injuries are considered preventable, including in high-risk patients.

* While correlation between HACs is evident, causation is not implied.

Adherence to repositioning protocols is low

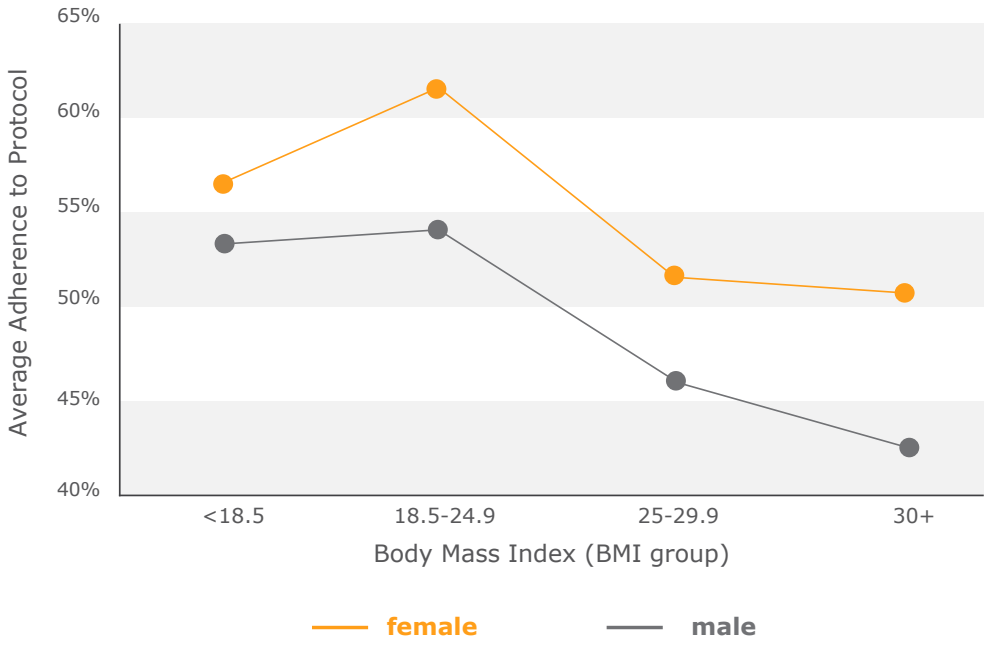
Pressure injuries develop when there is too much pressure for too long a time. Regular repositioning has been shown to decrease the risk of HAPIs by periodically relieving pressure off bony prominences.[2,5] A randomized controlled trial conducted in two critical care units found that patients who were repositioned more frequently were 33% less likely to develop a new pressure injury than patients repositioned less frequently.[6]

Although the rationale for regular repositioning is sound, compliance is often low. Studies have estimated adherence to turning protocols to range from 10% to 64%,[7,8] with the lowest rates occurring during the night shift.[9]



Patients with higher BMI are turned less frequently[1]

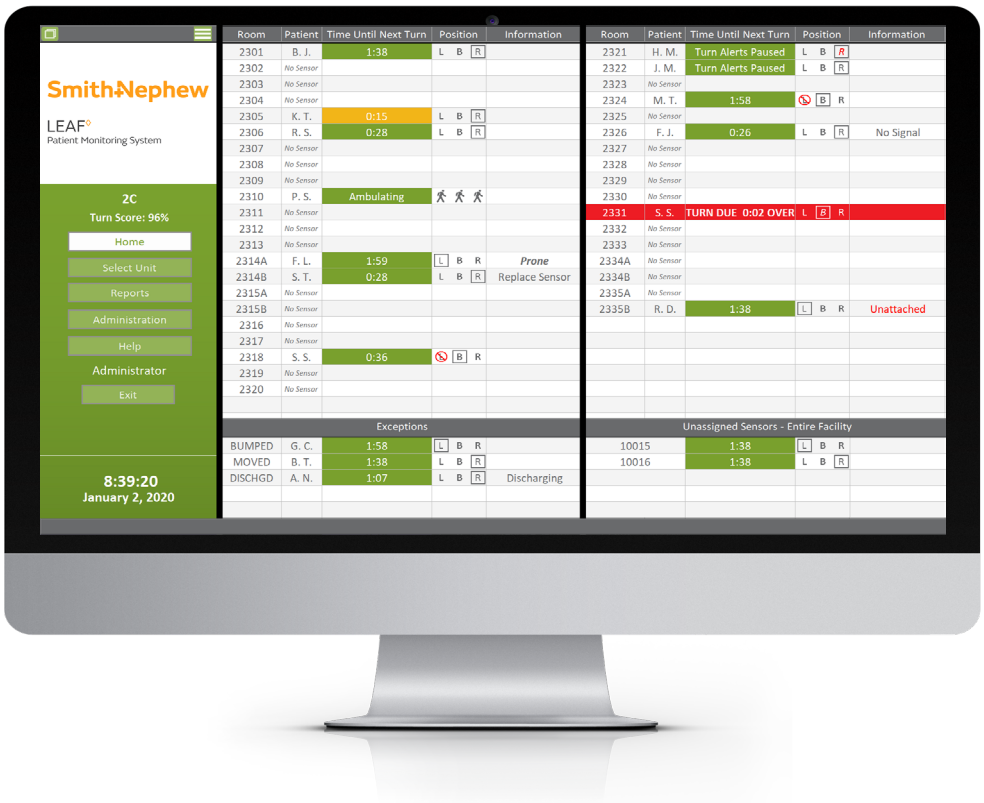
Male patients are turned less frequently than females, regardless of BMI[1]



Studies have also found variability in repositioning adherence by sex and BMI. Patients whose BMI classifies them as obese are repositioned much less frequently than normal weight or merely overweight patients, and men are repositioned less frequently than women regardless of BMI.[9]

Overview of the LEAF◊ Patient Monitoring System

The latest international guidelines recommend regular repositioning using effective reminders to achieve high level of adherence to the patient's individual turn protocol.[10] One such technology is the sensor-based visual cueing system, the LEAF Patient Monitoring System, which reminds health care providers with visual alerts when it is time to reposition the patient according to their individualized turn protocol. The LEAF System records and "credits" patients' self-turns and helps ensure that all repositioning events meet the threshold turn quality to offload bony prominences. The sensors also automatically document all patient repositioning events, thereby reducing documentation burden on the bedside nurses and providing a more efficient way to conduct root cause analyses.[11]



Visual, sensor-based cueing for turning and repositioning

The LEAF◊ Patient Monitoring System has four basic components to monitor patient mobility and cue staff when repositioning is necessary:

- A lightweight, **wearable patient sensor** that attaches to the patient's chest monitors the position of the patient and any movement, thus providing staff real-time, color-coded guidance about the patient's turn status and when an adequate turn angle has been achieved.

- Sensor data are transmitted across a **wireless mesh network** and data server to user interface, where patient position data are displayed.

- A **user interface** displays the patient's existing position and provides large, color-coded turn cues, at the nurse's station and local workstations, to help staff coordinate care and prioritize who needs to be turned and when.

- Automatically generated reports record a detailed patient repositioning history and can unburden bedside nurses from manual documentation and allow for efficient root cause analysis.

Using visual alerts, the LEAF Patient Monitoring System does not contribute to alarm fatigue but provides staff an effective way to optimize their patient turning care.

Clinical and financial outcomes

HAPIs are incredibly expensive and represent a substantial burden on the nation's health care system. The total costs for treatment of these injuries in the United States is estimated at $11 billion annually.[17] An analysis of 9 million records revealed that the average cost of treating a HAPI of any stage is $21,767, and the development of a HAPI results in an average increase of 9.5 days to the patient's hospitalization.[6] Preventing these injuries from happening has the potential to reduce costs and improve patient outcomes substantially.

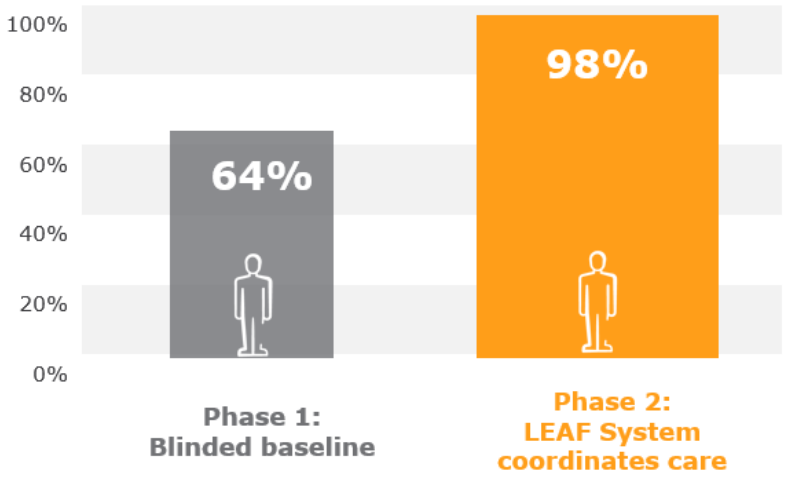
In several studies of the LEAF◊ Patient Monitoring System, data have shown that it can help health care facilities achieve multiple goals that enhance patient care and optimize performance, including:

- Improve patient turn protocol adherence
- Reduce the incidence of HAPIs
- Provide the hospital a positive return on investment in the form of harm avoidance

In an independent study, the LEAF System was demonstrated to improve patient turn protocol adherence, up to 98%, thus helping institutions achieve frequency and quality of turns.[17] In an independent, investigator-led, randomized controlled trial, the LEAF System helped reduce the risk of pressure injury development in high-risk patients by 73%.[6] The results were clinically significant.

In addition to the clinical outcomes, the LEAF System demonstrated financial benefits for the health care facilities.[17] These benefits include an estimated $776,690 annual return on investment for two Magnet hospital critical care units,[14] $71,500 saved in a single month for one facility in non-reimbursable intensive care unit (ICU) treatment costs at a level 1 trauma center,[15] and $120,000 estimated annual savings on specialty rental beds.[16]

Increased turn protocol adherence[17]



Phase 1: Blinded baseline
Patient movement monitored by sensor, but turn protocol coordinated in traditional fashion

Phase 2: LEAF System intervention
LEAF System monitoring patient movement and coordinating turn protocol

Case study

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LEAF◊ Patient Monitoring System

A quality improvement project conducted on two critical care units at the Mayo Clinic in Jacksonville, Florida highlights the benefits of improved patient repositioning. This hospital has 304 staffed beds and was featured as the Best Hospital in Florida in 2020 by *U.S. News & World Report*.[18] In 2018, the pressure injury rate at this facility was twice the National Database of Nursing Quality Indicators ICU 50th percentile mean, leaving much room for improvement. To improve their ratings, the facility decided to implement the LEAF Patient Monitoring System.

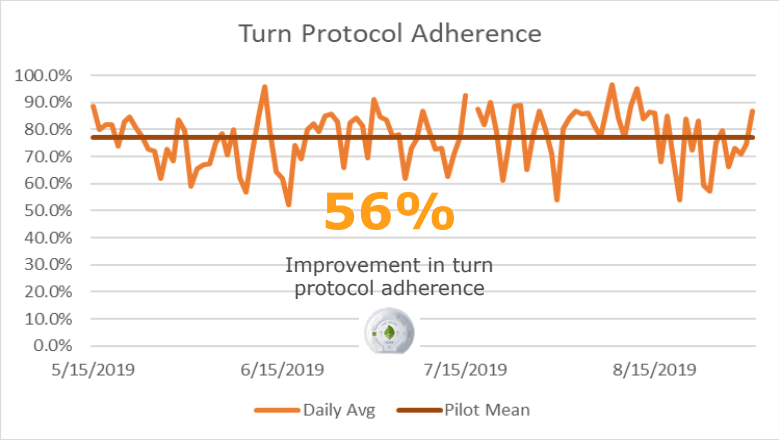
At the outset of the study, the facility had outlined four success criteria for the pilot program:

1. Improved turning adherence
2. Reduction in ICU-acquired sacral pressure injuries
3. Reduction in ventilator-associated events (such as pneumonias) as a result of increased manual turning
4. Reduction in the number wound nurse consultations

During the pilot period, 105 patients were monitored for 11,341 patient care hours. Patients with an anticipated ICU stay of greater than 48 hours and with other pressure injury risk factors were eligible for a LEAF Sensor. In addition to improvement in turning adherence, there was more even distribution on the sides of the body and increased use of the lateral positions. No additional staff was hired to turn patients.

The results from the four-month pilot were impressive:

- 56% improved turn protocol adherence
- 67% reduction in incidence of sacrococcygeal HAPIs and the avoidance of 14 sacral HAPIs compared with the same period in the previous year
- 97% of patients with a LEAF® System monitor remaining HAPI-free
- 92% of patients remaining free of ventilator-associated events
- 87% increase in wound consultations related to increased staff awareness and a proactive relationship with the wound team



3-month pilot return on investment	
Estimated cost to treat per HAPI	$43,180
Total HAPI costs avoided	$561,340
Cost of sensors	$25,200
ROI	$536,140

The facility champions estimated total treatment cost savings of $536,140 for the four-month pilot program. This translates to an estimated annual return on investment of over $3.4 million for house-wide adoption of the program.

Conclusion

Consistent repositioning using cueing technology, such as with the LEAF Patient Monitoring System, provides an effective way to help ensure adherence to repositioning schedules and thereby reduce the risk of HAPI development. The benefits from improved adherence to patient turn protocols can produce considerable improvement in patient outcomes and be cost saving to hospitals.

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