Novel patient monitoring system enables implementation of dynamic turning protocols in an effort to prevent pressure ulcers

Barrett Larson MD, Daniel Shen MS, Mark Weckwerth PhD

Background: Each year ~2.5 million Americans will suffer from a pressure ulcer, which accounts for an estimated $10 billion in annual healthcare spending. Perioperative patients are considered to be at a particularly high risk for developing pressure ulcers, given the significant pressure insult that occurs during surgery. It is well established that frequent and regular patient turning is a key element to pressure ulcer prevention. Traditionally, turning protocols have taken a "one size fits all" approach. The currently accepted standard of care is to turn high-risk patients every two hours, day and night. Many believe that this two-hour turning protocol originated during the Crimean War era, where it took Florence Nightingale and her colleagues two hours to turn all of the wounded soldiers on a given ward. However, despite the relatively simple nature of this "one size fits all" approach, studies have shown that compliance rates with standard turning protocols are only 60-70%.

To help address the need for improved pressure ulcer prevention methods, a wireless patient sensing system was developed (Leaf Healthcare, Pleasanton, CA). The system provides caregivers with information regarding a patient's position over time, thus enabling them to easily identify which patients are turning adequately on their own and which patients are in need of caregiver-assisted turns. Furthermore, the system was designed to enable customizable turning protocols to meet individual patient-care needs.

Methods: A small, wireless, disposable sensor is adhered to patients. The sensor continuously measures each patient's orientation and transmits this data wirelessly to a central monitoring station. A user-interface displays each patient's turn history and current status and also alerts staff if any patient requires a caregiver-assisted turn. Caregivers can easily customize turning protocol parameters for individual patients (turn angle, decompression time, turn period, head-of-bed angle, etc.). For perioperative patients, the system helps minimize post-surgical pressure ulcer risk by encouraging selective offloading of body regions pressurized during surgery. If patients are expected to remain on a particular side of their body during surgery, the system can help encourage pressure to be redistributed away from those sides in the pre-operative and/or post-operative setting by utilizing the "restricted side" feature of the system. If the patient turns onto a restricted side (which is defined by the caregiver) staff will be alerted and the patient can be turned.

Results: The monitoring system was successfully used in a medical-surgical unit. The system enabled the delivery of a dynamic and high-quality pressure ulcer prevention program. Following implementation of the monitoring system, compliance with the institution's turning protocol increased from 64% to 98%. This improvement was significant and sustained ($p<0.01$). The system's highly visual

monitoring display allowed nurses to easily prioritize patient care needs, while ensuring that no patient was neglected.

Conclusion: Continuous position monitoring technology opens the door for the development of dynamic turning protocols that are based on individual patient-care needs. This novel technology allows providers to easily customize turning protocols for patients and helps ensure compliance with these individualized protocols. The monitoring system enables a degree customization that was previously not possible. Furthermore, the system may be particularly useful in the perioperative setting, where pressure relief maneuvers can be employed before and after surgery to help offset the pressure insult that occurs intraoperatively. With this new monitoring technology, it now may be possible to develop more dynamic and sophisticated turning protocols in an effort to prevent pressure ulcers.