Predicting Pressure Injury Risk in Pediatric Patients: The Braden QD Scale

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Objective To describe the development and initial testing of the Braden QD Scale to predict both immobility-related and medical device–related pressure injury risk in pediatric patients.

Study design This was a multicenter, prospective cohort study enrolling hospitalized patients, preterm to 21 years of age, on bedrest for at least 24 hours with a medical device in place. Receiver operating characteristic curves using scores from the first observation day were used to characterize Braden QD Scale performance, including areas under the curve (AUC) with 95% CIs.

Results Eight centers enrolled 625 patients. A total of 86 hospital-acquired pressure injures were observed in 49 (8%) patients: 22 immobility-related pressure injuries in 14 (2%) patients and 64 medical device–related pressure injuries in 42 (7%) patients. The Braden QD Scale performed well in predicting immobility-related and medical device–related pressure injuries in the overall sample, with an AUC of 0.78 (95% CI 0.73-0.84). At a cutoff score of 13, the AUC was 0.72 (95% CI 0.67-0.78), providing a sensitivity of 0.86 (95% CI 0.76-0.92), specificity of 0.59 (95% CI 0.55-0.63), positive predictive value of 0.15 (95% CI 0.11-0.19), negative predictive value of 0.98 (95% CI 0.97-0.99), and a positive likelihood ratio of 2.09 (95% CI 0.95-4.58).

Conclusions The Braden QD Scale reliably predicts both immobility-related and device-related pressure injuries in the pediatric acute care environment and will be helpful in monitoring care and in guiding resource use in the prevention of hospital-acquired pressure injuries. *(J Pediatr 2018;192:189-95).*

Pediatric patients, regardless of age and developmental level, are at risk for developing immobility-related pressure injuries due to bed rest as well as medical device–related pressure injuries (MDPIs).[1-4] The personal suffering and financial costs associated with hospital-acquired pressure injuries (HAPIs) are significant.[5,6] Pressure injury per 1000 patient-days commonly is tracked by high-reliability organizations that focus on eliminating iatrogenic harm associated with pediatric care.[7-9] Although preventable, 1.4% of hospitalized infants and children experience pressure-related skin injuries.[10,11]

The prevention of pressure injury requires the accurate identification of patients at risk and the reliable implementation of prevention strategies in patients identified as being at risk.[12] Critical to this process is the availability of pediatric-specific, valid, and reliable instruments that predict the risk of pressure injury.[13] The Braden Q Scale is a widely used pediatric pressure injury risk assessment tool.[3,13,14] However, initial predictive validity testing of the Braden Q Scale only included immobility-related pressure injuries in critically ill pediatric patients aged 2 weeks to 8 years and excluded patients with congenital heart disease.[15] The purpose of this study was to build on our previous work and construct a new, parsimonious Braden QD Scale describing combined immobility-related and MDPI risk in a broader, more diverse sample of pediatric patients typically cared for in acute care environments. Our hypothesis was that a new scale would demonstrate sufficient sensitivity and specificity to predict both immobility-related pressure injuries and MDPIs. Secondary objectives were to determine the critical cutoff point for classifying risk of HAPI.

AUC	Area under the curve
HAPI	Hospital-acquired pressure injury
IRR	Inter-rater reliability
MDPI	Medical device–related pressure injury
PICU	Pediatric intensive care unit
RACHS-1	Risk Adjustment for Congenital Heart Surgery – Version 1
WOCN	Wound, ostomy, and continence nursing

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Methods

We conducted a multicenter, prospective cohort study. Patients were recruited from 8 pediatric academic medical centers across the US, each selected based on their capacity to enroll a broad, clinically diverse patient population under the leadership of an advanced practice nurse with expertise in wound, ostomy, and continence nursing (WOCN). Human subject approval was obtained from each hospital's institutional review board, and written informed consent was obtained from the parent/legal guardian of each enrolled patient. The first subject was enrolled on March 25, 2013 and the last on July 15, 2015.

Eligible patients were preterm to 21 years of age, on bedrest for at least 24 hours from hospital admission with a medical device attached to or traversing their skin or mucous membrane. Bedrest was operationalized per developmental age; specifically, infants not being held, toddlers not cruising, or children not walking per usual. We excluded patients with a pre-existing pressure injury or a do-not-resuscitate order. To ensure a study population generalizable to acute care pediatrics, we stratified enrollment by age, patient type (medical/surgical or cardiovascular), and unit type (pediatric intensive care unit [PICU] or ward). Each site limited enrollment to 25 subjects in each of the following age groups: preterm to 42 weeks, 43 weeks to 12 months, 13 months to 5 years, 6-12 years, and 13-21 years, with approximately 50% from each patient type. To avoid oversampling critically ill patients, we limited the number of endotracheally intubated subjects to 50% of each age group. We aimed for a target population of 600 subjects, so that subgroup analyses with 100 subjects would have half-widths of 95% CIs for proportions to be 0.10 or less.

Before data collection, WOCN leads and study nurses were trained in study procedures, scoring the Braden QD Scale, and staging of pressure injuries using digital photographs. Inter-rater reliability (IRR) was established before the start of data collection and was a 2-stage process. First, the lead WOCN nurses from each site were trained by the study investigators. After training, IRR was established by jointly rating 10 clinical scenarios. The percent agreement between raters was calculated, and a minimum agreement of 0.80 was established. Second, each site's lead WOCN nurse then replicated the IRR process with their respective nurse teams. IRR was re-established every 4 months during the data-collection period and whenever a new nurse joined the local data-collection team.

Each hospital screened for eligible subjects 3 times per week on Mondays, Wednesdays, and Fridays. To avoid selection bias, subjects were screened in sequence based on a randomization scheme that included all inpatient units (except inpatient psychiatric units) and the last digit of a patient's medical record number. Before enrollment, eligibility criteria were confirmed by the subject's bedside nurse. Once confirmed, the study nurse was introduced to the patient and parent/legal guardian to initiate the consent process. Patients were approached for assent if they were ≥8 years of age, not sedated, and cognitively capable (Pediatric Cerebral Performance Category ≤3).[16]

Severity of illness scores were completed on each enrolled subject by use of the worst-documented physiologic values from the first 12 hours of hospital admission. Medical-surgical subjects ≤2 weeks of age were scored with the Score for Neonatal Acute Physiology with Perinatal Extension II, and subjects ≥2 weeks of age were scored with the Pediatric Risk of Mortality score, Version III, first 12 hour model (PRISM III-12).[17,18] All cardiac subjects received a Risk Adjustment for Congenital Heart Surgery – Version 1 (RACHS-1) score based on their cardiac procedure/operation type.[19] The Pediatric Cerebral Performance Category and the Pediatric Overall Performance Category scales were used to quantify cognitive and overall functional status at admission.[16]

Pressure injury risk was described with the Braden Q Scale.[15] The Braden Q Scale reflects Braden and Bergstrom's conceptual framework[20] that identifies 2 determinants of immobility-related pressure injury: the intensity and duration of pressure and tissue tolerance. The Braden Q Scale operationalizes these 2 dimensions in 7 subscales: mobility, activity, sensory perception, skin moisture, friction and shear, nutrition, and tissue perfusion and oxygenation. Each subscale has 4 mutually exclusive levels that range from 1 (least favorable) to 4 (most favorable). Total Braden Q scores range from 7 to 28 points. Braden Q scores of ≤16 identify pediatric patients at risk for immobility-related pressure injuries with a sensitivity of 0.88 and specificity of 0.58.[15] To address risk specific to MDPI, 2 additional subscales were added to the Braden Q Scale to form the Braden QD Scale: total number of diagnostic or therapeutic devices that were attached to or traversed the patient's skin or mucous membrane and whether each of these devices could be repositioned and/or the skin under each device was protected.

Study procedures were separate from usual care. Two nursing teams evaluated enrolled subjects up to 3 times per week (Mondays, Wednesdays, and Fridays) for 2 full weeks, then weekly for 2 more weeks. Subject data were considered complete at hospital discharge or hospital day 28, whichever occurred first. Nurses in team I completed an intervention and device log through data extraction from the medical record or by observation of the subject's bed space. They also scored the subject's risk for HAPI using the Braden Q scale with a member of the subject's clinical team. Within 6 hours of the evaluation by nurses in team I, nurses in team II completed a head-to-toe skin assessment for HAPI with the assistance of the subject's bedside nurse. Nurses in teams I and II, blind to the other's assessments, used separate password-protected devices to enter data directly into a secure, web-based Research Electronic Data Capture (REDCap) application (hosted at the University of Pennsylvania).[21]

All HAPIs were photographed and then categorized as immobility-related or device-related and staged according to National Pressure Ulcer Advisory Panel guidelines.[4] The HAPI staging was determined by the local WOCN and confirmed by the core team's WOCN. After identification, all HAPIs were managed at the discretion of the clinical team.