OBJECTIVES: To validate the Pressure Ulcer Risk Scale (PURS) to screen for pressure ulcer (PU) outcomes in the acute hospital setting.

DESIGN: Secondary data analysis was undertaken using a combined dataset from three prospective cohort studies.

SETTING: General medical, surgical, and orthopedic wards in 11 hospitals in two states of Australia.

PARTICIPANTS: Individuals aged 70 and older admitted to the hospital for longer than 48 hours from July 2005 to May 2010 (N = 1418). Individuals in coronary or intensive care units, palliative care, or transferred out of the ward within 24 hours were excluded.

MEASUREMENTS: Trained nurses used the international Resident Assessment Instrument (interRAI) Acute Care (AC) assessment tool to collect data at admission and discharge. Adverse outcomes were documented on daily ward visits. The PURS was calculated from interRAI items, and its association with PU outcomes was tested using the c-statistic (area under the receiver operator characteristic curve).

RESULTS: Complete data were available for 1,371 (96.7%) participants, 85 of whom (6.2%) had a PU at admission. Of the 1,286 without PUs at admission, 42 (3.3%) developed a new PU during their hospital stay. The association between PURS and outcomes had a c-statistic of 0.81 (standard error (SE) 0.02) for prevalent ulcers at admission and 0.70 (SE 0.04) for incidence of new PUs.

CONCLUSION: When derived from the interRAI AC tool, the PURS demonstrated good to strong ability to screen for PU outcome in acute care. Assessment burden is reduced without loss of fidelity by integrating the risk scale into an existing assessment system. J Am Geriatr Soc 64:1324–1328, 2016.

Key words: geriatric assessment; pressure ulcer; interRAI Acute Care; risk scale; validation

Studies have reported that between 8% and 14% of individuals in acute care medical and surgical units have a pressure ulcer (PU)1,2 and that 3–5% acquire a new PU during a hospital stay.1–4 Reported rates in critical care units are often higher.1,5 Advanced age, restricted mobility, incontinence, undernutrition, poor physical health, and impaired cognition are risk factors for developing a PU after admission to the hospital.5,6 PUs are associated with excessive length of stay, morbidity, mortality, and economic burden to the health system.3,4 Prevalence and incidence of PUs are important quality indicators for nursing and health care.7

As the first step of prevention, it is important to identify persons at risk of developing a PU as early as possible. Several screening tools have been used in clinical practice, such as the Braden,8 Waterlow,9 and Norton scales,10 with reasonable sensitivity and specificity demonstrated in a systematic review of studies, although that review found that the use of risk assessment tools without accompanying prevention measures for those at risk does not, in itself, reduce PU incidence.11 Automatically triggered prevention care plans after risk factor assessment would aid decision-making and procedure monitoring. By using a single integrated instrument, these tasks could be achieved with maximum efficiency and minimal assessment burden.

The international Resident Assessment Instrument (interRAI) suite of assessment tools offers the opportunity for integrated multidomain assessment designed to support appraisal and care planning of persons with chronic illness, frailty, and disability across care settings.12 The instruments in the suite share common data items, assessment methods, outcome scales, and decision support tools for care planning. The interRAI Acute Care (AC) instrument
has been specifically developed for use in the acute care setting to support comprehensive geriatric assessment of older inpatients and incorporates diagnostic and risk screeners for adverse events that might occur during the inpatient stay and an array of scales that serve as severity and outcome measures. Data items in the instrument measure sociodemographic information, cognition, communication, mood and behavior, activities of daily living (ADLs), continence, falls, nutrition, skin integrity, medications, and medical diagnoses. The clinical items have been shown to have very good interrater reliability.

The interRAI Pressure Ulcer Risk Scale (PURS) was developed from the Minimum Data Set (MDS) and validated using other interRAI assessments for long-term institutional, palliative, and home care settings. The PURS was constructed from seven candidate items (walking, bed mobility, bowel continence, dyspnea, pain frequency, weight loss, history of resolved PU) after comparing items available in the MDS with the items of the Braden scale (activity, mobility, sensory perception, nutritional status, skin moisture, friction and shear) and based on the literature and clinical expert opinion. An additive score was then constructed, with history of resolved PU counting for 2 points if present and the other six items counting for 1 point if present, resulting in a scale of 0–8 (with higher scores indicating greater risk of PU development). The PURS showed good distributional characteristics in long-term institutional, palliative, and home care settings, with strong performance in predicting new PUs in individuals receiving continuing care and home care.

The PURS has yet to be validated for PU outcomes in individuals admitted to acute hospitals, where people have acute illness or acute exacerbation of chronic diseases or require surgery. In addition to the disabling effects of the acute event, hospitalization itself may result in deconditioning, functional decline, and social isolation. Hospitalized older adults may face greater risk of PU development than people receiving home care or long-term care residents, especially in situations in which they are restricted by medical devices, have longer periods of anesthesia and postoperative pain, or are bed or seat bound because of intravenous treatment. Alternatively, medical staff are likely to monitor hospitalized individuals more intensively, and interdisciplinary teams can implement robust care plans to prevent PU development.

The purpose of this study was to validate the PURS to screen for PU outcomes in acute care hospitals based on data collected from the interRAI AC instrument.

**METHODS**

**Study Setting and Participants**

The study sample comprised 1,418 individuals aged 70 and older admitted to 11 acute care hospitals in two states of Australia. The sites ranged from small secondary care centers (120–160 beds) to rural hospitals (250–280 beds) to metropolitan teaching facilities (300–450 beds) to major tertiary referral centers (>650 beds). Recruitment took place between July 2005 and May 2010 as part of three separate cohort studies, as previously described. Individuals were excluded if they were admitted to coronary or intensive care units, received palliative care only, or were transferred out of the ward within 24 hours of admission.

Ethical approval was obtained from human research and ethics committees of each participating hospital and the University of Queensland medical research ethics committee. Personal or proxy consent was obtained in writing before participation.

**Measures**

Trained nurse assessors used the interRAI AC to collect data within the first 24 hours of the individual’s admission to the ward and at discharge. All available sources of information, including the individual; caregivers; and medical, nursing and allied health staff and medical records were used to complete the assessment.

A PU is defined as a localized injury to the skin, underlying tissue, or both, usually over a bony prominence, as a result of pressure or pressure in combination with shear. Presence of a PU was coded from 1 to 4 based on the National Pressure Ulcer Advisory Panel classification system. As defined in the interRAI manual, these stages are (1) any area of persistent skin redness (without break in the skin) that does not disappear when pressure is relieved; (2) partial-thickness loss of skin that presents clinically as an abrasion, blister, or shallow crater; (3) full-thickness skin loss exposing subcutaneous tissue that presents as a deep crater with or without undermining of adjacent tissue; and (4) full-thickness loss of skin and subcutaneous tissue exposing muscle or bone. In the interRAI-AC system, there are also two other codes (0 = no PU; 5 = not codeable, e.g., necrotic eschar predominant).

In the current study, data on the presence of a PU were assessed at admission to the ward (within the first 24 hours) and on discharge from acute care. The research nurse also visited the wards daily and viewed medical charts to record adverse events, including onset and stage of any PU that developed during the acute care stay. A premorbid history of ever having had a PU that had healed was also recorded as part of the interRAI admission assessment.

The outcome measures, defined according to National Pressure Ulcer Advisory Panel White Paper, included PU prevalence (proportion who have a PU at a specific point in time, i.e., on admission to the ward) and incidence (new cases of PU developing in a PU free population over a period of time, i.e., during their hospital stay). Both measures were calculated including and excluding Stage 1 PUs. The rationale for excluding Stage 1 PUs is that distinguishing them from transient reactive hyperemia may be challenging to detect and report consistently.

**Pressure Ulcer Risk Scale**

All items in the PURS as originally developed were available in the interRAI AC, including walking, bed mobility, bowel continence, dyspnea, pain frequency, weight loss, and history of resolved PUs. The PURS was calculated as an additive score, the only modification being to include the highest AC pain frequency code of 2 (exhibited in the last 24 hours) as contributing to the PURS. In other inter-
Table 1. Characteristics of the Study Population (N = 1,418)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean ± standard deviation</td>
<td>81.0 ± 6.8</td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>780 (55.0)</td>
</tr>
<tr>
<td>Admitted to medical ward, n (%)</td>
<td>1,220 (86.0)</td>
</tr>
<tr>
<td>Length of stay, median (IQR)</td>
<td>6 (4–11)</td>
</tr>
<tr>
<td>Short activity of daily living scale26 score at admission, median (IQR) (range 0–16)</td>
<td>2 (0–7)</td>
</tr>
<tr>
<td>Cognitive Performance Scale26 score at admission, n (%) (range 0–6)</td>
<td>1,015 (71.9)</td>
</tr>
<tr>
<td>Walking (requiring at least extensive assistance, ≥4)</td>
<td>442 (31.2)</td>
</tr>
<tr>
<td>Bed mobility (requiring at least extensive assistance, ≥4)</td>
<td>271 (19.1)</td>
</tr>
<tr>
<td>Bowel control (incontinent, ≥3)</td>
<td>359 (25.3)</td>
</tr>
<tr>
<td>Dyspnea (present at rest or when performing daily activities, ≥2)</td>
<td>481 (34.4)</td>
</tr>
<tr>
<td>Pain frequency (pain exhibited in last 24 hours, ≥2)</td>
<td>694 (49.0)</td>
</tr>
<tr>
<td>Weight loss ≥5% in last 30 days or ≥10% in last 180 days</td>
<td>321 (22.9)</td>
</tr>
<tr>
<td>Prior pressure ulcer</td>
<td>91 (6.5)</td>
</tr>
</tbody>
</table>

Proportions were shown as percentage of cases with available data.
IQR, interquartile range.

aHigher scores indicate greater dependence.

bHigher scores indicate greater impairment.

RAI instruments, the highest pain frequency code is 3 (exhibited daily in the last 3 days).

Analysis

Descriptive statistics were used to examine the frequency distribution of PURS scores from 0 to 8 in relation to outcomes. Receiver operating characteristic (ROC) curves were used in analyzing sensitivity and specificity of PURS scores for PU outcomes with the null hypothesis of true area under the ROC curve (AUC) of 0.5.

Data were analyzed using SPSS version 22.0 (IBM, Armonk, NY).

RESULTS

The study population included 1,418 individuals with a mean age ± standard deviation of 81.0 ± 6.8; 780 (55.0%) were female. The median length of stay in acute care was 6 days (interquartile range (IQR) 4–11 days); 1,220 (86.0%) were admitted to medical wards. Characteristics of the population are shown in Table 1.

One thousand three hundred seventy-one individuals (96.7%) with complete data on PURS and PU outcome were included in the analysis. There were 85 (6.2%) individuals with PUs at admission, and 42 (3.3%) of the 1286 without a PU at admission assessment developed a new PU during the hospital stay. Table 2 shows the distribution of PURS scores for these outcomes. If Stage 1 PUs were excluded, there were 46 (3.4%) individuals with a PU at admission and 16 (1.2%) who developed a new PU during the hospital stay.

The sensitivity and specificity of the PURS for the outcome of PU prevalence and incidence including Stage 1 was tested using a ROC curve. The AUC (c-statistic) was 0.81 (standard error (SE) 0.02, 95% confidence interval (CI) = 0.76–0.86) for PU prevalence at admission (Figure 1A). For PU incidence, the c-statistic was 0.70 (SE 0.04, 95% CI = 0.63–0.77) (Figure 1B). At the cut off value of a PURS score of 3, sensitivity for PU prevalence was 72.9%, and specificity was 71.3%; for PU incidence, sensitivity was 50.0%, and specificity was 72.0%.

DISCUSSION

The study shows that the interRAI PURS is a valid measure of screening for PUs when applied in an acute care setting. The PURS had good distributional characteristics, with c-statistics of 0.700 for PU incidence and 0.807 for PU prevalence, indicating good to strong ability to screen. At the cutoff value of a PURS score of 3, sensitivity and specificity for PU prevalence and incidence were greater than 70%, except for PU incidence, for which sensitivity was 50.0%. This result compares favorably with those of other studies in acute care settings for the most widely used PU risk assessment scales,10,11 which show wide-ranging values for sensitivity (32–89%) and specificity (27–100%).

The advantage of an omnibus assessment system such as the interRAI AC is that it is designed with a single set of clinical observations to provide a range of clinical decision-support tools, which include diagnostic screening (delirium, dementia, undernutrition), risk screening (falls, delirium, PU), case mix tools, and quality indicators. The use of a single set of robust clinical observations to perform multiple tasks enables each item to contribute to many of these applications.22 PU risk assessment, an important part of nursing assessment and care planning, can be achieved with maximum efficiency and minimization of the duplication often required to support a separate PU clinical screening program. Having a compatible PU risk scale across the interRAI suite is an important advantage to support continuity of care and system-level quality improvement.
A major limitation of existing PU studies has been their small sample size (<200 participants), nonstandardized data collection methods and definitions, and limited information on clinical characteristics of the study population. The current study is one of the largest studies to profile the clinical characteristics of older adults admitted to acute care hospitals, which ranged in size and type and were broadly distributed across rural and metropolitan areas. In addition, trained research nurses collected data prospectively using a standardized protocol for daily monitoring of adverse events. Despite the large sample size, the low incidence of PUs (3.3%) may have limited the power to test the predictive validity of the PURS.

The findings of PU present at admission assessment (6.2%) or developing during the hospital stay (3.3%) are lower than those previously reported and may reflect a concerted effort in Australia over the last 15 years to reduce hospital-acquired PUs. The low incidence may also be a reflection of the short length of stay in acute care (median 6 days) and the exclusion of individuals requiring critical care.

CONCLUSION
The PURS developed from the interRAI AC demonstrated good to strong ability to screen for PU outcome in general medical, surgical, and orthopedic wards in acute care, comparable with that of other measures. Reduction in assessment burden without loss of fidelity can be achieved by integrating the risk scale into an existing assessment system.

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Author Contributions: All authors: study design, data analysis and interpretation, writing and editing of paper, agreement with content of manuscript.

Sponsor’s Role: None.

REFERENCES

Figure 1. Receiver operating characteristic (ROC) curve for (A) the Pressure Ulcer Risk Scale (PURS) and Pressure Ulcer (PU) prevalence at admission (area under the ROC curve (AUC) 0.81 (standard error (SE) 0.02) (95% confidence interval (CI) = 0.76–0.86) P < .001 and (B) the PURS and PU incidence during hospital stay (AUC 0.70 (SE 0.04) (95% CI = 0.63–0.77) P < .001. SE under nonparametric assumption. Null hypothesis is true area = 0.5.


