A Prospective Study of the Pressure Ulcer Scale for Healing (PUSH)

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Background. Although the recently developed Pressure Ulcer Scale for Healing (PUSH) was created to monitor healing over time, prospective evidence of its validity in measuring healing is lacking. The purpose of this study was to assess the validity of PUSH (version 3.0) when used to assess pressure ulcers in clinical practice.

Methods. The authors chose a prospective research design using a convenience sample of nursing home residents with pressure ulcers. The patients’ pressure ulcers were assessed each week with the PUSH and the Pressure Sore Status Tool. Surface area measurements derived from wound tracings were also obtained. Weekly assessments continued until the ulcer healed, the resident died, the resident transferred from the nursing home, or 6 months of assessments were complete.

Results. Thirty-two pressure ulcers comprised the study sample. Twenty-one (66%) healed during the 6-month study period and 11 (34%) did not heal. The PUSH scores decreased significantly over time among the healed ulcers but did not among the unhealed ulcers. Similarly, PUSH scores were significantly lower among the healed compared with the unhealed ulcers. Finally, total scores on PUSH were highly correlated with both the Pressure Sore Status Tool and surface area measurements.

Conclusions. The PUSH provides a valid measure of pressure ulcer healing over time and accurately differentiates a healing from a nonhealing ulcer. It is a clinically practical, evidence-based tool for tracking changes in pressure ulcer status when applied at weekly intervals.

Many measures of wound healing have been developed and applied in research studies. However, a clinical tool to track pressure ulcer healing that is accurate, easy to use, and sensitive to change has been lacking. In response to this need, the National Pressure Ulcer Advisory Panel developed the Pressure Ulcer Scale for Healing (PUSH) (1). Preliminary validation (2) and revision (3) of the PUSH focused on defining the wound characteristics most explanatory in a model of healing. These studies were limited to retrospective designs or secondary analyses of existing research data. Prospective evidence is needed to determine whether the PUSH provides a valid measure of healing progress. The purpose of this study was to determine the validity of the PUSH to assess pressure ulcers in clinical practice.

We addressed the following research questions:

1. Do the PUSH (version 3.0) total scores and item scores change significantly with time?
2. Are the PUSH total scores and item scores significantly different for pressure ulcers that heal and those that do not heal?
3. Are the PUSH total scores correlated with other measures of pressure ulcer healing?

The current (third) version of PUSH (3) contains three items: length × width, exudate amount, and tissue type. The integer scores of these items are summed for a total PUSH score (see the Appendix). The total score can range from 0 to 17, with 0 representing a healed wound. Changes in the total score over time are used to quantify healing progress.

In a previous study (3), PUSH was tested in 269 pressure ulcers using secondary analyses of existing research data. Principal components analysis revealed that the items of length × width, exudate amount, and tissue type accounted for 39%–57% of the variation over time for the sample. Limitations of this study included the retrospective study design (i.e., dependence on available data with a limited number of measurement points) and the relatively short follow-up time (i.e., 12 weeks). Because larger pressure ulcers require more time to close than do smaller pressure ulcers, assessment of the PUSH during a longer period of time could establish its assessment utility as a measure of healing among a broader range of ulcers.

Methods

In this study, we applied a prospective design using a convenience sample of nursing home residents with pressure ulcers and a 6-month follow-up period. Three nursing homes in two Midwestern states served as study sites. Site A was a 750-bed, state-owned, long-term care facility for veterans and their spouses. Site B was a 170-bed urban long-term care facility, and site C was a 160-bed rural long-term care facility. We obtained human participant approvals from each site. Participants included residents from each of the sites who had a stage 2 or greater pressure ulcer during a 6-month period.

The pressure ulcers of study participants were assessed each week using the PUSH, the Pressure Sore Status Tool (PSST) (4), and acetate tracings of the wound. The PSST is
A 15-item instrument that assesses various characteristics of the wound and surrounding tissue based on a 5-point Likert scale. The total score is followed over time to monitor healing. Widespread adoption of the PSST in practice has been limited by the large number of items that compromise its clinical practicality. Assessment with acetate tracings included outlining the wound perimeter on transparent film and calculating surface area (in square centimeters) using a digitizing tablet (Lasico, Los Angeles, CA). Time and cost restraints have restricted the use of acetate tracings for wound assessment primarily to wound healing research.

Weekly wound assessments continued until the ulcer healed, the resident died or was transferred from the facility, or 6 months of follow-up was completed. If residents had more than one pressure ulcer, we assessed all of them using the three tools. We considered an ulcer healed when visual depth of tissue injury as documented by the facility staff reassessed and remained at more than 90% throughout the study.

**RESULTS**

**Participants and Ulcers**

Twenty-three participants comprised the sample. Seven (30%) were from site A, 9 (39%) from site B, and 7 (30%) from site C. The mean participant age was 79.5 years (SD, 15.60). Twelve (52%) were men and 20 (87%) were white. The most common medical diagnoses were dementia (n = 9; 39%) and diabetes (n = 6; 26%). Eighteen participants (78%) had 1 pressure ulcer, 3 (13%) had 2 pressure ulcers, 1 (4%) had 3 pressure ulcers, and 1 (4%) had 5 pressure ulcers.

Table 1 lists the characteristics of the 32 pressure ulcers included in the analyses. Most were stage 2 and were located on the heel. Most were relatively new ulcers that had been present for 2 weeks or less before being entered into the study. Nearly all of the ulcers (84%) were treated with dressings or topical agents that could confound assessment of exudate amount (e.g., hydrocolloids).

Twenty-one (66%) ulcers healed during the study period, and 11 (34%) did not heal. The healed and unhealed ulcers were not significantly different with respect to ulcer stage, location, or duration before being entered into the study.

For the healed ulcers (n = 21), the mean number of weeks to closure was 5.6 (± 4.08), with a range of 2–18 weeks. Fifteen (71%) of the healed ulcers were closed by week 6, a finding consistent with the fact that many were new stage 2 ulcers. For the unhealed ulcers, 4 did not heal during the 6-month follow-up period, 4 were unhealed when the participant died, 2 were unhealed when the participant was transferred from the study site, and 1 ulcer was unhealed when the participant underwent limb amputation. The mean number of follow-up weeks for the unhealed ulcers was 10.4 (± 7.95).

**Measures of Healing**

Weekly assessments of the 32 ulcers resulted in 239 assessments with each of the measurement tools. Each ulcer was assessed at least twice (at weeks 1 and 2); 1 ulcer was assessed for 29 weeks. Only 20 ulcers had assessment data up to week 5; 11 in the healed group and 9 in the unhealed group.

Table 2 shows week 1 or baseline measures of healing. Total PUSH scores ranged from 3 to 14 among all the ulcers. Total PUSH scores were significantly lower among the healed ulcers (t = −2.741; p = .010). Analyses of individual PUSH items revealed that the healed ulcers had significantly lower length-by-width scores compared with the unhealed ulcers (t = −3.132; p = .004). The healed and unhealed ulcers were not significantly different with respect to item scores for tissue type or exudate amount. Total PSST scores for week 1 ranged from 16 to 39 among all ulcers. Neither PSST total scores nor PSST item scores for size were significantly higher in the unhealed compared with the healed ulcers, although PSST total scores showed a trend in this direction (t = −2.927; p = .064). Week 1 surface area measurements based on ulcer tracings ranged from 0.04 cm² to 19.43 cm². Surface area measurements also were not significantly greater among the unhealed compared with healed ulcers, although the analysis trended in this direction (t = −1.932; p = .063).

**Table 1. Ulcer Characteristics for all Ulcers and by Healing Outcome**

<table>
<thead>
<tr>
<th>Ulcer stage frequency (%)</th>
<th>All Ulcers (N = 32)</th>
<th>Healed (N = 21)</th>
<th>Unhealed (N = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>22 (69%)</td>
<td>17 (81%)</td>
<td>5 (46%)</td>
</tr>
<tr>
<td>3</td>
<td>6 (19%)</td>
<td>2 (9%)</td>
<td>4 (36%)</td>
</tr>
<tr>
<td>4</td>
<td>2 (6%)</td>
<td>1 (5%)</td>
<td>1 (9%)</td>
</tr>
<tr>
<td>5 (unable to stage)</td>
<td>2 (6%)</td>
<td>1 (5%)</td>
<td>1 (9%)</td>
</tr>
</tbody>
</table>

| Location frequency (%)   | Heel 11 (34%)       | 7 (34%)        | 4 (37%)           |
|                         | Coccys 8 (25%)      | 5 (24%)        | 3 (27%)           |
|                         | Ischial tuberosity 6 (19%) | 5 (24%)        | 1 (9%)            |
|                         | Malaceous 3 (9%)    | 2 (9%)         | 1 (9%)            |
|                         | Buttocks 2 (6%)     | 2 (9%)         | 0 (0%)            |
|                         | Others 2 (6%)       | 0 (0%)         | 2 (18%)           |

| Ulcer duration frequency (%) | ≤2 weeks 17 (55%) | 14 | 3 |
|                            | >2 weeks–1 month 5 (16%) | 1 | 4 |
|                            | >1 month–4 months 7 (23%) | 5 | 2 |
|                            | >4 months 2 (6%) | 0 | 2 |
| Mean months (SD)           | 2.0 (±4.40) | 1.0 (±1.01) | 4.3 (±6.88) |

Notes: * Duration data missing for one ulcer. SD = standard deviation.
**Pressure Ulcer Scale for Healing Score Change With Time**

We assessed PUSH scores for change over time using repeated measures analysis of variance for each group of ulcers (healed and unhealed). We analyzed each group because we anticipated that change in PUSH scores over time would be less demonstrable if we performed a single analysis of all ulcers. Because the number of ulcers with follow-up data beyond week 5 was few, we completed the repeated measures analysis of variance procedures for ulcers with week 1 through week 5 data (11 healed ulcers, 9 unhealed ulcers). The within-participant factor was the week of assessment (weeks 1–5).

Analyses revealed that total PUSH scores decreased significantly from weeks 1 to 5 among the healed ulcers ($df = 4; F = 5.901; p = .001$) but did not decrease significantly among the unhealed ulcers (Figure 1). Week-by-week comparisons of the healed ulcers revealed significant differences in total PUSH scores between weeks 4 and 5 ($df = 1; F = 7.364; p = .024$), differences between weeks 3 and 4 that trended toward significance ($df = 1; F = 4.893; p = .054$), and no significant difference in total PUSH scores between weeks 1 and 2.

Analyses of specific items on the PUSH for the healed ulcers revealed that the length-by-width item decreased significantly from weeks 1 through 5 ($df = 3.110; F = 5.884; p = .003$), whereas the remaining items, tissue type and exudate amount, did not decrease significantly with time in these ulcers. Figures 2 through 4 illustrate the mean item scores over time for the healed and unhealed ulcers.

**Differences in Pressure Ulcer Scale for Healing Scores Between Healed and Unhealed Ulcers**

We assessed differences in the healed and unhealed ulcers with respect to PUSH scores using 2-way repeated measures analysis of variance. The within-participant factor was time (weeks 1–5) and the between-participant factor was healing outcome: healed versus unhealed ($n = 20$). We found no significant interaction between week of assessment and healing outcome. The between-participants factor revealed significantly lower weeks 1–5 total PUSH scores among the healed compared with the unhealed ulcers ($df = 1; F = 4.399; p = .050$) (Figure 1).

**Correlation of the Pressure Ulcer Scale for Healing Scores With the Pressure Sore Status Tool and Ulcer Tracings**

We computed correlations among total PUSH scores, total PSST scores, and surface area measurements based on ulcer tracings separately for weeks 1–5 (Table 3). Unlike analyses of PUSH score change over time, we computed PUSH score correlations with other measures of healing using all ulcers in the sample because healing outcome should not modify the level of association. The number of ulcers included in each

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### Table 2. Week 1 Measures of Healing for all Ulcers and by Healing Outcome

<table>
<thead>
<tr>
<th></th>
<th>All Ulcers ($N = 32$)</th>
<th>Healed ($n = 21$)</th>
<th>Unhealed ($n = 11$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean total PUSH score (SD)*</td>
<td>8.6 (±3.06)</td>
<td>7.6 (±2.99)</td>
<td>10.5 (±2.30)</td>
</tr>
<tr>
<td>Length × width item</td>
<td>5.6 (±2.33)</td>
<td>4.9 (±2.37)</td>
<td>7.0 (±1.48)</td>
</tr>
<tr>
<td>Exudate amount item</td>
<td>0.4 (±0.49)</td>
<td>0.3 (±0.48)</td>
<td>0.5 (±0.52)</td>
</tr>
<tr>
<td>Tissue type item</td>
<td>2.6 (±0.91)</td>
<td>2.4 (±0.87)</td>
<td>3.0 (±0.90)</td>
</tr>
<tr>
<td>Mean total PSST score (SD)</td>
<td>26.3 (±6.90)</td>
<td>24.6 (±6.38)</td>
<td>29.4 (±7.08)</td>
</tr>
<tr>
<td>Size item (SD)</td>
<td>1.6 (±0.62)</td>
<td>1.4 (±0.60)</td>
<td>1.8 (±0.60)</td>
</tr>
<tr>
<td>Mean surface area cm² (SD)</td>
<td>3.7 (±4.15)</td>
<td>2.7 (±3.38)</td>
<td>5.5 (±4.97)</td>
</tr>
</tbody>
</table>

*Notes:* *p < .05.

PUSH = Pressure Ulcer Scale for Healing; SD = standard deviation; PSST = Pressure Sore Status Tool.
analysis decreased over time because some ulcers reached closure or the patients were lost to follow-up. Surface area data based on ulcer tracings beyond week 1 was missing for 1 ulcer, and these data for week 3 were missing for another ulcer. Total PUSH scores were highly correlated with both the PSST and surface area measurements. The level of association of the measures increased over time as the wounds progressed toward closure.

**DISCUSSION**

For a tool to measure healing validly, it must be sensitive to changes in the wound associated with progression toward wound closure. In this prospective study, the total PUSH scores decreased significantly over time in the ulcers that healed but not in the unhealed ulcers. The week-by-week comparisons of total PUSH scores in the healed group showed decreases consistent with the trajectory expected in a healing wound.

When we analyzed specific items in the PUSH separately, only length × width decreased significantly among the healed ulcers. This may be a reflection of the predominance of stage 2 ulcers in the sample, the limited number of study ulcers with exudate, and the minimal categories with which to discriminate changes in tissue type and exudate amount. Because tissue type and exudate amount did not change appreciably from week to week, the only portion of the tool that was contributing to changes in the PUSH score was length × width. This raises the question of whether simply monitoring changes in wound size (length × width) would be sufficient to document healing or absence of healing in stage 2 pressure ulcers.

Essential to the validity of a wound measurement tool is the ability to distinguish a healing wound from one that fails to progress toward closure. Comparison of PUSH total scores for healed and unhealed ulcers showed that scores differed significantly as the healed ulcers approached closure, confirming the ability of PUSH to differentiate healing from nonhealing ulcers. The primary element in the PUSH that accounted for the differences between healing and nonhealing ulcers was size (length × width), attributable to the predominance of stage 2 ulcers in the sample.

This validation study has several limitations. Although we included 3 long-term care facilities during a 6-month study period, the sample size was relatively small and consisted of predominantly stage 2 pressure ulcers. Further testing of the PUSH to establish validity in full-thickness (stages 3 and 4) pressure ulcers is warranted. Multiple types of treatments, such as hydrocolloids and topical agents, were being used that could interact with wound fluids and confound the assessment of wound exudate (5). We do not know to what extent this influenced the lack of significant change in the exudate component of PUSH in the healed ulcers. Furthermore, the predominance of stage 2 ulcers limited variability in tissue type and restricted the contribution of this element to defining healed ulcers.

The PUSH provides a valid measure of pressure ulcer healing over time and accurately differentiates a healing from a nonhealing ulcer. It is a clinically practical, evidence-based tool for tracking change in pressure ulcer status over time. However, its value in monitoring change may be limited when it is incorporated into quarterly assessments such as the Minimum Data Set required in long-term care by the Centers for Medicare and Medicaid Services. In the case of stage 2 ulcers, the relatively brief time required for healing would lead to ulcer closure within the 3 months between

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**Table 3. Correlations of PUSH Scores with PSST Scores and Ulcer Tracings by Week**

<table>
<thead>
<tr>
<th>Week</th>
<th>PSST and PUSH</th>
<th>Tracings and PUSH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pearson $r$</td>
<td>$p$ value</td>
</tr>
<tr>
<td>1 ($N = 32$)</td>
<td>.72</td>
<td>.000</td>
</tr>
<tr>
<td>2 ($N = 32$)</td>
<td>.76</td>
<td>.000</td>
</tr>
<tr>
<td>3 ($N = 26$)</td>
<td>.80</td>
<td>.000</td>
</tr>
<tr>
<td>4 ($N = 24$)</td>
<td>.90</td>
<td>.000</td>
</tr>
<tr>
<td>5 ($N = 20$)</td>
<td>.95</td>
<td>.000</td>
</tr>
</tbody>
</table>

*Note: PUSH = Pressure Ulcer Scale for Healing; PSST = Pressure Sore Status Tool.*

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Figure 3. Weekly Pressure Ulcer Scale for Healing (PUSH) tissue type scores are shown by healing outcome.

Figure 4. Weekly Pressure Ulcer Scale for Healing (PUSH) exudate amount scores are shown by healing outcome.
Minimum Data Set assessments. Consequently, it would not be possible to track change over time within the context of the quarterly Minimum Data Set assessments. The more useful outcome measure in these cases may be healed or unhealed ulcers. For those ulcers that have not achieved closure within the 3-month assessment period, the PUSH score could be used to monitor changes during a more extended follow-up period.

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REFERENCES


APPENDIX

Pressure Ulcer Scale for Healing (PUSH Tool v. 3.0)

Patient Name: ______________________________________ Patient ID#: ______________________________________
Ulcer Location: ____________________________________ Date: ____________________________________

DIRECTIONS:

Observe and measure the pressure ulcer. Categorize the ulcer with respect to surface area, exudate, and type of wound tissue. Record a sub-score for each of these ulcer characteristics. Add the sub-scores to obtain the total score. A comparison of total scores measured over time provides an indication of the improvement or deterioration in pressure ulcer healing.

Length × Width: Measure the greatest length (head to toe) and the greatest width (side to side) using a centimeter ruler. Multiply these two measurements (length x width) to obtain an estimate of surface area in square centimeters (cm²). Caveat: Do not guess! Always use a centimeter ruler and always use the same method each time the ulcer is measured.

Exudate Amount: Estimate the amount of exudate (drainage) present after removal of the dressing and before applying any topical agent to the ulcer. Estimate the exudate (drainage) as none, light, moderate, or heavy.

Tissue Type: This refers to the types of tissue that are present in the wound (ulcer) bed. Score as a “4” if there is any necrotic tissue present. Score as a “3” if there is any amount of slough present and necrotic tissue is absent. Score as a “2” if the wound is clean and contains granulation tissue. A superficial wound that is reepithelializing is scored as a “1.” When the wound is closed, score as a “0.”

1 - Epithelial Tissue: for superficial ulcers, new pink or shiny tissue (skin) that grows in from the edges or as islands on the ulcer surface.

2 - Granulation Tissue: pink or beefy red tissue with a shiny, moist, granular appearance.

3 - Slough: yellow or white tissue that adheres to the ulcer bed in strings or thick clumps, or is mucinous.

4 - Necrotic Tissue (Eschar): black, brown, or tan tissue that adheres firmly to the wound bed or ulcer edges and may be either firmer or softer than surrounding skin.

5 - Closed/Resurfaced: the wound is completely covered with epithelium (new skin).