Estimating the risk of pressure ulcer development: is it truly evidence based?

Catherine A Sharp, Mary-Louise McLaws

ABSTRACT

The aim of the current method of screening patients is to identify risk factors that are considered to cause, or contribute to, pressure ulcer (PU) development. Yet screening has not resulted in a reduction in pressure ulcer development. The literature was reviewed to identify the level of evidence for the inclusion of risk factors in six published pressure ulcer risk-screening tools. Evidence for each risk factor was ranked according to the National Health and Medical Research Council levels of evidence with a modification. Three of 19 risk factors (mobility, continence and nutrition) included in more than one screening tool have been tested for association with pressure ulcer development. While varying degrees of immobility and decreased serum albumin are reported to significantly increase the risk for PU development, the direction of the relationship, i.e. causal or resultant of PU, is not always clear. No publications reported a significant causal link between incontinence and PU development. Inclusion of risk factors for PU in screening tools must be evidence based. Until other risk factors have been tested for positive predictive value, the Ramstadius approach to screening is the only evidence-based tool.

Key words: immobility • incontinence • malnutrition • risk • screening

INTRODUCTION

Health care workers (HCW) have sanctioned the use of pressure ulcer (PU) risk-screening tools based on the argument that early identification of risk of PU will lead to interventions that will prevent PU. Unlike screening tools in medicine, none of these PU risk assessment tools has undergone rigorous testing for reliability and validity.

The predictive value of the screen test is important where the outcome of the disease/condition has serious complications.

INTRODUCTION

Health care workers (HCW) have sanctioned the use of pressure ulcer (PU) risk-screening tools based on the argument that early identification of risk of PU will lead to interventions that will prevent PU. The discerning influence of this reasoning led to the New South Wales (NSW) Health policy directive (1) for assessment of patients using a recommended PU risk assessment tool. This tool, along with other published PU risk assessment tools in use in Australia, the United Kingdom (UK) and the United States of America (USA) (Table 1) all contain parameters such as mobility, continence and nutrition by which patients are assessed subjectively and given a score. Depending on the tool used, the resultant sum categorises the patient on a scale ranging from ‘not at risk’ to ‘very high risk’ (1,2) or a combination of these terms (3-5).

Unlike screening tools in medicine, none of these PU risk assessment tools has undergone rigorous testing for reliability and validity. For a screening tool to be considered valid it must measure four things: sensitivity, specificity, positive predictive value and negative predictive value. A tool must be able to identify correctly as many individuals as possible, who have the disease (screen test positive). The screening test must also be able to correctly screen a patient as negative when they do not have the disease (screen test negative). The predictive value of the screen test is important where the outcome of the disease/condition has serious complications (6).
In the context of screening for PU risk, it is important to clarify the meaning of disease. Patients found to be at risk of PU could be considered positive (to have the disease) and those not at risk of PU considered negative (to be disease free). Unlike sensitivity in some tools that predict risk before the event, some investigators question whether persons have the disease (are at risk of PU) or are disease free (not at risk of PU) based on visible changes to intact skin, defined as a Stage 1 PU (7). The positive predictive value of a PU risk assessment tool refers to those patients identified as at-risk, who go on to develop a PU when interventions have not been optimal.

The PU risk assessment tool should be referred to as a risk-screening tool because by referring to it as an assessment tool the nursing and medical profession do not have not considered it to be a screening test that requires high levels of sensitivity and specificity. Consequently, calling it an assessment tool, precludes it from an expected rigor methodology. We are, therefore, going to refer to the tools as PU risk screening. This paper will examine the methodological problems with screening tests for PU risk.

The terminology used in some tools is not only confusing, but also time consuming, for the HCW (personal communication, Brenda Ramstadius). For example, in some tools 'mobility' refers to a range of patient movement categorised as 'activity' [sic] (3), 'lifts up' or 'gets up and walks.' (1,8) This risk factor is then further sub-categorised into: 'walks with help', 'chair bound', 'bedfast' (3) or 'chair fast', 'walks occasionally' and 'walks frequently' (5). The risk factor, 'level of consciousness', is expressed as 'unconscious' (1) or 'confused/illudicrous' (2). This classification of patients is a subjective assessment with no clear definition or criteria for the HCW to follow when applying the PU risk-screening tool. The threshold score at which a PU is expected to develop is set by the author of the tool and so differs across the tools (9). In addition, tools are used in clinical settings that differ from the group that the tool was originally developed. Health care facilities invariably alter the threshold score to 'fit' their patient population without testing its validity and reliability (10,11).

### Table 1: Published pressure ulcer (PU) screening tools in use in Australia, the United Kingdom (UK) and the United States of America (USA)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Continence</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Sensory perception</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Skin integrity</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Temperature</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Sex/Age</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Major surgery</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Decreased</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Pain</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Existing PU</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Medication</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Bodyweight</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Level of consciousness</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>

**Key Points**
- the PU risk assessment tool should be referred to as a risk-screening tool
- calling it an assessment tool precludes it from any expectation of rigorous methodology
- this paper will assess the methodological problems with screening tests for PU risk
- the terminology used in some tools is confusing and time consuming
- health care facilities alter the threshold score to 'fit' their patient population without testing its validity and reliability

PU, pressure ulcer; UK, United Kingdom; USA, United States of America; Y, yes; N, no.
Key Points
- the literature was reviewed with the aim of identifying the evidence for the inclusion of risk factors in six published PU risk-screening tools (Table 1) currently used in the UK, USA and Australia
- where a risk factor was included in two or more of the six tools (Table 2), the international literature was reviewed to establish the level of validity for causation of PU
- evidence for each factor was ranked according to the National Health and Medical Research Council levels of evidence with a modification, because a randomised control trial in this medical condition is not ethically possible to determine predictive value
- papers examining a risk factor for PU were identified using Medline, CINAHL, Full Text Journals and the Cochrane Database of Systematic Reviews in English
- only three of the 19 risk factors, mobility, continence and nutrition had been tested for validity

Risk of pressure ulcer development

geriatric patients (3,12) yet it has been widely used by Area Health Services in orthopaedic, vascular, medical and surgical patients (13).

The literature was reviewed with the aim of identifying the evidence for the inclusion of risk factors in six published PU risk-screening tools (Table 1) currently used in the UK, USA and/or Australia. These tools were

- The Pressure Sore Prediction Score (PSPS), UK (1987), the tool recommended for use by the New South Wales Health Department (2002) in a range of health care settings
- The Norton Pressure Sore Risk Assessment Scale, UK (1962)
- The Waterlow, UK (1984) and
- The Braden Scale for Predicting Pressure Sore Risk; USA (1987)
- The Walsall Pressure Sore Risk Score Calculator, UK (1992) and
- The Ramstadius Pressure Ulcer Risk Assessment and Intervention Tool, Australia (1994).

The Norton and Braden Scales are the most commonly used tools in the USA (14,15) and the Waterlow is most often used in the UK (16). The Walsall Pressure Sore Risk Score Calculator, UK (1992), has been included because it is the only published tool designed solely for use in the community setting by community nurses. The Ramstadius Pressure Ulcer Risk Assessment and Intervention Tool, Australia (1994) is the only validated and published non-numerical tool.

METHODS
Where a risk factor was included in two or more of the six tools (Table 2), the international literature was reviewed to establish the level of validity for causation of PU. The research strategy involved combining each of the six risk factors (Table 2) with the words 'pressure ulcer' with the following terms: systematic review, non randomised trials, cohort, historical cohort, case control, cross-sectional analytical and cross-sectional observational, limited to human and English language. Resultant publications were reviewed by two reviewers. Evidence for each risk factor was ranked according to the National Health and Medical Research Council levels of evidence (17) with a modification, because a randomised control trial in this medical condition is not ethically possible to determine predictive value. Hence, the following study designs were reassigned values for the quality of evidence: cohort (1a), historical cohort (1b), case-control or cross-sectional analytical (2) and cross-sectional observational (3). Papers examining a risk factor for PU were identified using Medline, CINAHL, Full Text Journals and the Cochrane Database of Systematic Reviews in English.

RESULTS
Review of literature for potential predictors
Only three of the tools, the Waterlow, Walsall and Ramstadius, give recommendations, such as alternating pressure air mattresses for immediate PU intervention in positive-screened patients. Only three of 19 (16%) risk factors, mobility, continence and nutrition had been tested for validity.

Description of risk factors used in each tool
Pressure Sore Prediction Score. New South Wales Health (2002) recommends the use of the PSPS tool in all health care facilities in NSW. Yet, the PSPS tool has only been tested on orthopaedic

Table 2 Physiological parameters included in screening tools

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O/S Mobility</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>O/S Continence</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>O/S Nutrition</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>O/S Skin integrity</td>
<td>Y</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>O/S Physical condition</td>
<td>Y</td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>O/S Medication</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
<td></td>
<td>Y</td>
</tr>
</tbody>
</table>

0, objective; S, subjective.
patients. It includes six risk factors, four of which, namely sitting up, unconscious, poor general condition and incontinence, can be given scores from 0 to 3 while the remaining two, lifts up and gets up/walks, can be scored from 0 to 2. The risk for PU increases with an increase in the score, where a score of <6 classifies the patient not at risk while a maximum score of 16 classifies them as high risk. A score of 10 is assigned to patients with an existing PU, which immediately classifies them as 'medium risk', without any other scoring, even if this patient may no longer have their original risk factors.

The Norton Pressure Sore Risk Assessment Scale. This tool was designed for geriatric patients and includes six risk factors with equal weighting, 4 = good, 3 = fair, 2 = poor and 1 = very bad, assigned to physical condition, mental condition, activity, mobility and incontinence, respectively. The lower the total score, the higher the risk, with scores of ≤14 assigned to at-risk patients.

The Waterlow Risk Assessment Chart. The Waterlow tool was designed for both medical and surgical patients. Risk factors for body weight for height, continence, skin type, visual risk areas and appetite are categorised and scored from 0 to 3 and sex and age from 1 to 5. Mobility is categorised into fully mobile, restless/fitful; aphetic; restricted; immobile and chair bound, each of which is scored from 1 to 5. Special risk factors include tissue nutrition, neurological deficit, major surgery/trauma and medication and can be scored from 1 to 8 with more than one risk factor being scored in each subsection. A score >10 means that the patient is at risk, >15 means a high risk and >20 means a very high risk.

The Braden Scale. The Braden scale contains six risk factors: sensory perception, mobility, activity, moisture, nutrition, friction and shear. Mobility and activity are assessed separately. Incontinence, per se, is not a risk factor, but a score can be assigned for skin exposed to moisture, such as perspiration. The risk factor ‘nutrition’ is measured by ‘usual food intake pattern’. This factor may be difficult to equate to a biological measure of nutrition and there is no guarantee of inter-rater reliability between those HCW assessing several meals over several days. Scores from 1 to 4 are assigned to all risk factors with the exception of friction and shear, which is scored from 1 to 3. The lower the score the higher the risk of PU development.

Waterlow Community Pressure Sore Risk Score Calculator. This tool provides six risk factors presented in columns to be assessed up to six times, on one page, at the community nurse’s discretion to illustrate the risk status between home visits. Risk factors include level of consciousness, mobility/ambulation, skin condition, nutritional status and care input with fecal and urinary incontinence (UI) scored separately. The risk scores range from 3 to 5 (very low), 6 to 11 (low), 12 to 22 (medium) and 23 to 36 (high risk).

Ramstadius Pressure Ulcer Risk Assessment. This is a non numerical tool and begins with the assessment of mobility as yes/no. If the patients can reposition themselves independently, such as rolling over in bed and/or is fully mobile, the assessment is complete with the patient classified as not being at risk of PU. If patients cannot reposition themselves without assistance then additional risk factors are assessed: age, medication, skin integrity, temperature, decreased blood volume, dyspnoea and the presence of an existing PU. If the patient is at risk of PU, guidance is provided for suitable preventative equipment, such as an alternating pressure air mattress.

The six risk factors common to two or more screening tools

Physiological parameters included in more than one tool (Table 2) were

- mobility
- continence
- nutrition
- skin integrity
- physical condition
- medication.

Physiological parameters, which were not included in the literature review for evidence of causality, were those featured in fewer than two of the risk-screening tools.

Evaluation of predictors for evidence of PU risk (Table 3)

There have been no evaluations in the scientific literature of the predictive value of skin integrity, physical condition and medication for PU development. Mobility, continence and nutrition were all ranked at ‘1a’ indicating a cohort design was used to assess the risk factors for
### Risk of pressure ulcer development

#### Key Points
- All studies employed a logistic regression analysis.
- Mobility was left to the individual assessor to interpret in all six tools.
- No publications were found that reported a statistically significant causal link between incontinence and PU development.

### Table 3: Level of evidence of causation of physiological parameters included in two or more screening tools

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Authors</th>
<th>Population</th>
<th>Modified level of evidence</th>
<th>Strength of association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immobility</td>
<td>Allman et al. (1995)(25)</td>
<td>Hospital patients (n = 286)</td>
<td>Ia</td>
<td>Odds ratio: 2.36, 95% CI: 1.14-4.85, P = 0.02</td>
</tr>
<tr>
<td>Mobility</td>
<td>Lindgren et al. (2004)(22)</td>
<td>Hospital patients (n = 530)</td>
<td>Ia</td>
<td>Odds ratio: 0.53, 95% CI: 0.33-0.86, P = 0.011</td>
</tr>
<tr>
<td>Immobility</td>
<td>Mino et al. (2001)(31)</td>
<td>Hospital for the elderly (n = 468)</td>
<td>II</td>
<td>Odds ratio: 1.54-10.9, P = 0.005</td>
</tr>
<tr>
<td>Immobility</td>
<td>Van Marum et al. (2000)(18)</td>
<td>Nursing home patients (n = 220)</td>
<td>Ia</td>
<td>Odds ratio: 6.3-37.1, P = 0.0005</td>
</tr>
<tr>
<td>Serum albumin (decrease of 1 g/dl)</td>
<td>Allman et al. (1996)(19)</td>
<td>Hospital patients (n = 634)</td>
<td>Ia/n/u</td>
<td>Odds ratio: 3, 95% CI: 1.2-7.1, P = 0.001</td>
</tr>
<tr>
<td>Urinary incontinence</td>
<td>Berlowitz et al. (2001)(31)</td>
<td>Nursing home patients (n = 14, 507)</td>
<td>Ia</td>
<td>Odds ratio: 1.4, 95% CI: 1.1-1.6, P = 0.03</td>
</tr>
<tr>
<td>Fecal incontinence</td>
<td>Allman et al. (1996)(19)</td>
<td>Hospital patients (n = 634)</td>
<td>Ia/n/u</td>
<td>Odds ratio: 3.5, 95% CI: 1.1-8.3, P = 0.03</td>
</tr>
<tr>
<td>Skin integrity</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Physical condition</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Medication</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

CI, confidence interval; N/A, not applicable; RR, relative risk.
*Simultaneously included in predictive analysis.

Causality: All studies employed a logistic regression analysis. Each of the risk factors, immobility, faecal and UI and poor nutrition, showed a significant relationship with PU development and are discussed below:

**Mobility.** Mobility sometimes labelled 'activity', is the patient’s ability to move independently, although the definition was left to the individual assessor to interpret in all six tools. Immobility or decreased mobility was significantly associated with PU development (18-23) and being incapable of turning over in bed was associated with approximately a fourfold greater relative risk for the development of PU (21). Only one study (24) contradicting all other findings, found no significant relationship between mobility and PU (odds ratio 1.36, 95% confidence interval 0.907-2.031, P = 0.14).

**Incontinence.** No publications were found that reported a statistically significant causal link between incontinence and PU development. An examination of the literature, and the risk factors for incontinence, included in all tools, except the Braden and Ramstad indices, revealed the potential difficulty screening poses for HCW. Most PU risk-screening tools, as well as the studies that have reported on incontinence as a potential risk factor for PU development (23-29), do not differentiate between 'urinary incontinence' (UI) and 'faecal incontinence' (FI). None differentiates between the different types of UI, stress or functional incontinence (30).

Many assessment tools have combined UI and FI into one risk factor 'incontinence'. It is, therefore, difficult to objectively assess 'incontinence' as a causal risk factor, or an intervening variable coming after a predictive factor, prior to PU development. However, bivariate analysis has shown UI to be associated with a significantly higher rate of PU development (31). However, Berlowitz (2001) (31) reported that continent residents had a higher rate of PU 90 days after the initial screening than those coded as 'usually continent' or 'incontinent'. This prospective study was carried out on 14, 607 nursing home residents who were without a Stage 2 PU, or larger, although these Stages were not defined. PU developed predominantly in those patients with UI who had an indwelling urinary drainage catheter. It is not known whether PU developed in patients prior to the insertion of the urinary drainage catheter.
catheter. Many of these residents may already have had a Stage 1 PU and developing ‘middle model’ PU (7). Pressure ulcers developed in 5.6% of 1730 residents with an indwelling urinary catheter compared with 1.9% among those without \( (P = 0.001) \) (31). Yet, one explanation could be that some patients may have developed Stages 1 or 2 PU, at the time of a cerebrovascular accident that simultaneously rendered them immobile and incontinent prior to the insertion of an indwelling urinary catheter for UI. Horn et al. (2004) (32) reported that patients catheterised for 14 days or longer are more likely to develop a PU. However, patients who were without a catheter, and mobile enough to be able to walk to the toilet with or without assistance, were also included in the study. For UI to be considered a predictor, rather than an intervening variable, where PU developed in patients catheterised to manage UI, a better study design is required to determine whether UI manifests prior to PU development.

Nurses described patients with UI and FI as continent if they had urinary catheters or ostomies, without reported leakage of urine or faeces and categorised the frequency of incontinence as always versus occasional/never for all analyses (25). Leaking, indwelling catheters may keep skin moist, increasing patient’s risk of skin maceration. Skin maceration may be mistaken for a Stage 1 or a Stage 2 PU, when skin appears to have an increased vulnerability (33). In one randomised crossover study a greater incidence of Stage 2 PU was noted in patients with UI during a less-frequent pad-changing regime (33). Eider (2002) suggested that a less-frequent pad-changing regime may have an effect on skin integrity; however, the association between PU and UI was not statistically significant (33). Screening for incontinence using the PSIPS tool, e.g., asks ‘Is the patient wet or soiled underneath?’ with choices of ‘urine, faeces, perspiration or wound drainage’ and without differentiation between the sources. The assess or has a choice of UI or perspiration, but not FI, under the parameter ‘moisture’ in the Braden tool. Neither tool has instructions to double the score if more than one source were present at the time of screening, yet some staff may do this. Only the Waterlow tool separates UI from FI for score allocation. The scoring gave UI and FI equal weighting while patients with both urinary and FI scored higher resulting in a higher risk category for PU development. There is no evidence from multiple logistic regression analysis for this conclusion. The terminology for incontinence in both the Norton and Waterlow tools makes differentiation between FI and UI impossible.

Faecal incontinence alone has been weakly associated \( (r = 0.30; P < 0.001) \) with PU (25), suggesting that it may not be an important variable but resulting from immobility. While FI and low serum albumin have been reported to be significant risk factors \( (P \leq 0.05) \) for PU during multiple logistic regression analysis (19), the temporal relationship is not always clear in cross-sectional surveys.

**Nutrition.** Poor nutritional status has been reported by several investigators \( (19,31,34,35) \) as a contributing factor to PU development. Yet, poor nutrition may be the outcome rather than a predisposing factor of PU (34). Serum albumin concentration was found to be low \( (2.6 \pm 0.5 \text{ g/dl} \text{ compared with } 3.1 \pm 0.7 \text{ g/dl; } P = 0.08) \) in 7.7% \( (6/72) \) of patients at risk of PU who developed a PU (19). Low serum albumin may result from exudate draining from the PU rather than low levels causing PU (34). In addition, some studies (24) did not objectively measure albumin.

When ‘nutrition’ was added to a PU risk-screening tool a 50% reduction in PU incidence was reported in a British hospital when coupled with regular patient mobilisation (36). The authors suggested that poor nutrition played a large part in the frequency of PU development. However, malnutrition may pose less risk for PU if the patient is mobile unlike the immobile patient whose malnourishment may contribute more to the physiology of PU development through ischaemia-reperfusion injury (7). Malnutrition in obese patients may be an intervening variable by decreasing patient mobility, resulting in increased risk of PU development. The emaciated patient may not be at risk if fully mobile whilst the same patient with limited mobility is (37).

With PU risk-screening tools that measure nutritional status subjectively, reduced nutritional intake/poor nutritional status has been reported as a risk factor for PU (38,39). New PU in the malnourished patient may appear as a marker for shearing (7). Once we understand the speed with which PU develop (40), and
that patients who develop one are at risk of dying (41), trying to improve nutrition within an admission may benefit the patient but plays no part as an acute prophylaxis for PU (40).

DISCUSSION

This paper has examined some of the methodological problems with screening tools for PU risk. A modified grading system of the National Health and Medical Research Council (17), was used for evidence of the validity of six individual risk factors: mobility, continence, nutrition, skin integrity, physical condition and medication (Table 3). These six factors were listed in two or more of the six PU risk-screening tools described in this chapter. No evidence could be found for the inclusion of skin integrity, physical condition and medication. The literature review found no evidence of predictive value of incontinence or poor nutrition for PU development. Immobility was found to be the only evidence-based risk factor for PU with the highest levels of evidence, cohort (18,22,25) and case-control or cross-sectional analytical (20,21). One specific aspect of immobility reveals that patients incapable of turning over in bed have a fourfold greater relative risk of PU (21). The importance of immobility compared with other factors needs to be treated for predictive value. Until then it may be time effective to use immobility, with an accompanying definition, as a single screen test.

The purpose of using a risk-screening tool is to identify patients at risk of PU (1,42,43) and intervene immediately with appropriate equipment to reduce the incidence of PU. Screening tools must enable the rater to reliably measure risk factors to produce consistent results, especially when applying the risk-screening tool to the same subjects at different times to enable accurate assessments changes in clinical condition (10). Relying on experience 40% of nurse respondents, who did not use a PU risk-screening tool, used words such as 'inactive', 'immobility' or some equivalent to identify patients at risk for PU (44).

New South Wales Health (2002) (1) asserts that 'a pressure ulcer may be caused by pressure, friction and shear' and the implication is that these risk factors should be assessed. Yet, the risk-screening tool recommended by NSW Health, the PSFS (10), does not contain these three factors. It is impossible to know whether pressure, friction and shear occur simultaneously and/or intermittently. Immobility is presently a variable with strong evidence to support it as an important risk factor for PU (18,20–22,25) whereas the process of friction and shearing is so far only theoretical. Friction may result in a redness and/or grasping of the surface of the skin, often confused with a Stage 1 or a Stage 2 PU while shear remains an invisible process possibly causing deep tissue damage potentially resulting in the 'middle model' PU (7).

An additional shortfall in the PSFS risk-screening tool is its original design for the assessment of orthopaedic patients for risk of PU (8). However, NSW Health (2002) (1) recommended its use in all health care facilities in NSW. No positive predictive values of the items in the PSFS tool, for all mix of patients, have been provided. Designing a tool for one patient group may change the ability of a tool to accurately classify patients when applied to a different patient group (14).

A methodological limitation of many risk-screening tools is the subjective nature of measurements, which may alter reliability of the final at-risk score and limit the ability to generalise the findings of PU across patient populations (45). The lack of uniformity and objectiveness in the terminology used for both continence and nutrition should also be addressed. Continence is not clearly defined in any PU risk-screening tool or study; therefore, it is not possible to assign the risk of pressure to UI or FI. Stress incontinence may occur following surgery for radical prostatectomy, e.g. and it is clear that this type of incontinence is not a cause of PU (30). On the other hand functional incontinence can occur in patients with decreased mobility that have a hard time getting to the toilet in time because of arthritis, e.g. Their decreased mobility may well put them at risk of PU. Incontinence may also be a predisposing factor for PU, not because of the associated moisture, but rather because UI or FI may be associated with immobility (7,31). In fact, in two studies using the Norton score incontinence was not associated with PU risk (18,20) and in another study patients with indwelling urinary catheters were classed as incontinent (31). This suggests that incontinence may simply be a proxy for PU because it describes a dimension of immobility and has nothing to do with

© 2006 The Authors. Journal Compilations © 2006 Blackwell Publishing Ltd and Medicalhelplines.com Inc.
erythema caused by wet skin but often mistaken for a Stage 1 or a Stage 2 PU. The term 'wet skin abrasion' to describe skin damage due to incontinence may be more appropriate than 'Stage 2 PU' (33).

The patient with UI who is catheterised is presumably dry all the time and less likely to require a change of bed sheets as frequently as a patient with UI who does not have an indwelling urinary drainage catheterised and is habitually wet. Patients with wet sheets or using disposable briefs would be moved, pressure would be relieved for a period and the patient may be repositioned both actions, which may help prevent PU (32). Likewise the task of changing bed sheets requires that the patient be moved around, perhaps stood out of bed, in effect repositioned; thus potentially preventing PU. The patient with the indwelling urinary drainage may not require a change of pad or sheets and may remain in the same position for lengthy periods and it is these periods of immobility that result in unrelieved pressure leading to PU. The occasional episode of minor incontinence may be undetected for longer, thereby increasing the risk to the skin (23) but rather than causing PU, incontinence may simply be associated with PU development in an immobile patient.

The evidence for UI as a predictor of PU is not logical although there is a statistically significant association between UI and PU at the highest level of evidence. Incontinence can also be the result of overflow of urine from the bladder if an enlarged prostate is blocking the urethra (30).

Serum albumin was used as a marker for nutritional status in several studies examining risk factors for PU development (19,21,25,34). None of these studies defined PU. It was apparent that low serum albumin levels were associated with PU (87); however, serum albumin may have been lost from a PU at Stage 2 or greater and while the skin is intact, serum albumin can still be lost from the circulating blood due to ischaemia-reperfusion injury in the 'middle model' (7).

Well-informed staff may not use the PU risk-screening tools because the tools 'have low levels of reliability and predictive validity' (45). The subjectivity required to apply the tests of each risk factor could be one reason why tools are not routinely used. Another reason could be that when screen-positive patients are identified the staff is unable to implement timely repositioning regimens and procure preventive equipment so that the HCW perceives the use of a tool as unproductive (13). Five of the six risk-screening tools reviewed, the PSSS, the Norton, the Waterlow, the Braden and the Walsall were numerical. These tools required all patients to be assessed against every category and subsection. Such testing takes time, which may not be productive when 50% of patients have been found not to fall into any risk category (4). For this reason the Ranstadius tool has the advantage of requiring one factor only to be assessed — mobility. Until other risk factors have been tested for positive predictive value, the Ranstadius approach is evidence-based and may be cost-effective.

Gradually, the need to examine the predictive value of all other risk factors and levels of risks can be excluded. It seems clear that UI and FI are not direct causal factors for PU and need not be measured. However, incontinence and the terminology require further work to determine the importance of UI and FI in mobile and immobile patients for PU development.

Further research to assess nutritional status could include serial measurements of serum albumin levels prior to the development of PU in mobile and immobile patients before it can be identified as a risk factor, an effect modifier (increasing the effect of immobility) and an intervening variable.

We looked no further into the validity of any of the risk factors that featured in fewer than two of the risk-screening tools. They are all conditions thought to be risk factors for PU. Nevertheless, it is important that screening for PU is carried out in the simplest manner in order that appropriate interventions are instituted immediately. Our search for evidence has shown that the greatest effort in assessing PU risk needs to focus on mobility.

REFERENCES
Risk of pressure ulcer development

39. The Joanna Briggs Institute for Evidence-Based Nursing and Midwifery. Pressure sores – part 1:
41 Bills MR. Part 1 adapted from a talk given at the Fifth Oxford European Wound Healing Summer School held at St Anne's College, Oxford, 28 June to 1 July, 2000.