ARTICLE

Predictive validity of pressure risk assessment scales in a private sector trauma intensive care unit

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Background. Risk assessment scales are considered essential tools in pressure ulcer prevention, but none of them have been tested for predictive validity (sensitivity, specificity and positive and negative predictive value) in intensive care, especially in the South African context.

Purpose. To compare the sensitivity, specificity and predictive value of a pressure ulcer risk assessment scale developed for intensive care unit patients (research scale) with the one that was currently being used in the research unit (control scale).

Method. Sixty-six patients were assessed over a period of 3 months. Pressure ulcer risk was calculated on a weekly basis using both assessment scales. Predictive risk was compared with the actual outcome (pressure ulcer development) in order to determine the sensitivity and specificity of each scale.

Results. Twenty-five (38%) of the sampled patients developed pressure ulcers. There was significant asymmetry ($p < 0.05$) between the two scales, with the control scale having a tendency to classify more patients as being at risk. The two scales matched well for sensitivity, but the research scale had a higher specificity (71% v. 29%) and positive predictive value (63% v. 44%).

Conclusion. It was concluded that the research scale is superior to the control scale, as it was able to predict risk with more accuracy.

Risk assessment scales are considered essential tools in pressure ulcer prevention.[1] They are capable of predicting which patients are more likely to develop pressure ulcers and describing interventions to be directed at the most vulnerable patients in prevention programmes.[2] Pressure ulcers have significant implications for the quality and cost of health care.[2,3]

Although the popular risk assessment scales such as the Norton (1975)[4] and Waterlow (1985) are used extensively in the hospital setting, these scales have been criticised as being inappropriate for critically ill patients in the intensive care unit (ICU), where the development of pressure ulcers is often related to physiological and metabolic derangements of acute illness.[5] These aetiological factors, specific to critical illness, are not included in the Norton or Waterlow risk assessment scales.[6-8]

Based on these limitations Cubbin and Jackson[6] developed a risk assessment scale specifically for the ICU. This scale was found to be 100% sensitive but only 54% specific.[7] The scale was modified by Lowery in 1995,[8] after which several attempts were made to test it; however, to date no actual testing for validity and specificity has been documented.

The hospital under study developed a risk assessment scale that is widely used in the private health care sector. However, on closer scrutiny it was found that this risk assessment scale comprised a combination of items derived from both the Norton and Waterlow scales. There is no evidence that this adapted scale has undergone any testing for validity and predictive value. On the basis of concern about a rising number of pressure sores in the ICU, the nursing staff felt that the currently used risk assessment scale was subjective and not specific to the realities of the intensive care context. To this end, this study introduced Cubbin and Jackson's[6] ICU pressure risk assessment scale as modified by Lowery[8] into the ICU of a private hospital, to evaluate the sensitivity, specificity and predictive value in identifying patients at risk compared with the risk assessment scale that was currently being used in the hospital under study.

The literature review that follows incorporates a review of risk assessment scales and their development as related to this particular study.

Literature review

The current worldwide literature cites more than 20 risk assessment scales developed since the early 1960s,[9] the majority of which have not undergone rigorous scrutiny in terms of their reliability and validity.[10,11] More recent studies[2,1,3] suggest that selection of a risk assessment scale should also include an evaluation of its predictive validity, which comprises sensitivity and specificity, as well as positive predictive and negative predictive values[1] and appropriateness for the patients for whom it is intended.[12]

The hospital under study, part of a private health care group, undertook to develop a risk assessment scale for use in all its hospitals. The first scale was the original Norton Scale, which was subsequently modified by combining items from both the Norton and the Waterlow scales. The adapted scale comprises the following categories: physical condition, mental condition, activity, mobility, incontinence and skin type. These categories are scored and add up to a total score of 24. A further category of other risk factors is also included on the adapted scale, comprising nutritional deficiencies, neurological deficit, poor circulation, poor hydration, infection, anaemia, patient positioned on hard surfaces for more than 2 hours, medication, and age > 65 years. Two points are subtracted for each of these risk factors identified. The total for this second category is subtracted from the first total to arrive at a final score.

The maximum score on this adapted scale is 24, and there is no minimum score, since the total score depends on the number of 'negative' scores. A score of 20 or less is considered to indicate possible risk for pressure ulcer development, a score of 16 definite risk, and a score of 8 high risk. The scale also provides time intervals for pressure relieving strategies based on the calculated risk score, with recommendations to do 1-hourly pressure care for patients with a score of less than 8. However, to date no actual testing for validity and specificity of the instrument have been documented.

The Norton scale was developed in Europe in 1962.[4] It was designed for and researched with elderly patients in hospital, and has been found to be less reliable outside this population group. According to Wardman,[13] it was probably the first scale for assessing pressure ulcer risk. The scale comprises five items: physical condition, mental condition, activity, mobility and incontinence. Each item is rated on a scale ranging from 1 to 4, with all scored items adding up to a total score between 5 and 20. A score of 16 and below is considered to indicate high risk for pressure ulcer development. Although the scale is used extensively throughout the world because of its simplicity and ease of use, it is dependent on the subjective assessment of the assessing nurse.[6,14]

The Waterlow scale was introduced in 1985, and provides a wider basis for assessment than the Norton.[14] Designed to be more than a risk assessment tool it also includes a pressure ulcer prevention treatment policy,[15] and it has been used in hospital settings for both medical and surgical patients. The scale comprises the following predisposing factors: build/weight, continence, skin type, mobility, sex, age and appetite. A further category includes risk factors divided into the following subscales: medication, tissue malnutrition, neurological deficit and major surgery/trauma. Patients with a total score below 10 are considered at risk, those scoring 15 - 20 at high risk, and those scoring 20 and above at very high risk. When using the Waterlow scale it is difficult to determine the maximum score, since several scores can be awarded in each item category. This scale is, however, widely used in the UK, and has been shown to be more accurate than the Norton scale.[13]

Owing to the inappropriateness of existing pressure risk assessment scales for use in critically ill patients, Cubbin and Jackson[6] adapted the familiar Norton scale to meet the needs of critically ill patients. Instead of 5 original categories used by Norton,[4] Cubbin and Jackson[6] used the same scoring system but included 9 items specifically relevant to the critically ill patient population. These were age, weight, skin condition, mobility, haemodynamic status, respiration, nutrition, incontinence and hygiene. The maximum score on their scale is 40, with a score of less than 25 indicating risk for pressure ulcer development. This scale was only tested on 5 patients and its predictive value was not determined.

This scale was further tested by Hunt[7] and Lowery,[8] who questioned the validity of the section on mobility, arguing that since patients in the ICU are generally bedridden because of being sedated and ventilated, there is little variability in their ability to mobilise. Lowery[8] therefore modified the scale by removing the category on mobility and replacing it with alterations in body temperature. Categories on debilitating illness and the need for blood products were also added to the haemodynamic category, replacing the categories on age and hygiene, respectively, on the original scale. Furthermore, the cut-off point for patients considered to be at risk for pressure ulcer development was increased from 25 to 28.[8]

Purpose of the study

The purpose of the present study was to evaluate an ICU pressure ulcer risk assessment scale (research scale) in order to determine whether it was more sensitive and specific and had a greater predictive value in identifying patients at risk than the

assessment scale (control scale) that was in use at the time in a private sector ICU.

The main objectives of the study were to:

- determine whether the research scale was more sensitive and specific than the control scale in identifying patients at risk in the ICU
- compare the predictive values of the research scale and the control scale.

Population and sample

The study population comprised all patients admitted to the ICU of a private sector health care institution over a 3-month period.

Following discussion with a statistician, a sample size of 66 was agreed upon. Purposive sampling was used to select participants until the desired sample was reached. Criteria for inclusion included age between 18 and 65 years, and no pressure ulcers on admission. Only patients on total bed rest due to injuries or medical interventions were included in the study. The focal criterion for exclusion was extensive burns involving the back, buttocks and legs, as this made it difficult to assess these areas for pressure ulcers.

Methods and procedures

A correlational design was used to determine the sensitivity, specificity and predictive value of the research and control risk assessment scales in patients in the ICU between April and June 2003. Data were collected by means of a prospective record review of the patient's hospital records, ICU charts and both research (used with permission; see appendix A) and control (adapted; see appendix B) risk assessment scales.

Baseline data were collected within 24 hours of the patient's admission to the ICU. Thereafter, data regarding the patient's vital signs and risk factors, as well as the development of pressure ulcers, were collected on a daily basis. Risk scores were calculated on a weekly basis using both risk assessment scales for each patient. Data collection stopped after 3 weeks of reassessment or if the patient was discharged or died before the 3 weeks elapsed. All the data collected were used for analysis.

Data analysis

Both scales were compared for symmetry, sensitivity and specificity. Each patient's risk for pressure ulcers was calculated using both risk assessment scales. The cut-off points for risk and no-risk categories were set according to the descriptions of each scale, i.e. total score of 35 - 40 and 21 - 24 indicating no risk for the research and control scales, respectively. Risk scores calculated on admission and on a weekly basis (i.e. 0 = admission, 1 = 7 days, 2 = day 14, 3 = day 21) were used for analysis and comparative purposes. This was achieved by first determining the symmetry of the two scales with regard to at-risk and no-risk patients, using McNemar's test for symmetry. A p-value of < 0.05 was considered significantly asymmetrical. Inferential statistics were used to compare the total scores (predicted risk) with the outcome (pressure ulcer development), in order to determine their predictive values.

Ethical considerations

Permission to conduct the study and to access patients was obtained from the Chief Executive Officer and Deputy Director of Nursing Services of the Hospital, the Clinical Director and the registered nurse in charge of the participating intensive care unit. Ethical clearance was obtained from the hospital under study and the Committee for Research on Human Subjects (Medical), University of the Witwatersrand, to ensure compliance with ethical standards.

Owing to the critical nature of the patients' illness, informed and written consent was obtained from family members. In addition, retrospective written consent to use the information obtained in the study was obtained from the participants during the recovery period. Participants' names and identifying characteristics were not documented and records were encoded to ensure anonymity and confidentiality during data collection and reporting. The identity of intensive care personnel treating the patient and recording such treatment also remained confidential throughout the study.

Main findings

Sixty-six patients were enrolled in the study, with male and female patients accounting for 85% (N = 56) and 15% (N = 10) of the sample, respectively. Their ages ranged between 18 and 65 years, with 29% (N = 19) of the sample aged between 26 and 35, 27% (N = 18) between 36 and 45, 24% (N = 16) between 46 and 65, and 20% (N = 13) under 20.

Fifty per cent (N = 33) of the patients admitted to the ICU had been injured in a motor accident, followed by 15% (N = 10) with gunshot wounds, while only 8% (N = 5) and 5% (N = 3) had been injured in motorbike and pedestrian vehicle accidents, respectively. Twenty-three per cent (N = 15) of the sample had other mechanisms of injury. The mean distribution times for the total sample in casualty and operating room were 2.67 (SD 1.72) and 3.33 (SD 1.49) hours, respectively.

Frequency distribution of risk scores

The total risk for each scale was obtained by adding up the sub-total scores of the specific risk factors in each scale. On admission, 54 patients (82%) were identified as being at risk by the research scale, in comparison with 64 (97%) by the control scale (Table I). The

Table I. Frequency distribution of risk scores over three weeks

Risk assessment scale	0 (*N* = 66)		1 (*N* = 66)		2 (*N* = 34)		3 (*N* = 17)	
	Risk	No risk	Risk	No risk	Risk	No risk	Risk	No risk
Research								
Frequency	54	12	34	32	18	16	8	9
%	82	18	52	48	53	47	47	53
Control								
Frequency	64	2	52	14	31	3	16	1
%	97	3	79	21	91	9	94	6

0 = assessment on admission; 1 = re-assessment day 7; 2 = re-assessment day 14; 3 = re-assessment day 21.

subsequent assessments revealed a similar trend, with the control scale classifying more patients at risk.

Comparison of risk scores for symmetry

The two scales were tested for symmetry in order to determine how well they agreed with regard to determining risk versus no risk. Since the majority of the patients exited from the study within the first 2 weeks, either due to death or discharge to the high-care or step-down facility, the risk scores obtained during the first two assessment points (0 and 1) were used for this purpose. These two assessment points were also considered to be more appropriate as they were performed during the acute phase of the patient's ICU stay. Furthermore, all the patients would have had at least two assessments during their stay in the ICU even if they stayed less than 7 days.

There was significant asymmetry ($p = 0.0348$) of scores indicating disagreement of the two scales with respect to patients at risk and these at no risk. This was because of disagreement between the two scales on 11 patients who were classified as being at higher risk by the control scale and not at risk by the research scale. Similarly, in the second assessment (1) there was disagreement between the two scales regarding 20 patients classified as at risk by the control scale and not at risk by the research scale. According to the findings, the control scale appears to have a greater tendency to classify patients as being at risk on admission ($p = 0.0039$) and at assessment 1 ($p = 0.000$). This disagreement can be explained by the fact that most of the risk factors used in the two scales are totally different.

Frequency of pressure ulcer development (outcome)

Table II indicates that 25 (38%) of the patients developed one or more pressure ulcers during the study period while 41 (62%) did not.

Pressure ulcer location

Forty-four pressure ulcers were observed in 25 patients, since some patients had more than one pressure ulcer. As illustrated in Table III, the most common site for pressure ulcer development in the study group was the heels, accounting for 43% (*N* = 19) of all pressure ulcers. This site was followed by the occiput and buttocks, accounting for 16% (*N* = 7) each. Two patients were nursed in the prone position; both developed pressure ulcers on the knees and one of them also on the nose and forehead. In one further patient the pulse oximeter probe caused a pressure ulcer on the ear.

Table II. Frequency distribution of pressure ulcer development (outcome)

Outcome	Frequency	Percentage	Cumulative total
Pressure ulcer	25	38%	38%
No pressure ulcer	41	62%	100%
Total	66	100%	

Table III. Distribution of pressure ulcer location

Pressure area	Frequency (*N*)	%
Heels	19	43
Occiput	7	16
Buttocks	7	16
Sacrum	3	7
Ankles	2	5
Knees	2	5
Elbows	1	2
Ears	1	2
Nose	1	2
Forehead	1	2

Comparison of risk scores with respect to outcome

Twenty-five patients developed pressure ulcers, comprising 46% of the 54 patients classified as being at risk by the research scale and 39% of the 64 assessed as at risk by the control scale. A similar trend was observed by the third assessment point, with 100% of the patients classified as being at risk by the research scale developing pressure ulcers compared with 75% of those classified as at risk by the control scale.

The research scale classified 12 patients as at no risk on admission while the control scale classified only 2.

However, by the second assessment the research scale classified 32 patients as no risk but 15% of them developed pressure ulcers. The control scale classified 14 patients as at no risk and 14% of them developed pressure ulcers.

The 66 patients were divided into two groups according to outcome, i.e. pressure ulcer group and no pressure ulcer group. Symmetry was calculated for the two risk assessment scales with respect to these outcomes.

Both the research and control scales were in 100% agreement for the admission scores in that all the patients identified as being at risk developed pressure ulcers by the third assessment point. However, at the second assessment there was marginal asymmetry (p = 0.0833), in that 3 of the patients who developed pressure ulcers were classified as at no risk by the research scale and as at risk by the control scale.

For the 41 patients who did not develop pressure ulcers, there was significant asymmetry on both admission and subsequent scores. There was disagreement in 11 of the patients who did not develop pressure ulcers while having been classified on admission by the control scale as being at risk and by the research scale as at no risk (p = 0.00039). Disagreement was even greater at the second assessment, when 17 patients who did not develop pressure ulcers were classified as at risk by the control scale and as at no risk by the research scale (p = 0.0000).

Comparison for sensitivity

Table IV shows that on admission the two scales were equally highly sensitive at 100%. However, at the second assessment the control scale (92%) was slightly more sensitive than the research scale (80%).

Table IV. Comparison of the research and control scales for sensitivity (N = 25)

Assessment point	Research scale	Control scale
0	100%	100%
1	80%	92%

0 = assessment on admission; 1 = re-assessment day 7.

Comparison for specificity

Table V shows that the research scale was found to be more specific on admission (29%) than the control scale (5%). However, the specificity of the two scales appeared to increase by the second assessment, with the research scale being more specific (71%) than the control scale (29%). A probable explanation for this is that the effects and physical signs of the physiological and metabolic changes that result from the inflammatory response only become evident after the first 24 hours following trauma. Furthermore,

Table V. Comparison of research and control scale for specificity (N = 41)

Assessment point	Research scale	Control scale
0	29%	5%
1	71%	29%

0 = assessment on admission; 1 = re-assessment day 7.

haemodynamically unstable patients are only started on inotropic drugs such as adrenalin after all resuscitation efforts have failed. These factors have heavy weighting on the research scale, which explains the higher specificity compared with the control scale.

Comparison for predictive value

The predictive value of the two scales was calculated, and although both scales had a negative predictive value of 100%, the research scale had a higher positive predictive value (46%) than the control scale (39%). On the second assessment, the negative predictive value went down to 85% and 86% for the research scale and the control scale, respectively. However, the positive predictive value of the research scale went up to 63% while that for control scale only increased to 44%. A summary of trends in predictive values is presented in Fig. 1.

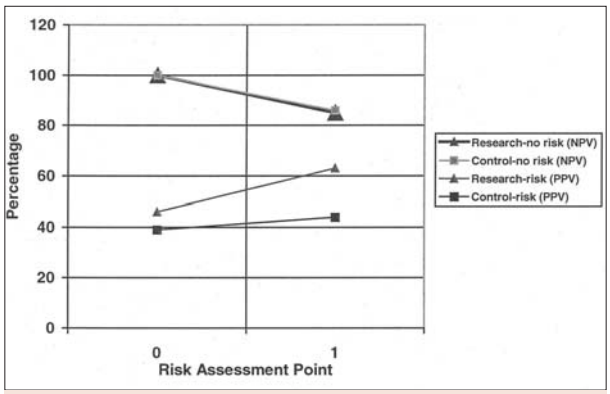

Fig. 1. Frequency distribution of positive (PPV) and negative (NPV) predictive values of the risk assessment scales.

Discussion

During the course of this study the researcher discovered that there are many pressure ulcer risk assessment scales in existence. Unfortunately, few of them have undergone actual scientific testing. The research scale was tested by Hunt[7] in 100 ICU patients and found to be 100% sensitive and 54% specific using a risk cut-off point of 24. However, since it was modified by Lowery,[8] several attempts have been made to test it, but to date no actual testing for validity and specificity has been documented. Likewise, there is no evidence that the control scale has been tested for sensitivity and specificity, although the Norton scale (from which the control scale was adapted) has been tested and described as being highly sensitive (89%)

with very low specificity (36%), and thus as having a tendency to over-predict the risk of pressure ulcer development.[16]

The findings of our study confirm this problem, with the control scale being very sensitive and having low specificity compared with the research scale. This has important relevance for clinical practice, because a scale that has high sensitivity and rather low specificity could lead to over-prediction of risk and therefore unnecessary implementation of costly pressure-relieving strategies on 'non-risk' patients who are classified as at risk.

Although generalisation of these findings may be limited because our study was carried out in one specialised ICU with a small sample size (N = 66), it may be necessary for each ICU to determine which risk factors are applicable to their patient profiles in the selection of an appropriate risk assessment scale. This study has highlighted the need to select a risk assessment scale on the basis of evaluation of its predictive validity in the population group for which it is intended.

Conclusion

The aim of the study was to compare the sensitivity, specificity and predictive values of the pressure risk assessment scale (control scale) used in a private hospital with one developed specifically for ICU patients (research scale). A critical comparison of the two scales showed significant asymmetry, with the control scale having a higher tendency to classify patients as being at risk. It was concluded that the research scale is more accurate at predicting the risk of pressure ulcers in ICU patients, and appears to be superior to the control scale. These findings answer the research questions posed at the beginning of the study and refute the hypothesis that there was no difference in the sensitivity, specificity and predictive values of the two risk assessment scales.

Appendix A. Research scale ICU risk assessment scale

Medical condition		**Weight**		**Skin condition**		**Mental condition**		**Temperature**		
Requires ICU admission/single system injury	4	Average weight	4	Intact	4	Awake & alert	4	36 - 37.4°C	4	
Diabetic/ hyperglycaemic	3	Obese	3	Red skin	3	Agitated/ confused	3	37.5 - 37.9°C	3	
Renal failure/ dialysis	2	Cachectic	2	Grazed/ excoriated	2	Sedated/ apathetic	2	> 38°C	2	
Multisystem injury	1	Oedema	1	Necrotic exuding areas/burns	1	Coma/ unresponsive	1	< 36°C	1	
Nutrition		**Respiration**		**Haemodynamic status**				**Incontinence**		
Full diet & fluids	4	Spontaneous breathing	4	No inotropic support	4	Requires no blood replacement	4	Anuric/has catheter	4	
Enteral feeding	3	CPAP/ASB	3	Stable with inotropes	3	Requires blood replacement	3	Urine	3	
Parenteral feeding	2	SIMV/PCV/ BIPAP	2	Unstable without inotropes	2	Requires platelets	2	Faeces	2	
Clear IV fluids only	1	Breathless at rest or on exertion	1	Critical with high-dose inotropes	1	Requires blood/ platelets	1	Urine & faeces	1	

Total score = / 40

IMPLICATIONS OF SCORE and DIRECTION:

Score: 35 - 40: No risk
30 - 35: At risk. 2-hrly pressure care and positioning
25 – 30: High risk. Add mattress overlay to above
< 25: Very high risk. Mattress replacement and 2-hrly pressure care

Reprinted from Lowery M. A pressure sore risk calculator for intensive care patients: the Sunderland experience. *Intensive and Critical Care Nursing* 1995; **11:** (page 351), copyright 1995, with permission from Elsevier.
CPAP = continuous positive airway pressure; ASB = assisted spontaneous breathing; SIMV = synchronised intermittent mandatory ventilation; PCV = pressure controlled ventilation; BIPAP = biphasic positive airway pressure.

Appendix B: Control scale

Physical		Mental		Activity		Mobility		Incontinence		Skin type		2. Other risks
Good	4	Alert	4	Ambulant	4	Full	4	None/ catheter	4	Healthy	4	• Nutritional deficiencies • Neurological deficit, e.g. diabetes, MS, CVA, paraplegia, motor sensory • Poor circulation • Poor hydration • Infection • Anaemia • On hard surface > 2hrs. • Medication, e.g. high-dose steroids, cytotoxins, anti-inflammatory (long-term) • Age 65+ (**Subtract 2 points for each risk**)
Fair	3	Apathetic	3	Walk/help	3	Limited	3	Occasional	3	Thin/dry	3	
Poor	2	Confused	2	Chair	2	Very limited	2	Urine/ faecal	2	Clammy/ oedematous	2	
Very bad	1	Stuporous	1	Bedfast	1	Immobile	1	Double incontinence	1	Spot/discol/ broken	1	
								SCORE	**1**	**TOTAL**		**TOTAL SCORE 2 =**

Score: 24 - 21	No risk	**TOTAL SCORE: SCORE 1 MINUS SCORE 2 =**
20 or less:	At risk. Start preventive measures, 4 - 6-hrly pressure care	
16 or less:	Definite risk. 2-hrly pressure care	
8 or less:	High risk. 1-hrly pressure care	

1. Defloor T, Grypdonck M. Validation of pressure ulcer risk assessment scales: a critique. *J Adv Nurs* 2004: **48**(6): 613-621.
2. Edwards M. The rationale for the use of risk calculators in pressure sore prevention, and the evidence of the reliability and validity of published results. *J Adv Nurs* 1994; **20:** 288-296.
3. Gould D, Goldstone L, Gammon J, *et al.* Establishing validity of pressure risk assessment scales: a novel approach using illustrated patient scenarios. *Int J Nurs Stud* 2002; **39:** 215-228.
4. Norton D, McClaren R, Exton Smith A. *An Investigation of Geriatric Nursing Problems in Hospital.* Edinburgh: Churchill Livingstone, 1975.
5. Batson S, Adam S, Hall G, *et al.* The development of a pressure area scoring system for critically ill patients: a pilot study. *Intensive and Critical Care Nursing* 1993; **9:** 146-151.
6. Cubbin B, Jackson C. Trial of a pressure area risk calculator for intensive therapy patients. *Intensive and Critical Care Nursing* 1991; **7:** 40-44.
7. Hunt J. Application of a pressure area risk calculator in an intensive care unit. *Intensive and Critical Care Nursing* 1993; **9:** 226 - 231.
8. Lowery M. A pressure sore risk calculator for intensive care patients: the Sunderland experience. *Intensive and Critical Care Nursing* 1995; **11:** 344 - 353.
9. Papanikolaou P, Clark M, Lyne P. Improving the accuracy of pressure ulcer risk calculators: some preliminary evidence. *Int J Nurs Stud* 2002; **39:** 187-194.
10. Bridel J. The epidemiology of pressure sores. *Nursing Standard* 1993; **7**(42): 25-30.
11. Hamilton F. An analysis of the literature pertaining to pressure sore risk assessment scales. *Journal of Clinical Nursing* 1992; **1:** 185-193.
12. Dealey C. *Managing Pressure Sore Prevention.* Dinton: Quay Books, 1997.
13. Wardman C. Norton v Waterlow. *Nursing Times* 1991; **87**(13): 74, 76, 78.
14. Williams C. Journal of wound care nursing. Comparing Norton and Medley. *Nursing Times* 1991; **87**(36): 66, 68.
15. Haoli J. Pressure sore prevention in acutely ill patients. *Professional Nurse Supplement* 1997; **12**(6): 6-9.
16. Keller B, Wille J, van Ramshorst B, *et al.* Pressure ulcers in intensive care patients: a preview of risks and preventions. *Intensive Care Med* 2002; **28**(10): 1379-1388.