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# Prevalence, incidence and risk: a study of pressure ulcers at a rural base hospital

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## **Abstract**

*This project was conducted in an Australian rural base hospital. It compared the Norton and Waterlow pressure ulcer risk assessment scales with an informal nurse assessment via a prevalence and an incidence study of inpatients.*

*This study, more a pilot study due to the small sample size, suggests that the pressure ulcer prevalence and incidence within this Australian hospital was comparable to national and overseas studies. Statistical analysis of the incidence data using the Kappa and McNemar tests showed that the Waterlow risk assessment scale performed better than both the Norton scale and the informal nurse assessment when identifying patients at risk of developing pressure ulcers.*

## **Introduction**

The hospital in which this research project was conducted is an 80 bed facility. Numbers of inpatients are progressively higher among the older population brackets, with an average length of stay of 4-5 days<sup>1</sup>.

Pressure ulcers, also known as decubitous ulcers, pressure sores, bed sores or pressure areas<sup>2,3</sup>, are defined as “any lesion caused by unrelieved pressure resulting in damage of underlying tissue”<sup>4</sup>. Put simply, they are ischaemic ulcers due to pressure<sup>2</sup>. They usually affect tissue over bony prominences<sup>2,4</sup> such as the sacrum and coccyx, ischial tuberosities, greater trochanters, external malleoli, heels, occiput and elbows<sup>2,5</sup>.

Pressure ulcers are graded according to their severity. The most common system for classifying pressure ulcers appears to be the 1995 AHCPR<sup>4</sup> definition, which classifies ulcers as Stage I-IV, according to the amount of tissue damage observed by the clinician. Although widely used, it is, however, open to limitations and error. For example, Stage I pressure ulcers, although the least severe in the staging system, may mask more significant damage. They may also be difficult to assess in skin of darker pigmentation<sup>5</sup>. In addition, when assessing people with

pressure ulcers of Stage II or more, any eschar present must be removed before the wound is assessed to minimise inaccuracies<sup>2,4</sup>.

Pressure ulcers may be caused by anything that applies a force to tissue to the extent that the cells are deprived of an adequate level of oxygen to maintain perfusion<sup>6</sup>. Any external compressing force that exceeds the mean blood pressure of 25mmHg in the capillary bed is enough to interrupt blood flow<sup>7</sup>. If such a force is maintained or increased, it will begin to occlude larger vessels such as arterioles<sup>7</sup> or venules. Should this be maintained for over 2 hours, the combination of oxygen deprivation and the accumulation of metabolic end products will result in irreversible tissue damage.

Pressure ulcers may occur over any part of the body, particularly those areas subjected to friction or shearing forces<sup>7</sup> which cause damage through sliding one layer of tissue over another<sup>7</sup>. The angulation and the stretching of the vessels during the sliding process result in injury, such as trauma and bleeding, to the vessels concerned<sup>7</sup>. These processes may be due to, or exacerbated by, illness, immobility<sup>6</sup> or forces such as those applied during repositioning or sliding down in an inclined bed<sup>6,7</sup>.

## **Factors for risk**

Factors that may place a person at risk of developing pressure ulcers may be considered as intrinsic or extrinsic.

### **Intrinsic**

- *Mobility*: the less mobile a person, the more they are exposed to prolonged periods of pressure.

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- *Medical history*: pre-existing disease predisposes people to greater risk of pressure ulcers, particularly individuals with affected sensory perception, deficits in consciousness, neurologic disease, general ill health, increased body temperature, abnormal body mass index, dehydration and hypotension.
- *Age*: individuals over 65 years of age are at particular risk, especially when their situation is complicated by illness.
- *Nutrition*: nutritional deficits are associated with pressure ulcer development. Low protein and albumin levels are particularly linked with full-thickness ulcers, while dehydration, vitamin and zinc deficiencies are associated with poor wound healing<sup>3, 8-10</sup>.

### Extrinsic

- *Drugs*: sedatives and analgesics decrease the sensation of pain and decrease mobility, while some hypotensives decrease blood flow, thereby decreasing tissue perfusion.
- *Moisture*: exposure to moisture over a prolonged period of time results in maceration of skin which makes the skin more susceptible to injury.
- *Mattress quality*: long periods on hard mattresses increases risk of pressure ulcer development.
- *Patient handling techniques*: incorrect lifting and manual handling techniques may increase shear and friction forces<sup>3, 8-10</sup>.

For the person who develops a pressure ulcer, the wound may cause significant physical and psychological pain, physical disfigurement, distress, personal inconvenience and cost<sup>4, 11, 12</sup>. To the health care provider they may represent increased length of stay, increased use of wound care products, the use of surgical management techniques such as debridement and the potential for complications such as infection or sepsis<sup>9, 13</sup>.

### Prevalence vs incidence

As a result of increased attention to the human and economic cost of pressure ulcers in recent years, government involvement in both the United Kingdom and America has seen the implementation of quality assurance strategies aimed at reducing the number of pressure ulcers present at any given time (prevalence), and the rate at which they occur (incidence)<sup>4, 14</sup>. Regular prevalence and incidence studies are the best way to monitor the progress of such strategies<sup>15</sup>. Prevalence data is useful in providing clinicians with baseline data; however, incidence monitoring is commonly considered the most

important figure as it is used as an indicator of the quality of care within an institution<sup>15</sup>.

Current data on the prevalence and incidence of pressure ulcers in Australian institutions indicates that the prevalence of pressure ulcers varies between 3.4 and 32 per cent<sup>16-18</sup> whilst the incidence rate was calculated at 2-3 per cent as early as 1983<sup>19</sup>. Discussion of this data, speculation on the prevalence and incidence of pressure ulcers within the hospital, and the need to establish whether a formal tool would be useful in assisting nurses in the identification of patients at risk of developing ulcers, initiated this research project. Prior discussion at a nurse based discussion group had identified anecdotal evidence as a basis for this study. Incorporating a nurse assessment into the study was identified as one way of informally testing the current assessment methods against formal assessment scales.

The limitations to this study were that the Norton assessment scale was designed in 1962<sup>20</sup> for use among aged patients and the Waterlow scale<sup>21</sup> in the mid 1980s for use in English health institutions. The actual nurse assessment process designed by the researcher in this study was informal and no records were kept as to the number of registered or enrolled nurses included in the study, their familiarity with wound care or the effect that participating in the study had upon their management of pressure ulcers in direct patient care. A further limitation was identified after the study was complete; the anecdotal evidence originated prior to the hospital moving into a new building. New 'medicraft' beds with eggshell mattresses were bought and installed in the new hospital which is where the data was collected. This provided inherent better management just prior to the data collection process.

Risk assessment tools are widely used in helping members of the health care team identify patients at risk of pressure ulcers<sup>14</sup>. Both the Norton scale<sup>20</sup> and the Waterlow scale<sup>21</sup>, are well established and widely used to assess patients in acute facilities for risk of developing pressure ulcers<sup>14, 22</sup>. The ideal risk assessment tool should show "good predictive value, high sensitivity and specificity and be easy to use"<sup>5, 14</sup>. It has also been suggested that the validity and reliability of some tools is poor<sup>14</sup>.

This study was developed towards the end of 1999 following discussion at a nurses' journal club within an 80 bed rural base hospital. The study endeavoured to:

- Establish baseline data for the health service community on the prevalence and incidence of pressure ulcers within the inpatient population.
- Compare the effectiveness of two common, well-respected assessment scales against an informal nurse assessment.

In doing so, it was envisaged that the study would assist in determining whether the implementation of a formal assessment tool, to assess for pressure ulcer risk at the point of admission, would assist the nurse in identifying the patient population at risk of pressure ulcer development.

## Method

In order to examine both the prevalence and incidence of pressure ulcers, the study was designed along two planes; a cross-sectional study and a prospective longitudinal study. The cross-sectional plane being the prevalence study, a ‘snapshot’ of pressure ulcers at any given time, and the prospective longitudinal study being the incidence study.

The prevalence data was collected from 0700 to 1900 only on Day 1 of the study period. All inpatients within the hospital on the day of the study were included.

The incidence study was also commenced on Day 1 of the study period. Only new inpatients were included for the complete study period of the incidence study. All new inpatients were included in the incidence study for a period of 7 days, with each new admission being followed up on a daily basis for 7 days or the extent of their admission, if it was shorter than the 7 days.

Written consent or witnessed verbal consent was obtained from each patient or their next of kin. This process was authorised by the Research Ethics Advisory Committee for Health (REACH), the ethics committee for the area health service. Consent allowed the researcher to complete the following assessments on each patient:

- The Norton risk assessment scale <sup>20</sup>
- The Waterlow risk assessment scale <sup>21</sup>
- A skin examination to assess for skin integrity and the presence of pressure ulcers, and to allow the nurse caring for the patient to state the patient’s pressure ulcer risk status.

Both the prevalence and incidence studies were carried out in conjunction with the three risk assessment scales: the Norton scale, the Waterlow scale and the nurse assessment. The latter

involved asking “Is this patient at risk of developing pressure ulcers?” This question was directed to the nurse (registered or enrolled) responsible for the patient’s care on the day of assessment, or alternately to the team leader, and was designed to reflect the mix of nursing skill at the point of patient care. No data were kept on the ratio of registered nurses versus enrolled nurses participating in the study. No formal risk assessment tools were being implemented in hospital at the time of the study.

The data collection tool as a whole was devised by the researcher and peer reviewed by the head of the University Department of Rural Health which was linked to the hospital.

Demographic data for the prevalence study was obtained from the use of the assessment scales, particularly the Waterlow scale.

In order to establish the reliability of the Norton and Waterlow scales, as compared to the informal nurse assessment, the data obtained during collection was coded in order to apply statistical analysis. Tests used comprised the Kappa test, McNemar test, Log rank analysis and survival curves.

The Norton scale is based upon five categories of patient assessment, each of which gives a score 0-4, with a total score out of 20. A score of 14 or less is indicative of patient risk of pressure ulcer development <sup>12,20</sup>. This was coded for analysis by assigning:

- < 15 = risk = 1
- 15 - 20 = no risk = 0

Similar coding was applied to the Waterlow scale where:

- 10+ = at risk
- 15+ = at high risk
- 20+ = at very high risk

So therefore:

- > 9 = risk = 1
- < 10 = no risk = 0

For the nurse assessment the, Yes/No response to the question: “Is this patient, (name), at risk of developing pressure ulcers?”, was coded as follows:

- Yes = risk = 1
- No = no risk = 0

Once these scales were in uniform format, statistical analysis methods were applied to the data obtained from the incidence

study. The Kappa test and McNemar test were used to determine the agreement between the data, while Log Rank tests and survival graphs were used to determine the sensitivity and specificity of the assessment scales used.

There was one researcher only for this research project which aided in reducing error in data collection and collation. However, this was also a limitation in the study in that the patient assessment relied on the accuracy of one data collector.

## Results and analysis

### Prevalence study

The cross-sectional study, designed to find the prevalence of pressure ulcers within the hospital, was carried out over a period of 12 hours on Monday the 24th of January 2000.

Fifty nine inpatients out of a possible 62 were included in the study; three had been excluded due to inability to obtain consent. Of the total patients studied, there were 28 males (47.5 per cent) and 31 females (52.5 per cent). Of the 59 inpatients, seven patients (four males, three females) were found to have pressure ulcers: a prevalence of 12 per cent. Four had more than one pressure ulcer.

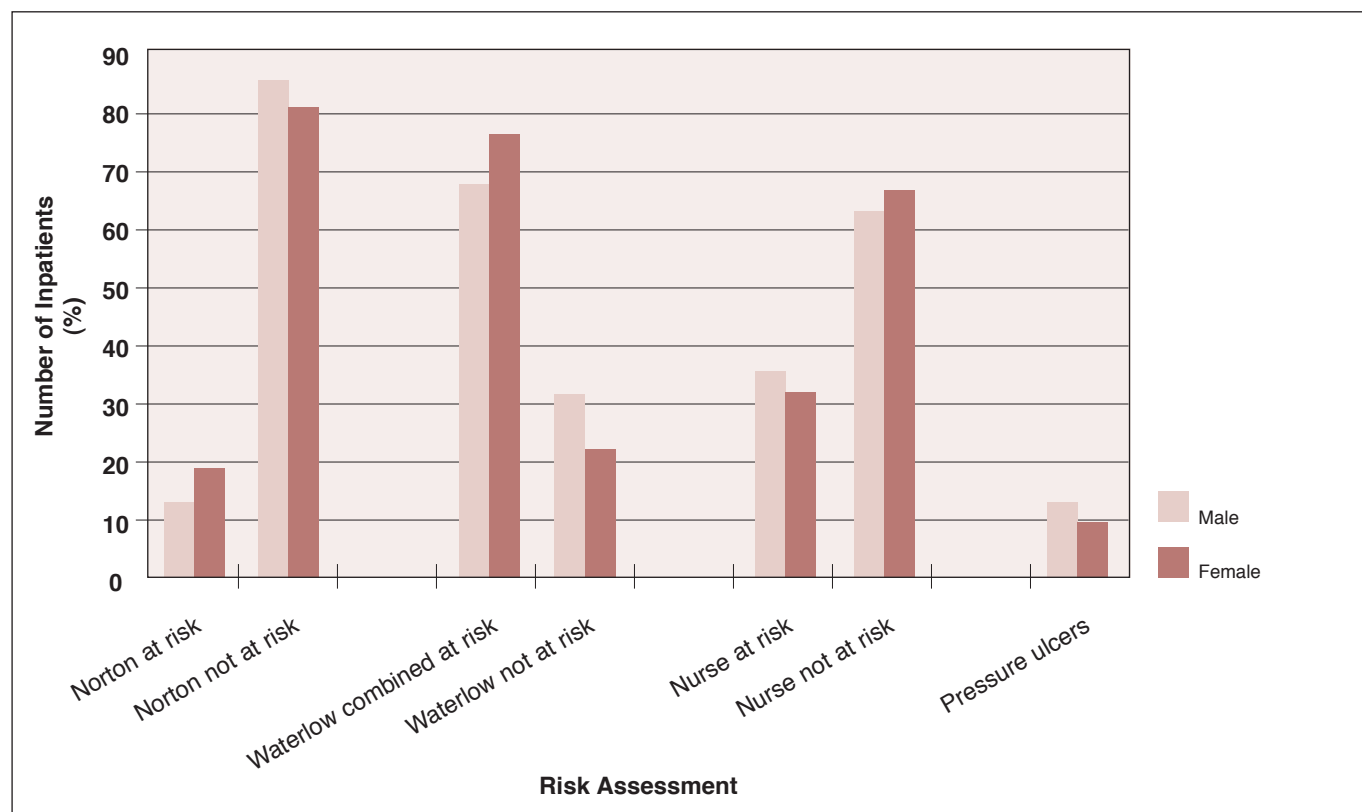
The severity of the ulcers found is listed in Table 1. Amongst the male population, the prevalence of patients with ulcers was 14 per cent and 7 per cent for ulcers graded as Stage III or greater. For females, the prevalence was 10 per cent overall and 3 per cent for patients with ulcers graded as Stage III to IV. There were no stage II pressure ulcers in either the male or female population.

The Waterlow scale proved an efficient means of collecting additional demographic data for the prevalence study, particularly in regard to age and sex (Figure 1).

**Table 1. Number of pressure ulcers in the prevalence study, as compared to severity and anatomical location.**

	Stage I	Stage II	Stage III	Stage IV
Sacrum	1			1
Coccyx	2			1
Buttocks	2			
Spine	3		1	
Heels				2

**Figure 1. Prevalence study: risk profile of males and females.**



Assessed risk using each of the tools was similar for males and females, even though the total number assessed at risk varied between each tool. The Norton and nurse assessment methods were closest in assessing risk in the prevalence study, as compared to the number of inpatients with ulcers. The age and

risk profiles for each of the three assessment scales is shown in Figures 2, 3 and 4.

It is clear from the trends that the greatest risk is in the groups over the age of 65 years which corresponds to the risk factors identified by many authors<sup>3,7-9</sup>. There was a female in the 14-

Figure 2. Age and risk status of pressure ulcers as assessed by the Norton Scale.

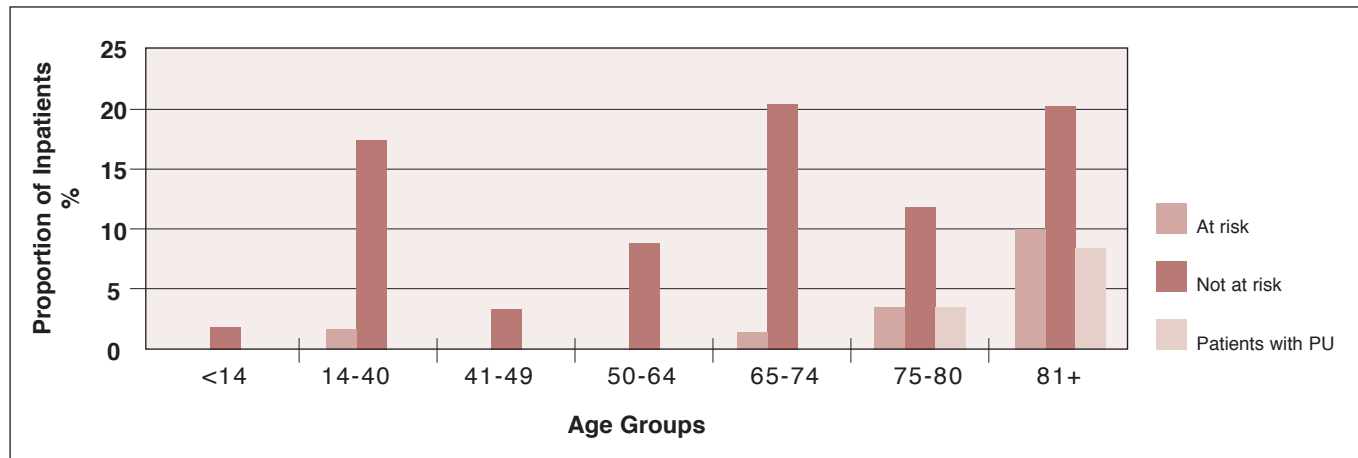


Figure 3. Age and risk status as assessed by the Waterlow Scale.

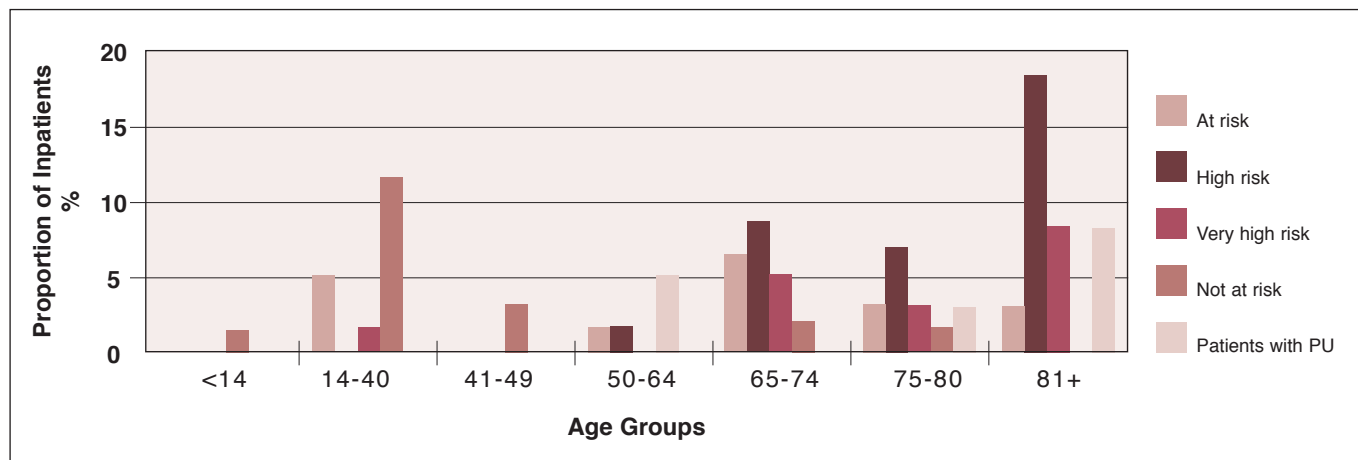
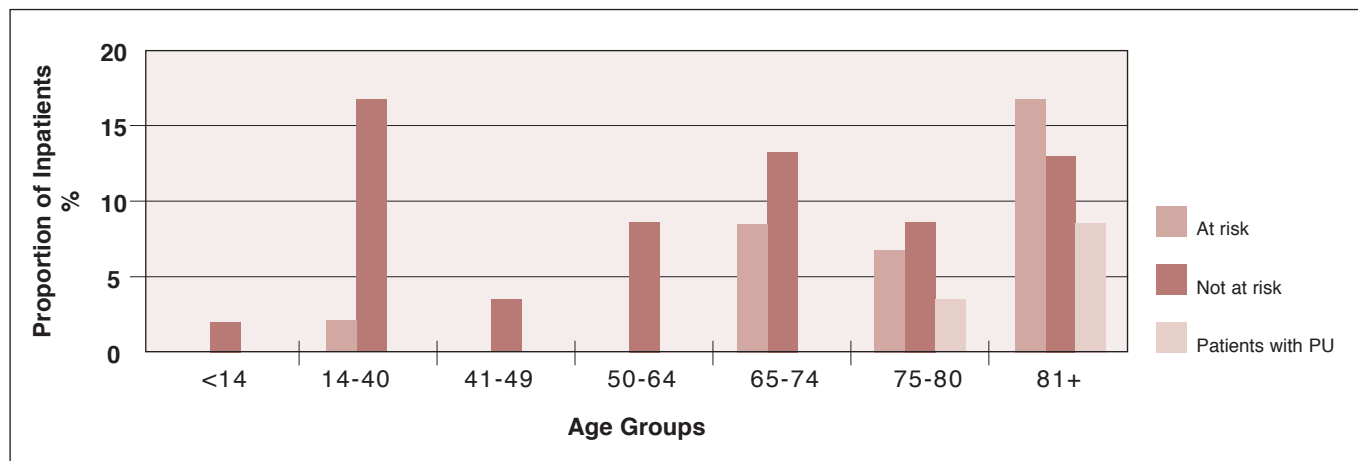


Figure 4. Age and risk status as identified by the nurse/team leader responsible for the patient.



40 year old group who was identified at risk by all three methods of risk assessment, and a further two females and one male from the same age group who were identified as at risk by the Waterlow scale alone. Once again, it is clear from the graphs that the Norton and nurse assessment methods were closest in assessing the patient for risk as compared to the number of patients who had ulcers when they were assessed in the prevalence study.

### Incidence study

Sixty two patients from a possible 70 were included in the incidence study which included all patients in the hospital. Seven patients were excluded due to unobtainable consent and one withdrew from the study. Data was collected on admission and on a daily basis for the extent of admission (or 7 days) by the same sole researcher as in the prevalence study. Similarly, the same three risk assessment tools were used in the incidence study as in the prevalence study.

During the study period, five pressure ulcers developed amongst four inpatients in the studied patient population. This represented an incidence of 6.5 per cent across all Stages (I-IV) of pressure ulcers, and an incidence of just 2 per cent for ulcers of Stage II or over (Table 2).

Of the 62 inpatients that participated in the study, 33 (53 per cent) were female and 29 (47 per cent) were male. There were three females in the study who developed four pressure ulcers. This represented an incidence of 9 per cent across all stages of ulcers; only one patient developed a Stage II ulcer, representing an incidence of 3 per cent. Amongst the males included in the study, one Stage I ulcer developed, representing an incidence of 3 per cent.

### Incidence study: risk assessment scale analysis

Using the coding methods previously detailed (risk = 1 and no risk = 0), all participants and their risk status on Day 7 of data

**Table 2. Number of pressure ulcers in incidence study as compared to ulcer severity and anatomical location.**

Location	Stage I	Stage II
Coccyx	2	
Buttocks	1	1
Heels	1	

collection or their last day of admission, if earlier, were tabulated against each other. Also tabulated was the actual presence of any pressure ulcer development.

Using the Kappa test to measure the agreement of the data, it was found that when the Waterlow scale and the Norton scale were compared against each other, there was no significant agreement (Table 3). The Norton scale identified only four patients at risk of pressure ulcers, as compared to the Waterlow scale where 34 patients were identified at risk. The two tests agreed in only four cases of identification of risk.

Kappa analysis of the data indicates there is a chance-adjusted agreement of only 0.1074,  $p=0.6058$ , where perfect agreement is a value of 1.00.

The Waterlow and Norton scales were also tested using the McNemar test, which also showed that the two scales disagreed significantly.

The Norton scale was compared to the nurse assessment, also for the purposes of measuring agreement between the two tests, and better measurements of agreement were obtained. The nurse assessment identified 11 patients (18 per cent) in the incidence study at risk of pressure ulcers as compared to the Norton scale's four patients (6.5 per cent) (Table 4). The two forms of assessment agreed that 50 patients (81 per cent) were not at risk of developing pressure ulcers and agreed that three patients were at risk. This produced a Kappa test value of 0.33729, where  $p=0.002$  which represents agreement in approximately one third of patients and statistical significance in agreement between the two scales. Even though better agreement is demonstrated with the McNemar test, the two forms of assessment are statistically dissimilar,  $p=0.04$ ; the Norton scale underestimates patient risk as compared to the nurse assessment.

The final comparison was to compare the Waterlow scale and the nurse assessment. The two scales agreed in 11 instances (18 per cent) that patients were at risk of pressure ulcers and agreed in 28 instances (45 per cent) that patients were not at risk of developing pressure ulcers (Table 5). This represented a Kappa Value of 0.30167 ( $p=0.001$ ), showing that the two tests agree in nearly a third of cases, which represents statistical significance in agreement.

When the McNemar test was applied, results demonstrated that although the Waterlow scale agreed with the nurse assessment on assessments made, the two forms of assessment are statistically dissimilar ( $p < 0.001$ ).

The three forms of risk assessment were also measured for their predictive value: the number of times a patient who was assessed as being at risk actually developed a pressure ulcer. Log rank tests were carried out to assess this function.

The Norton scale placed 58 inpatients in the 'not at risk' category; of these, two developed pressure ulcers. Of the four patients assessed as being 'at risk', two developed pressure ulcers. When the log rank analysis was applied it produced a log

rank statistic value of 11.27 and a significance value of  $p = 0.0008$ . With the  $p$  value so close to zero, the results indicated that, for inpatients placed in the not at risk category, very few ulcer events occurred. The analysis showed that Norton scale was a good means of assessing patients potentially at risk of developing pressure ulcers.

The Waterlow scale placed 28 patients of the 62 assessed as 'not at risk'. This was less than half of the participants in the incidence study. No patients of this group developed pressure ulcers. Of the 34 participants in the group assessed as 'at risk', four developed pressure ulcers. This produced a log rank value for the Waterlow scale of 1.36 and a significance of  $p = 0.2442$ .

**Table 3. Kappa test analysis: Waterlow vs Norton.**

		Waterlow scale		
		0	1	Total No.
Norton scale	0	28	30	58 (94%)
	1		4	4 (6%)
	Total No.	28 (45%)	34 (55%)	62 (100%)

0 = no risk of pressure ulcer development    1 = risk of pressure ulcers

**Table 4. Kappa test analysis: Norton scale vs nurse assessment.**

		Nurse assessment		
		0	1	Total No.
Norton scale	0	50	8	58 (94%)
	1	1	3	4 (6%)
	Total No.	51 (82%)	11 (18%)	62 (100%)

0 = no risk of pressure ulcer development    1 = risk of pressure ulcers

**Table 5. Kappa test analysis: nurse assessment vs Waterlow scale.**

		Nurse assessment		
		0	1	Total No.
Waterlow scale	0	28	0	28 (45%)
	1	23	11	34 (55%)
	Total No.	51 (82%)	11 (18%)	62 (100%)

0 = no risk of pressure ulcer development    1 = risk of pressure ulcers

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These figures indicate that the Waterlow scale was not as reliable in assessing patients at risk of developing pressure ulcers whilst in hospital.

The nurse assessment placed 51 participants in the 'not at risk group', and 11 patients in the 'at risk' group. One of the patients in the 'not at risk' group developed a pressure ulcer, whilst three of the 11 patients identified as being 'at risk' developed ulcers. This represents a log rank statistical value of 5.95 and a significance of  $p=0.0147$ . This showed that although the nurse assessment was more reliable in identifying patients at potential risk of developing pressure ulcers than the Waterlow scale, it was not as reliable as the Norton scale.

## Conclusion

This study placed the prevalence of pressure ulcers at a rural base hospital at 22 per cent across all stages of pressure ulcers and 8.5 per cent for pressure ulcers present of Stage II-IV. These data fit well within the middle range of pressure ulcer prevalence in America<sup>15</sup> and, more importantly, indicate a similar picture when compared with Australian data, where previous studies have placed the prevalence at between 3.4 and 32 per cent<sup>16-18</sup>.

One problem that arises when analysing the prevalence and incidence data that is the demographic spread of the hospital populations studied is not always provided<sup>19</sup>. This is important as the types of patients studied, proportions of age groups present, timing of data collection, presentations of risk factors, and interventions by staff will all influence the outcome of data collection and the outcome of the study. Because this information is not always present, the impact of the comparison of results decreases. In this study, as evident in Figure 4, the highest proportion of inpatients is represented in the 81 years and over age group, and indeed from 65 years upward.

Incidence data collected by the American AHCP<sup>4</sup> indicates the incidence of pressure ulcers among American hospitals ranges from 3-30 per cent. Australian data from a 1983 study places the rate in our country as between 2-3 per cent<sup>19</sup>. Therefore, the incidence of pressure ulcers found in the studied hospital: 6 per cent overall and 2 per cent for pressure ulcers of Stage II-IV, is quite comparable.

Increasingly, pressure ulcer prevalence and incidence rates are used as indicators of the quality of care within an institution.

The results of this study are encouraging in terms of the incidence of pressure ulcers with regard to implications about the quality of care provided, showing that the incidence of pressure ulcers within the studied hospital are comparable to current Australian standards of care.

The Norton and the Waterlow scales were chosen because they are widely used and respected. This study found that the Waterlow scale, although highly unspecific was more sensitive than both the Norton scale and the nurse assessment in identifying the specific patient population at risk of developing pressure ulcers.

Prior to the study, it had been suggested that a formal tool be implemented on admission to improve care; in terms of this study, the nurse assessment performed well as an assessment method, and although not the best of the three tools, it was highly specific and reasonably sensitive. Even though a small percentage of 'at risk' patients were not recognised and went on to develop ulcers, it performed well in comparison to the formal tools, implying that perhaps the use of such tools is not always warranted.

Assessing patients for risk and identifying their needs in terms of pressure ulcer prevention is merely the first step in managing pressure ulcer care within an institution. Ultimately, an assessment tool can never be used to predict the outcome of pressure ulcer development unless management strategies are included in the assessment or the tool is used as part of a management pathway.

The results of this study may be used as baseline data for the hospital itself and also as a pilot for further studies within the area and the state. A comparison of whether the use of a formal assessment tool would be more useful cannot be carried out unless an examination of current management strategies is made.

The hypothesis – that the Waterlow scale, the Norton scale and the informal nurse assessment would identify all of the patients at risk of developing pressure ulcers – was not supported. Only the Waterlow scale identified all of the patients at risk of pressure ulcers. None of the scales performed brilliantly in all areas. Health care institutions need to identify which scale is most useful for them, particularly when considering management strategies.



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