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Pressure Ulcer Preventive Device Use Among Elderly Patients Early in the Hospital Stay

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Abstract

Background—Clinical guidelines for the prevention of pressure ulcers advise that pressure-reducing devices should be used for all patients at risk of or with pressure ulcers and that all pressure ulcers should be documented in the patient record. Adherence to these guidelines among elderly hospital patients early in the hospital stay has not been examined in prior studies.

Objective—The objective of this study was to examine adherence to guidelines by determining the frequency and correlates of use of preventive devices early in the hospital stay of elderly patients and by determining the frequency and correlates of recording pressure ulcers in the patient record.

Methods—This was a cross-sectional study of 792 patients aged 65 years or older admitted through the emergency department to the inpatient medical service at two teaching hospitals in Philadelphia, Pennsylvania, between 1998 and 2001. Patients were examined by a research nurse on Hospital Day 3 (median of 48 hours after admission) to determine the use of preventive devices, presence of pressure ulcers, and risk of pressure ulcers (by Norton scale). Data on additional risk factors were obtained from the admission nursing assessment in the patient record. Data on documentation of pressure ulcers were obtained by chart abstraction.

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This study was presented as a poster at the 59th Annual Scientific Meeting of the Gerontological Society of America, Dallas, Texas, November 19, 2006. Data from this study have been the subject of other analyses, the results of which have been previously published. The publications are as follows: (a) Baumgarten, M., Margolis, D. J., Localio, A. R., Kagan, S. H., Lowe, R. A., Kinoshian, B., et al. (2008). Extrinsic risk factors for pressure ulcers early in the hospital stay: A nested case-control study. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, 63(4), 408–413. (b) Compher, C., Kinoshian, B. P., Ratcliffe, S. J., & Baumgarten, M. (2007). Obesity reduces the risk of pressure ulcers in elderly hospitalized patients. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, 62(11), 1310–1312. (c) Baumgarten, M., Margolis, D. J., Localio, A. R., Kagan, S. H., Lowe, R. A., Kinoshian, B., et al. (2006). Pressure ulcers among elderly patients early in the hospital stay. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*, 61(7), 749–754. (e) Localio, A. R., Margolis, D. J., Kagan, S. H., Lowe, R. A., Kinoshian, B., Abbuhl, S., et al. (2006). Use of photographs for the identification of pressure ulcers in elderly hospitalized patients: Validity and reliability. *Wound Repair and Regeneration*, 14(4), 506–513. None of these previously published articles have examined the hypotheses that are addressed in this article.

Results—Only 15% of patients had any preventive devices in use at the time of the examination. Among patients considered at risk of pressure ulcers (Norton score ≤ 14), only 51% had a preventive device. In multivariable analyses, high risk of pressure ulcers was associated with use of preventive devices (odds ratio = 41.8, 95% confidence interval = 14.0–124.6), whereas the type and stage of pressure ulcer were not. Documentation of a pressure ulcer was present for only 68% of patients who had a pressure ulcer according to the research examination.

Discussion—Use of preventive devices and documentation of pressure ulcers are suboptimal even among patients at high risk.

Keywords

documentation; pressure ulcer; prevention and control

Pressure ulcers are areas of breakdown of the skin and subcutaneous tissues caused by pressure, friction, or shearing (Benbow, 2006). Among hospital patients, pressure ulcers are an important clinical problem in terms of frequency (Whittington & Briones, 2004) and cost (Zhan & Miller, 2003) as well as patient suffering (Langemo, 2005). Recently, attention has been focused on the problem of pressure ulcers in hospitals as a preventable adverse outcome, with new rules limiting Medicare reimbursement for costs due to hospital-acquired pressure ulcers (Rosenthal, 2007). Elderly hospital patients are at particularly high risk (Allman, Goode, Patrick, Burst, & Bartolucci, 1995; Perneger, Heliot, Rae, Borst, & Gaspoz, 1998).

There is evidence supporting the effectiveness of some pressure ulcer preventive measures (Cullum, McInnes, Bell-Syer, & Legood, 2004; Reddy, Gill, & Rochon, 2006), and national clinical guidelines for prevention of pressure ulcers advise that all patients at risk of or with pressure ulcers should receive preventive measures such as risk assessment (Bergstrom et al., 1992; Frantz, 2004; National Collaborating Centre for Nursing and Supportive Care, 2003; Registered Nurses Association of Ontario [RNAO], 2005; Royal College of Nursing [RCN], 2001; Wound, Ostomy, and Continence Nurses Society [WOCN], 2003) using an instrument such as the Braden (Bergstrom, Braden, Laguzza, & Holman, 1987) or Norton (Norton, McLaren, & Exton-Smith, 1975) scales, pressure-reducing devices such as overlays or mattresses (Bergstrom et al., 1992; Frantz, 2004; National Collaborating Centre for Nursing and Supportive Care, 2003; RNAO, 2005; RCN, 2001; WOCN, 2003), avoidance of exposure of skin to moisture from urinary or fecal incontinence (Bergstrom et al., 1992; RNAO, 2005; RCN, 2001; WOCN, 2003), reduction of shear forces by limiting the head of the bed to an angle below 30° (Frantz, 2004; RNAO, 2005; WOCN, 2003), and regular repositioning of immobile patients (Bergstrom et al., 1992; Frantz, 2004; National Collaborating Centre for Nursing and Supportive Care, 2003; RNAO, 2005; RCN, 2001; WOCN, 2003). Also suggested is careful documentation of pressure ulcers and of preventive interventions (Bergstrom et al., 1992; Frantz, 2004; National Collaborating Centre for Nursing and Supportive Care, 2003; RNAO, 2007; WOCN, 2003). Most of these recommendations are based on limited evidence (primarily expert opinion), except for the use of pressure-reducing devices (Bergstrom et al., 1992; RNAO, 2005; WOCN, 2003) for which the evidence includes systematic reviews of randomized controlled trials (Cullum et al., 2004; Reddy et al., 2006; Vanderwee, Grypdonck, & Defloor, 2008). Results of these trials suggest that specialized foam mattresses can reduce pressure ulcer incidence compared with standard hospital mattresses and that alternating pressure mattresses are also likely to reduce pressure ulcer incidence (although this evidence is less clear because of methodological issues).

It has been shown that preventive measures are under-used in at-risk populations of hospital patients (Gunningberg, 2005; Gunningberg, Lindholm, Carlsson, & Sjoden, 2001; Perneger et al., 1998; Pieper, Sugrue, Weiland, Sprague, & Heiman, 1997; Pieper, Sugrue, Weiland, Sprague, & Heiman, 1998). In two studies, fewer than 25% of patients had any preventive

device in use (Gunningberg, 2005; Perneger et al., 1998). Use of preventive measures, and devices in particular, generally has been found to be more frequent for patients at high risk, as measured by the Norton (Allman et al., 1995) or Braden (Gunningberg, 2005; Pieper et al., 1997) scale, and for patients with a pressure ulcer (Perneger et al., 1998). Patients with pressure ulcers may benefit from these devices in terms of improved healing of existing pressure ulcers and prevention of additional pressure ulcers (WOCN, 2003).

Evidence from studies in animals (Kosiak, 1961) and humans (Defloor, De Bacquer, & Grypdonck, 2005; Norton et al., 1975) suggests that pressure ulcers can arise after short periods of immobility. This evidence suggests that preventive measures should be implemented early in the hospital stay. In prior studies of use of preventive measures, cross-sections of the hospital population have been used (Gunningberg, 2005; Gunningberg et al., 2001; Perneger et al., 1998) or patients have been followed prospectively across their stay (Pieper et al., 1997, 1998), but none have examined the use of preventive measures early in the hospital stay. It is important to determine whether guidelines for prevention of pressure ulcers are being implemented early in the hospital stay to maximize effectiveness of preventive measures.

The aims of this study were to determine the frequency and correlates of use of pressure ulcer preventive devices early in the hospital stay of elderly patients and to determine the frequency and correlates of recording of pressure ulcers in the patient record. The hypotheses were that, if guidelines are being applied appropriately, device use would be more frequent among patients with pressure ulcers or who are at higher risk of pressure ulcers and that all pressure ulcers observed in the research assessment would be documented in the patient record.

Methods

Participants

Data for this study were from a nested case-control study of patients aged 65 years or older admitted through the emergency department to the inpatient medical service at two large teaching hospitals in Philadelphia, Pennsylvania, between 1998 and 2001. The methods for this study have been described previously (Baumgarten et al., 2006, 2008). Briefly, daily lists were obtained of all potentially eligible patients admitted to the study hospitals. Potential participants were approached on Hospital Day 3 (where Day 1 was defined as the day of inpatient admission) to obtain verbal consent. A proxy was contacted to obtain consent if the patient was too sick or confused.

Skin examinations were performed on Hospital Day 3 to determine pressure ulcer status. Each pressure ulcer was classified as preexisting (present at hospital admission) or hospital-acquired (acquired between admission and the skin examination), based on interviews with the patient, family, or hospital caregiver or the patient record or transfer form. Pressure ulcers that were considered possibly or definitely hospital-acquired were classified as hospital-acquired.

In the parent study, cases were defined as individuals with one or more hospital-acquired pressure ulcers of any stage (Figure 1). In the parent study, three controls for each case were sampled randomly from among all noncases admitted to the same hospital in the same calendar month. The sample for the current study consists of these case and control patients because, in the parent study, the data of interest were collected only for these patients. The study protocol was approved by the institutional review board of the University of Pennsylvania. This research is in accordance with all ethical standards of the American Psychological Association.

Data Collection

Pressure ulcer status was determined by a thorough visual skin assessment conducted by specially trained research nurses in a standardized fashion (Baumgarten et al., 2006). Training

of the research nurses was conducted by one of the coauthors, a dermatologist with a large practice specializing in the diagnosis and treatment of wounds, and by a wound care specialist at one of the study hospitals. Topics for training included differentiating pressure ulcers from other types of wounds, staging, how to position the patient for the examination, and lighting.

On the basis of the skin assessment, the research nurses recorded the characteristics (including stage) of all pressure ulcers observed. Given the difficulties in diagnosing Stage 1 pressure ulcers, patients were distinguished according to whether they had at least one pressure ulcer Stage 2 or higher or only Stage 1 pressure ulcers. Patients were also categorized based on the presence and type of pressure ulcers. Thus, categories for pressure ulcers were both preexisting and hospital-acquired pressure ulcers of any stage, preexisting pressure ulcers Stage 2 or higher, preexisting Stage 1 pressure ulcers, hospital-acquired pressure ulcers Stage 2 or higher, hospital-acquired Stage 1 pressure ulcers, and none.

The use of preventive devices was determined by the research nurse at the time of the skin examination. Use of preventive devices was recorded in broad categories (mattress or bed other than standard mattress, mattress overlay, positioning pillows, heel protectors, chair cushion, or other device). Research nurses also quantified patient risk of pressure ulcers at the time of the examination using the Norton scale, a brief tool based on scoring of the patient's overall physical condition, mental condition, activity level, mobility level, and incontinence type and frequency (Norton et al., 1975). This scale is used widely for clinical evaluation of pressure ulcer risk (Papanikolaou, Lyne, & Anthony, 2007), and it has been recommended to guide the use of preventive interventions and programs for reducing pressure ulcer incidence (Bolton, 2007). This scale was chosen because of its utility when the patient is observed for only a short period, as in this study. Norton scores were classified into four categories (5–10, 11–14, 15–18, and 19–20), based on the conventional cut point (Norton et al., 1975) for clinical risk (≤ 14 vs. >14) and on the distribution of scores.

Systematic reviews have identified a strong relationship between malnutrition (including factors such as decreased weight, impaired dietary intake, dehydration, and low serum albumin level) and pressure ulcer development (Ferguson, Cook, Rimmasch, Bender, & Voss, 2000; Langer, Schloemer, Knerr, Kuss, & Behrens, 2003). Given this relationship, nutritional status was included as a risk factor of interest. Research nurses classified nutritional status using the Subjective Global Assessment of Nutritional Status (Detsky, Smalley, & Chang, 1994). This scale is used to identify patients at risk of nutrition-related complications, using information from the patient's history and physical examination (Reilly, 1996). This scale has been shown to be as valid or more valid than objective methods in evaluating nutritional status (Detsky, Baker, et al., 1987; Detsky, McLaughlin, et al., 1987).

Information on additional pressure ulcer risk factors including comorbidity, incontinence, mental status, and functional status was obtained from the admission nursing assessment in the patient record. Although the Norton scale also includes information about incontinence, mental status, and functional status, the information used to compute the Norton score in this study was based on patient status at the time of skin examination, whereas the information for the individual risk factors was based on the patient's status at admission. Comorbidity was quantified using the Charlson comorbidity index (Charlson, Szatrowski, Peterson, & Gold, 1994). Incontinence status was categorized as none, fecal incontinence with or without urinary incontinence, and urinary incontinence only. Mental status was dichotomized in terms of whether the patient was oriented to person, place, and time. If specific information about orientation was missing, the patient record was reviewed to determine whether confusion or delirium was noted. Functional status was defined in terms of the number of activities of daily living (ADL) with which the patient needed assistance (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963). A brief patient or proxy interview was used to obtain demographic information.

Chart documentation of pressure ulcers was operationalized in two ways—the presence of a pressure ulcer noted anywhere in the patient record or the presence of International Classification of Diseases-9 code 707.0 in the discharge summary.

Analysis

Analyses were performed using SAS Version 9.1 (SAS Institute Inc., Cary, NC). Frequency of preventive device use at the time of examination was determined for subgroups defined by the pressure ulcer risk factors (Norton score, risk of nutrition-related complications, incontinence status, mental status, functional status, and comorbidity). Frequency of device use was also determined for subgroups defined by the presence, type, and highest stage of pressure ulcers at the skin examination because the presence of pressure ulcers is a risk factor for the development of additional pressure ulcers (Allman et al., 1995). Frequency of device use by age, gender, and race was also examined. Because the parent study had a nested case-control design, all frequencies were weighted by the inverse probability of being selected into the study so that results can be generalized to the population from which patients were selected. That is, observations for patients with hospital-acquired pressure ulcers were weighted by 1 (all patients in the cohort with hospital-acquired pressure ulcers were eligible for inclusion as cases), whereas observations for patients with no hospital-acquired pressure ulcers were weighted by 3,032/597 (inverse of the sampling fraction for control patients from the cohort in the case-control study). The frequency estimates also accounted for matching as controls in the parent study were frequency matched to the cases by hospital and 6-month admission period. Thus, although data were from a nested case-control study, reported frequencies are weighted to generalize to the study cohort. The p values were determined by chi-square test, and statistical significance was defined as $p < .05$.

Logistic regression was performed using PROC SURVEYLOGISTIC to determine the strength of association between risk factors and preventive device use. These models were weighted and accounted for stratification by hospital and 6-month admission period, reflecting the study design. Thus, reported measures of association are generalizable to the study cohort. Bivariate models were fit for all risk factors followed by additional models to estimate adjusted odds ratios (ORs) for each risk factor. In the first model, the ORs for Norton score categories were adjusted for demographic characteristics (age, gender, and race), type and stage of pressure ulcers, risk of nutrition-related complications, and comorbidity. Other pressure ulcer risk factors were not included in this model because of the overlap between these risk factors and the Norton subscales (e.g., mental status variable and the Norton subscale for mental condition). In the second model, ORs for risk factors that overlap with Norton subscale definitions (incontinence status, mental status, and functional status) were adjusted for demographic characteristics and all risk factors other than the Norton score. Because information for these variables was taken from the admission nursing assessment, this model provides information beyond the Norton score, which was determined at the skin examination. A third model included demographic characteristics and all risk factors to estimate adjusted ORs for type and stage of pressure ulcers, risk of nutrition-related complications, comorbidity, and demographic variables.

Given the importance of Norton score and pressure ulcer presence and type in prior studies of preventive device use (Gunningberg, 2005; Gunningberg et al., 2001; Perneger et al., 1998; Pieper et al., 1997, 1998), an interaction between these variables was explored. Because the number of patients in some combinations of Norton score category and pressure ulcer status was small, Norton score was dichotomized for this analysis using the conventional cut point (≤ 14 vs. > 14), and pressure ulcer status was categorized by the presence and type only (without regard to stage). Pressure ulcer stage was not included in the model because presence of a pressure ulcer cannot vary while the stage is held constant (i.e., no pressure ulcers implies Stage

0). A weighted logistic regression model was fit that included this interaction term along with main effects for pressure ulcer presence and type and for Norton score. This model accounted for the stratified study design and adjusted for demographic characteristics, risk of nutrition-related complications, and comorbidity.

Completeness of chart documentation was assessed only for patients with pressure ulcers at the skin examination. Frequency of chart documentation was determined for subgroups defined by type and stage of pressure ulcers and for subgroups defined by number of pressure ulcers. Frequencies were weighted and accounted for the stratified study design.

Results

The mean age of patients in the study population was 77.3 years ($SD = 7.8$ years; Table 1). Patients in the study population were primarily women (60.2%) and Black (71.4%), and most had lived at home with others before admission (58.3%). Approximately equal numbers of patients were recruited from each hospital. The median length of stay for this sample was 5 days (interquartile range = 3–8 days), whereas the median time between hospital admission and the study examination was 48 hours (interquartile range = 44.2–60.5 hours). Few patients in the study population had surgical procedures (2.5%) or stayed in an intensive care unit or postanesthesia care unit (13.9%) before the study examination.

The study sample included 29 patients with both preexisting and hospital-acquired pressure ulcers, 36 patients with one or more preexisting pressure ulcers but no hospital-acquired pressure ulcers (14 of whom had at least one Stage 2+ ulcer), 166 patients with one or more hospital-acquired pressure ulcers but no preexisting pressure ulcers (71 of whom had at least one Stage 2+ ulcer), and 561 patients with no pressure ulcers. Thus, most patients in the study population had no pressure ulcers (88.3%). Among those with pressure ulcers, it was most common to have just one pressure ulcer (7.4% of the study population), although 1.9% had two pressure ulcers and 2.4% had at least three pressure ulcers at examination.

Approximately 17% of patients in the study cohort were classified as being at risk of pressure ulcers (Norton score ≤ 14). There were also substantial proportions of patients with the individual pressure ulcer risk factors examined. For example, 24.5% of patients in the study cohort had an intermediate or high risk of nutrition-related complications. Almost 21% of patients in the study cohort were not oriented fully to person, place, and time, whereas 18.9% of patients in the study cohort had urinary incontinence, fecal incontinence, or both (not tabulated).

Fifteen percent of patients had one or more preventive devices for pressure ulcers in use (Table 2). Frequencies for individual devices were 0.4% for replacement mattress, 3.6% for mattress overlay, 2.9% for heel protectors, 1.1% for chair cushion, 11.4% for positioning pillows, and 0.6% for another preventive device.

All examined risk factors were associated significantly with device use (Table 2). In particular, the presence of pressure ulcers was associated with the use of pressure ulcer preventive devices ($p < .001$). Patients with both hospital-acquired and preexisting pressure ulcers were most likely to have a preventive device (75.9%). Frequency of device use was lower for those with hospital-acquired pressure ulcers than for those with preexisting pressure ulcers (43.2% vs. 50.0% for those with Stage 2+ pressure ulcers, respectively, and 32.4% vs. 64.3% for those with Stage 1 pressure ulcers only). Patients with Stage 1 hospital-acquired pressure ulcers were less likely to have preventive devices in use than were those with Stage 2+ hospital-acquired pressure ulcers. The opposite association with stage was observed for preexisting pressure ulcers.

There was a gradient of decreasing frequency of preventive device use with decreasing pressure ulcer risk (indicated by lower Norton scores) and with decreasing risk of nutrition-related complications. Fifty-one percent of patients classified as at risk by the Norton score (≤ 14) had a preventive device in use ($p < .001$). Even in the highest pressure ulcer risk group (defined as Norton score 5–10), only 62.4% of patients had a preventive device in use. Similarly, among patients at high risk of nutrition-related complications, only 36.3% had a preventive device. Greater comorbidity, presence of incontinence, disorientation, and more ADL dependencies were associated with preventive device use ($p < .001$ for each). Less than half of the patient population were using preventive devices in the high-risk category of each of these risk factors. Higher age was associated also with use of preventive devices ($p = .011$), but gender ($p = .13$) and Black race were not ($p = .37$).

In the unadjusted model, there was a strong association between pressure ulcer type and stage and preventive device use, but this association was no longer significant once the model was adjusted for Norton score and the other covariates. For example, the OR for device use comparing those with both types of pressure ulcers with those with no pressure ulcers was 26.7 (95% confidence interval [CI] = 10.9–65.4) before adjustment but only 1.2 (95% CI = 0.5–2.9) after adjustment. In contrast, the association between Norton score category and preventive device use was strong regardless of adjustment for covariates including pressure ulcer type and stage. Those with Norton scores of 5–10 had a much higher odds of preventive device use (adjusted OR = 41.8, 95% CI = 14.0–124.6) compared with the odds of those with scores of 19–20. The adjusted OR for the other at-risk category (Norton scores 11–14) was also large (OR = 21.1, 95% CI = 8.4–52.9). Comorbidity (OR = 1.1, 95% CI = 1.0–1.3), urinary incontinence (OR = 2.5, 95% CI = 1.3–5.1), and having six ADL dependencies (OR = 2.2, 95% CI = 1.1–4.4) were the only other variables that remained significantly associated with device use in the multivariable models.

The association between Norton at-risk status and use of preventive devices was strongest among those with no pressure ulcers (OR = 9.3, 95% CI = 4.8–18.2; Figure 2) or with hospital-acquired pressure ulcers only (OR = 9.4, 95% CI = 1.4–64.2). The association was also strong among those with preexisting pressure ulcers only (OR = 6.0, 95% CI = 2.5–14.2). Among those with both hospital-acquired and preexisting pressure ulcers, there was no significant association between Norton at-risk status and preventive device use. The interaction between Norton at-risk status (≤ 14 vs. > 14) and pressure ulcer type was not significant ($\chi^2[3, n = 739] = 3.36, p = .34$, not tabulated).

The frequency of documentation of pressure ulcers in the patient record was low (Table 3). Only 67.5% of patients who had pressure ulcers at the skin examination had any pressure ulcer indicated in the patient record. Pressure ulcers were more likely to be noted in the patient record or discharge documentation if the pressure ulcer at examination was Stage 2 or higher, if the pressure ulcers were preexisting (rather than hospital-acquired), or if the patient had both types of pressure ulcers. Documentation was also more frequent as the number of pressure ulcers present at the examination increased.

Discussion

In this study, the use of pressure ulcer preventive devices early in the hospital stay and its association with pressure ulcer risk factors were examined. Although the use of preventive measures for at-risk patients has been examined previously in a few studies (Gunningberg, 2005; Gunningberg et al., 2001; Perneger et al., 1998; Pieper et al., 1997, 1998), no prior studies were found to have examined use early in the hospital stay. Because pressure ulcers may develop after only a few hours of immobility-induced pressure (Defloor et al., 2005; Kosiak, 1961; Norton et al., 1975), devices may need to be in place soon after admission to be effective

in the prevention of pressure ulcers. Even if these devices are used later in a patient's hospitalization, the fact that they are not used early means that prevention may be initiated too late for full effectiveness. For this study, the use of preventive devices was examined on Hospital Day 3; half of the participants were examined within 48 hours of hospital admission.

All of the pressure ulcer risk factors of interest were associated with the use of preventive devices, both risk factors evaluated by research nurses directly and those based on the admission nursing assessment in the patient record. Use of preventive devices was more frequent for patients with a pressure ulcer, particularly for those with a preexisting pressure ulcer and those with both preexisting and hospital-acquired pressure ulcers. The association between device use and the presence and type of pressure ulcers was fairly consistent even among patients with only Stage 1 pressure ulcers, despite the difficulties in diagnosing these pressure ulcers. The ORs for device use comparing the high risk to the lowest risk Norton score categories were very large. With only 2.8% of patients in the lowest risk category using preventive devices, the ORs for device use were expected to be very large. The more frequent use of preventive devices among those with pressure ulcers and among at-risk patients is encouraging because it may indicate that nursing staff correctly allocate these devices to individuals most likely to benefit, as recommended by clinical guidelines (Bergstrom et al., 1992). Use of preventive devices is indicated for patients with pressure ulcers to prevent development of additional pressure ulcers and advancement of existing pressure ulcers (WOCN, 2003). A higher Norton score was associated with device use, even after adjustment for pressure ulcer presence and type, indicating that at-risk patients were more likely to be allocated a device even if they did not have a pressure ulcer. This study could not distinguish between patients who were not allocated devices and those who were allocated devices but were not using them. Thus, the association between preventive device use and pressure ulcer risk factors may also represent a higher level of adherence among at-risk patients. In either case, it is encouraging that the patients who are most likely to benefit are those most likely to have these devices in use.

However, the prevalence of use of preventive devices was suboptimal even in the highest risk groups. Although nearly all of these patients would be expected to have a device in use, only approximately three quarters of those with both preexisting and hospital-acquired pressure ulcers had a preventive device in use at the time of the skin examination. Similarly, although almost all patients considered at risk using the conventional cutoff of the Norton score (≤ 14) would be expected to have a device in use, only approximately one half of those at risk by this definition had a preventive device. Even lower frequencies of device use were found for patients with the other risk factors. These results are similar to those of previous studies (Gunningberg, 2005; Gunningberg et al., 2001; Perneger et al., 1998; Pieper et al., 1997, 1998). This relatively low level of use by high-risk patients is of concern because it indicates a likely failure to follow guidelines (Bergstrom et al., 1992) and implement strategies that have potential to prevent pressure ulcers. As allocation appears to properly target patients at greatest risk, it is possible that the suboptimal levels of device use overall were due to insufficient resources or an overall lack of patient adherence rather than an issue of quality of nursing care. It is important that hospital administrators understand the substantial personal and institutional costs of pressure ulcers and allocate resources to devices for their prevention.

Frequency of documentation of pressure ulcers was also low, as was found previously (Gunningberg & Ehrenberg, 2004; Knox, 1998). In this study, the documentation was not required to correspond to the pressure ulcer noted on examination, and the quality of documentation (e.g., recording of stage, site, and clinical characteristics) was not examined, so significant gaps in recording may have existed even among patients with documentation of a pressure ulcer. Documentation is important to ensure proper communication within the healthcare team, as well as ensuring the accuracy of audits (Gunningberg & Ehrenberg,

2004; Knox, 1998). The low level of documentation found in this study suggests that many healthcare teams may not be maintaining proper communication to ensure effective management of this important health concern. Documentation may have been infrequent because of a lack of knowledge of skin assessment by the nurses, a misunderstanding of the importance of pressure ulcers in patient care, or too little time spent on documentation. Hospitals should ensure that nurses are properly trained in chronic wound prevention and care, including an understanding of the importance of pressure ulcers in patient care. They should also consider implementing standardized wound assessment protocols to ensure that skin integrity is assessed regularly and all wounds are documented and treated properly.

Caution is required when considering the results of this study because the data were gathered between 1998 and 2001. The frequency of device use and of pressure ulcer documentation may have changed in the intervening years, although the prevalence of pressure ulcers has remained fairly stable (Whittington & Briones, 2004). Also, interpretation of these results may be limited because most data were collected at a single brief examination. Therefore, there is the possibility of underdetection of device use and difficulty in assessing the risk of pressure ulcers and nutritional status. There is also the possibility of overdiagnosis of pressure ulcers by the research nurses, which could result in spuriously low levels of pressure ulcer documentation. Although this study was intended to estimate the frequency of device use early in the hospital stay, data collection was limited to an examination on Hospital Day 3, and information about earlier device use cannot be provided. Data sparseness precluded determination of characteristics associated with the use of specific types of preventive devices as the frequency of use of each type was less than 12%. Pressure ulcer status, Norton score, and preventive device use were assessed at the same examination, so temporality of proposed risk factors relative to device use could not be determined. However, pressure ulcer status and Norton subscales are relatively stable over several days, whereas the use of a preventive device may change at any time, so the temporal order is plausible. As the study population is not representative of the general population, caution should be used in generalizing this study's results.

Given the low level of use of pressure ulcer preventive devices, efforts need to be expanded so that more patients benefit from these devices. It is important to implement guidelines for pressure ulcer prevention properly and fully because pressure ulcers are a significant source of morbidity for elderly hospital patients. Further research into the reasons for nonuse may be helpful for the development of interventions to increase use of preventive devices. Pressure ulcer documentation was also infrequent, so an effort should be made to ensure that the hospital nursing staff is trained properly in this aspect of care. The development of more standardized protocols for documentation of pressure ulcers should also be pursued.

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FIGURE 1.
Selection of patients for the current study. PrU = pressure ulcer.

FIGURE 2.

Odds ratio (95% confidence interval) for use of preventive devices comparing those with Norton score ≤ 14 with those with Norton score > 14 , stratified by the presence and type of pressure ulcers. Details of statistical model are provided in the Methods section.

TABLE 1

Characteristics of Study Population ($N = 792$)

Characteristics	n^a	% ^b
Age (years)		
M, SD	792	77.34, 7.82
65–74	311	42.1
75–84	312	40.1
≥ 85	169	17.8
Female	475	60.2
Race		
Black	572	71.4
Non-Black	218	28.6
Place lived before admission		
At home alone	237	32.4
At home with others	448	58.3
Nursing home	94	7.9
Other	10	1.5
Hospital A ^c	369	48.6
Year of admission ^c		
1998–1999	338	42.7
2000	235	29.8
2001	219	27.5
Primary discharge diagnosis ^d		
Circulatory diseases	210	28.6
Respiratory diseases	124	13.8
Digestive diseases	73	9.8
Genitourinary diseases	55	6.5
Endocrine, nutritional, or metabolic diseases	56	6.2
Other ^e	217	27.6
Missing	57	7.5
Length of stay (days), median, interquartile range	792	5, 3–8
Surgical procedures before study examination	18	2.5
Intensive care unit or postanesthesia care unit stay before study examination	115	13.9
Type and stage of pressure ulcers		
Both preexisting and hospital-acquired, any stage	29	0.9
Preexisting only, at least one Stage 2+	22	3.5
Preexisting only, Stage 1 only	14	2.2
Hospital-acquired only, at least one Stage 2+	95	3.0
Hospital-acquired only, Stage 1 only	71	2.2
None	561	88.3
Number of pressure ulcers ^f		
1	146	7.4

Characteristics	<i>n</i> ^a	% ^b
2	40	1.9
3	45	2.4
Norton score ^g		
5–10	94	6.6
11–14	93	10.1
15–18	246	34.5
19–20	309	48.8
Number of ADL dependencies		
6	127	9.8
1–5	71	8.5
0	594	81.7
Risk of nutrition-related complications		
High	61	4.9
Intermediate	177	19.6
Low	552	75.5
Charlson comorbidity index		
>4	147	18.2
3–4	238	29.1
2	167	21.2
0–1	240	31.5

Note. ADL = activities of daily living.

^aUnweighted sample size for each characteristic.

^bPercentages were weighted by the inverse probability of being selected into the study and account for stratified sampling by hospital and 6-month admission period (matching variables for the parent study). Percentages for some variables may not total to 100 because of rounding.

^cOn the basis of the design of the parent study, patients with any hospital-acquired pressure ulcers and patients with no hospital-acquired pressure ulcers were matched on hospital and 6-month time period.

^dBased on the chart abstraction of the patient's first listed discharge diagnosis; International Classification of Diseases-9 codes were classified into 16 disease categories.

^eDiagnoses of infectious diseases, neoplasms, diseases of the blood, mental disorders, central or nervous system diseases, skin and subcutaneous tissue diseases, musculoskeletal diseases, injuries and poisonings, and other diseases, as well as those with ill-defined symptoms and signs were included.

^fNumber of pressure ulcers (range = 1–3) includes both hospital-acquired and preexisting pressure ulcers of any stage found at the skin examination.

^gNorton score ranges from 5 to 20; lower scores indicate higher risk. A Norton score ≤ 14 is considered to indicate high risk of pressure ulcers (Norton et al., 1975).

TABLE 2

Frequency of Device Use by the Presence of Risk Factors

Risk factor	Any devices used		χ^2p	Unadjusted model		Adjusted model	
	%			OR	95% CI	OR	95% CI
Overall	15.1	NA		NA	NA	NA	NA
Type and stage of pressure ulcers							
Both preexisting and hospital-acquired, any stage	75.9	<.001		26.7	10.9–65.4	1.2 ^a	0.5–2.9
Preexisting only, at least one Stage 2+	50.0			8.5	3.5–20.6	1.8	0.9–3.5
Preexisting only, Stage 1 only	64.3			15.3	5.0–47.4	4.0	1.0–17.0
Hospital-acquired only, at least one Stage 2+	43.2			6.5	4.0–10.6	2.0	0.7–5.2
Hospital-acquired only, Stage 1 only	32.4			4.1	2.3–7.2	3.0	0.8–11.9
None	10.5			1.0	Reference	1.0	Reference
Norton score ^b			<.001				
5–10	62.4			58.4	24.2–141.1	41.8 ^c	14.0–124.6
11–14	43.7			27.3	11.8–63.3	21.1	8.4–52.9
15–18	12.9			5.2	2.3–11.5	5.2	2.3–11.7
19–20	2.8			1.0	Reference	1.0	Reference
Risk of nutrition-related complications			<.001				
High	36.3			4.0	2.0–8.0	1.5 ^a	0.6–3.9
Intermediate	19.6			1.7	1.0–2.8	0.9	0.5–1.7
Low	12.5			1.0	Reference	1.0	Reference
Charlson comorbidity index			.002	1.2	1.1–1.3	1.1 ^a	1.0–1.3
>4	22.6						
3–4	18.9						
2	11.2						
0–1	9.9						
Incontinence			<.001				
Fecal with or without urinary	37.5			5.3	3.0–9.4	1.0 ^d	0.5–2.4
Urinary only	35.6			4.9	2.9–8.4	2.5	1.3–5.1
None	10.1			1.0	Reference	1.0	Reference

Risk factor	Any devices used		Unadjusted model		Adjusted model	
	%	χ^2p	OR	95% CI	OR	95% CI
Oriented to person, place, and time		<.001				
No	34.3		4.7	3.0–7.2	1.8 ^d	0.9–3.5
Yes	10.1		1.0	Reference	1.0	Reference
Number of ADL dependencies		<.001				
6	47.9		7.9	4.7–13.3	2.2 ^d	1.1–4.4
1–5	22.5		2.5	1.3–4.8	1.2	0.5–2.6
0	10.4		1.0	Reference	1.0	Reference
Age (years)		.011				
≥85	20.9		2.2	1.3–3.9	0.9 ^a	0.4–1.9
75–84	17.2		1.7	1.1–2.8	1.0	0.5–1.8
65–74	10.7		1.0	Reference	1.0	Reference
Gender		.134				
Female	16.7		1.4	0.9–2.1	1.1 ^a	0.6–2.0
Male	12.7		1.0	Reference	1.0	Reference
Race		.37				
Black	15.9		1.2	0.8–2.0	0.7	0.4–1.3
Non-Black	13.2		1.0	Reference	1.0	Reference

Note. All results were weighted by the inverse probability of being selected into the study and account for stratified sampling by hospital and 6-month admission period (matching variables for the parent study). OR = odds ratio; CI = confidence interval; NA = not applicable; ADL = activities of daily living.

^aResults are adjusted for age, gender, and race, as well as all risk factors listed.

^bNorton score ranges from 5 to 20, with lower scores indicating higher risk. Norton score ≤14 is considered to indicate high risk of pressure ulcers (Norton et al., 1975).

^cResults are adjusted for age, gender, and race, as well as type and stage of pressure ulcers, risk of nutrition-related complications, and Charlson comorbidity score.

^dResults are adjusted for age, gender, and race, as well as all risk factors listed other than the Norton score.

TABLE 3

Frequency of Documentation of Pressure Ulcers

Pressure ulcer according to research assessment	Pressure ulcer noted in patient record (%)	$\chi^2 p$	ICD-9 code 707.0 in discharge documentation (%)	$\chi^2 p$
Overall	67.5		16.3	
Type and stage of pressure ulcers		NA ^a		.005
Hospital-acquired only, Stage 1 only	52.1		7.0	
Hospital-acquired only, at least one Stage 2+	55.8		5.3	
Preexisting only, Stage 1 only	64.3		14.3	
Preexisting only, at least one Stage 2	81.8		27.3	
+ Both preexisting and hospital-acquired, any stage	96.6		37.9	
Number of pressure ulcers ^b		.008		.004
1	58.5		9.7	
2	76.7		13.4	
3	88.3		39.1	

Note. All results are weighted by the inverse probability of being selected into the study and account for stratified sampling by hospital and 6-month admission period (matching variables for the parent study). Only patients with pressure ulcers according to the research assessment were included in this analysis. ICD = International Classification of Diseases; NA = not applicable.

^a $\chi^2 p$ value could not be calculated because there was a cell with 0 patients (i.e., all patients with both preexisting and hospital-acquired pressure ulcers had at least one pressure ulcer documented in the patient record).

^b Number of pressure ulcers (range = 1–3) includes both preexisting and hospital-acquired pressure ulcers of any stage found at the skin examination.