Pressure Ulcers Among Elderly Patients
Early in the Hospital Stay

Mona Baumgarten,1 David J. Margolis,2 A. Russell Localio,2 Sarah H. Kagan,3 Robert A. Lowe,4
Bruce Kinosian,2 John H. Holmes,2 Stephanie B. Abbuhl,2 William Kavesh,5 and Althea Ruffin2

1University of Maryland School of Medicine, Baltimore.
2University of Pennsylvania Schools of Medicine and Nursing, Philadelphia.
3Oregon Health & Science University, Portland.
4Oregon Health & Science University, Portland.
5Philadelphia VA Medical Center, Pennsylvania.

Background. Pressure ulcers among elderly hospital patients diminish quality of life and increase the cost of hospital care. Evidence suggests that pressure ulcers can arise after only a few hours of immobility. The goals of this study were to estimate the incidence of hospital-acquired pressure ulcers in the first 2 days of the hospital stay and to identify patient characteristics associated with higher incidence.

Methods. A prospective cohort study was performed between 1998 and 2001. A total of 3233 patients 65 years old or older admitted through the Emergency Department to the inpatient Medical Service at two study hospitals were examined by a research nurse on the third day of hospitalization. Pressure ulcers were ascertained using standard criteria and were classified as either preexisting, possibly hospital-acquired, or definitely hospital-acquired.

Results. There were 201 patients with one or more possibly or definitely hospital-acquired pressure ulcers for a cumulative incidence of 6.2% (95% confidence interval, 5.4%–7.1%). Most of the pressure ulcers were stage 2, and the majority were in the sacral area or on the heels. In multivariable analysis, pressure ulcer incidence was significantly associated with increasing age, male gender, dry skin, urinary and fecal incontinence, difficulty turning in bed, nursing home residence prior to admission, recent hospitalization, and poor nutritional status.

Conclusions. A small but significant proportion of elderly emergently admitted hospital patients acquire pressure ulcers soon after their admission. New models of care may be required to ensure that preventive interventions are provided very early in the elderly person’s hospital stay.

Despite a growing awareness of the dramatic impact of pressure ulcers on quality of life and the cost of hospital care (1,2), the frequency of pressure ulcers among elderly hospital patients has not decreased in recent years (3). There is evidence that the sequence of events resulting in pressure ulcers may be initiated after only a few hours of immobility-induced pressure (4–8). Many studies have examined the incidence of pressure ulcers in acute care settings, but none has provided information on pressure ulcers that develop early in the hospital stay. This issue is important to hospital care providers because it has implications for the timing of preventive interventions. The goals of this study were to estimate the incidence of hospital-acquired pressure ulcers in the first 2 days of the hospital stay and to identify patient characteristics that are associated with higher incidence.

Methods

Design and Participants

As the first phase of a nested case–control study of extrinsic risk factors for hospital-acquired pressure ulcers, we carried out a prospective cohort study between 1998 and 2001 in two large inner city teaching hospitals. Eligible patients were 65 years old or older, admitted through the Emergency Department to the inpatient Medical Service, and in hospital on day 3 of the hospitalization (where day 1 was defined as the day of inpatient admission). Verbal consent was obtained from participants or from a proxy if the patient was too sick or confused. The protocol was approved by the Institutional Review Board of the University of Pennsylvania.

Pressure Ulcer Assessment

Patients were examined once, on hospital day 3. Specially trained research nurses determined pressure ulcer status (stage 1–4) by visual skin assessment. Standardized examinations were performed in the patient’s hospital room with overhead fluorescent fixtures turned on, with the patient in flat supine position and 45° supine–lateral positions on right and left sides (9). Lesions in areas with active skin disease (e.g., psoriasis, eczema, tinea corporis, or dermatophyte infection), wounds on the plantar surface of the forefoot or midfoot, and wounds in the gaiter area (just above the malleolus to midcalf) of the leg were not considered to be pressure ulcers. Standard recommendations were followed for patients with dark skin (10). In a related substudy, the sensitivity and specificity of our research nurses’ ascertainment of pressure ulcers from digital photographs (with consensus assessment by two wound experts as the gold standard) were 97% (95% confidence interval [CI], 94%–98%) and 81% (95% CI, 77%–86%), respectively (11).

The research nurses recorded characteristics (including
stage and site) of all pressure ulcers. To differentiate pressure ulcers present at hospital admission from those acquired during the hospital stay, we interviewed the patient, patient’s family, nurse, and/or other hospital caregiver, and reviewed the hospital chart and transfer form, if the patient came from another facility. Based on this information, each pressure ulcer was classified as definitely preexisting, possibly hospital-acquired, or definitely hospital-acquired (algorithm available from the authors on request). For the purpose of this report, possibly hospital-acquired and definitely hospital-acquired pressure ulcers were combined.

Other Measures
In the course of the examination, other clinical observations were made. Dry skin was defined as nonerythematous skin with flaky nonadherent scale over one or more bony prominences. Urinary or fecal incontinence was present if the examiner noted moisture due to urine or soiling due to stool. The patient’s mobility was defined in terms of needing help turning during the skin examination. Information on demographic characteristics, weight, height, prehospital residence, and previous hospitalizations was obtained during an interview with the patient or proxy respondent. We used the Subjective Global Assessment of Nutritional Status (12), a validated method that integrates information on clinical symptoms and signs, to classify individuals as being at low, moderate, or high risk of nutrition-associated complications.

Body mass index (BMI) was defined as weight/height$^2$. Height and weight were available by self-report for all study patients and also by medical record abstraction for approximately 23% of patients. When both sources were available but disagreed, the medical record value was used. Approximately 10% of the BMI observations were missing. We used multiple imputation as implemented in SAS (version 8.0: SAS Institute, Cary, NC) (PROC MI) to estimate missing BMI as a function of demographic characteristics, anthropometric measures, and presence of a hospital-acquired or preexisting pressure ulcer (13,14).

Analysis
The cumulative incidence of hospital-acquired pressure ulcers was estimated by dividing the number of patients with one or more possibly or definitely hospital-acquired pressure ulcers by the total number of patients examined. The chi-square test was used to compare subgroups with respect to the proportion of patients with pressure ulcers. Logistic regression was used to estimate the association between hospital-acquired pressure ulcers and each patient characteristic, controlling for other characteristics. Results of the logistic regression analysis are expressed as odds ratios with 95% CIs. Three secondary analyses were performed, one excluding stage 1 pressure ulcers from the definition of the outcome, one limiting the definition of the outcome to definitely hospital-acquired pressure ulcers, and one excluding patients with preexisting pressure ulcers. Because these analyses yielded similar results, only the results of the primary analysis are presented.

RESULTS
A total of 5305 eligible patients were identified, of whom 3233 (60.9%) were enrolled. There were 1536 eligible patients (29.0%) who refused to participate; 132 eligible patients or their proxies (2.5%) could not be located. For 124 patients (2.3%) the physician or nurse refused to have patient participate, and 280 patients (5.3%) were excluded for other reasons. There was no significant difference between study participants and nonparticipants regarding gender or study hospital. Participants were significantly more likely than were nonparticipants to be 80 years old or older and to be African American, although differences were small.

More than half of study participants were female, almost 70% were African American, and 18.2% were 85 years old or older (Table 1). Dry skin over a bony prominence was present in more than 75% of patients. About 4% of patients had evidence of urinary incontinence, about the same proportion had evidence of fecal incontinence, and 1.1% had both. Approximately one quarter of participants needed help turning in bed. Most patients were living at home before admission, and more than one third had been hospitalized in the previous 6 months. More than half of the patients were overweight (BMI ≥ 25). Almost 10% were underweight (BMI < 18.5), and about one quarter were at moderate or high risk for nutrition-related complications.

Of the 3233 patients examined, 201 (6.2%; 95% CI, 5.4%–7.1%) had one or more possibly or definitely hospital-acquired pressure ulcers. The mean number of pressure ulcers among patients with pressure ulcers was 1.3 (standard deviation 0.6); 75.1% had one pressure ulcer, 17.4% had two, and 7.5% had three or more. There were 266 pressure ulcers among the 201 patients with at least one pressure ulcer. Most of the pressure ulcers were stage 2 (54.1%; Table 2). Almost half of the pressure ulcers were on the sacrum. Slightly more than half of the pressure ulcers were definitely hospital-acquired.

Pressure ulcer incidence rose with increasing age ($p < .001$; Table 1). Caucasians had a somewhat lower incidence of pressure ulcers than did non-Caucasians, although the difference was not significant. There were strong, statistically significant associations between pressure ulcer incidence and the following patient characteristics: needing help to turn in bed, living in nursing home before hospitalization, being hospitalized in previous 6 months, having a BMI < 18.5, being at high risk for nutrition-related complications, and having a pressure ulcer(s) at hospital admission. Higher pressure ulcer incidence was associated with moisture due to urinary incontinence and with soiling due to fecal incontinence; patients with both types of incontinence had a particularly high incidence. A urinary catheter was observed during the examination in 25% of patients with no observed moisture and in 20% of those with observed moisture (data not tabulated). Gender and dry skin were not significantly associated with higher pressure ulcer risk.

In the logistic regression analysis, patient characteristics listed in Table 1 (except pressure ulcers at hospital admission) were entered simultaneously. The presence of pressure ulcers at hospital admission was not included as a covariate.
because it can be viewed as a variable that is intermediate in the causal pathway. In this analysis, all variables except BMI and race were significantly associated with pressure ulcer risk (Table 3).

## DISCUSSION

In one of the largest studies of hospitalized older people to date, we found that 6.2% of patients developed one or more pressure ulcers (Table 1). A comprehensive approach to identifying patients at risk of pressure ulcers is required because there are many factors that influence the development of pressure ulcers. The development of a comprehensive assessment tool for identifying patients at risk of pressure ulcers would allow for targeted interventions to decrease the incidence of pressure ulcers. We have identified a number of factors that influence the development of pressure ulcers, including patients' characteristics, pressures, and provisions of care. Understanding these factors is important for developing strategies to decrease the incidence of pressure ulcers.
more possibly or definitely hospital-acquired pressure ulcers in the first 2 days of their hospital stay. Earlier studies of the incidence of pressure ulcers in acute care settings assessed the development of pressure ulcers throughout the patient’s hospital stay or over a fixed interval such as the first 3 weeks of the stay. When previous studies (which varied considerably by study methods and patient populations) were limited to those that included only elderly, frail, or high-risk patients (15–24), the median incidence proportion was 15.7%. Comparing that estimate to our estimate of 6.2% suggests that one third to one half of hospital-acquired pressure ulcers in elderly patients may arise early in the hospital stay. The plausibility of pressure ulcers arising after short periods of immobility is supported by early studies in animals (4) and by indirect evidence in humans (5,7,8).

Pressure ulcers observed early in the hospital stay may represent two distinct entities: (i) superficial ulcers induced by acute exposure to friction or pressure, and (ii) deep ulcers reflecting a pressure-related insult occurring earlier, even before hospitalization. More than 80% of all the possibly or definitely hospital-acquired pressure ulcers observed in this study were stage 1 or 2 (Table 2). Only two (<1%) were classified as stage 3. A further 18% were unstageable because of necrotic tissue or dressing. Even if some of the unstageable ulcers were deep ulcers, it seems likely that the great majority of pressure ulcers in this study were superficial. Deep tissue injury may be present even when the skin is intact. Although clinical features have been proposed that may help distinguish between superficial lesions and deep tissue injury (25), these features have not been validated and, in any case, information on these features was not available in this study.

There was a strong and statistically significant association between pressure ulcer incidence and poor nutritional status, a finding that is consistent with other observational studies [e.g., (15,26,27)]. However, causality is difficult to establish, because some variables used as markers of nutritional status may simply be markers for underlying poor health and co-morbidity (28). Given the multifactorial nature of pressure ulcer risk, it has been difficult to demonstrate a clear impact of nutritional interventions on pressure ulcer development (29), although one recent trial (30) demonstrated that nutritional supplementation can significantly reduce pressure ulcer risk in a frail, elderly, hospitalized population.

As in other studies (31,32), low BMI was strongly and significantly associated with the incidence of hospital-acquired pressure ulcers. It may be that low BMI is a marker for disease-associated cachexia and poor health (28). This would explain why the association of pressure ulcers with BMI was attenuated after controlling for other indicators of poor health, such as admission from nursing home, recent hospitalization, and poor nutritional status.

There was no difference, in multivariable analysis, between African Americans and others with respect to pressure ulcer incidence. Earlier studies among nursing home residents and hospital patients have yielded conflicting results [e.g., (33–36)]. Although undertreatment of pressure ulcers in darkly pigmented persons is often cited as a threat to the validity of comparisons between racial groups (10,17), our preliminary work revealed high sensitivity and specificity of the research diagnosis in a sample of patients made up primarily of African Americans (11).

Men in this study had a significantly higher incidence than did women; this finding is similar to those in at least one other study (37). Older women have a lower waist–hip ratio (38–40) and larger hip circumference (40) than do men. Thicker gluteal subcutaneous fat may protect women from the effects of pressure on the part of the body that is most vulnerable to immobility-related pressure ulcers. However, the situation may be more complex, because a higher risk has been found for women in some studies [e.g., (32)] and no association with gender in others [e.g., (16)]. Alternatively, the apparent excess risk for men may be due to confounding by other factors, such as comorbidity. Dry skin was associated with higher risk in this study as in other studies [e.g., (41)]. Dehydration of the stratum corneum may reduce its pliability, making the skin more vulnerable to mechanical insult (42). The high prevalence of dry skin in this patient population (>75%) may result from the more liberal definition of dry skin (over any bony prominence) in this study than in, for example, the study by Allman and colleagues (15) in which the definition was restricted to dry skin over the sacrococcygeal bone.

Both urinary and fecal incontinence were associated with higher pressure ulcer risk in our study, as in several others [e.g., (43,44)]. In contrast, some studies have found increased risk with fecal but not urinary incontinence [e.g., (45)]. Patients in our study with both urinary and fecal incontinence were at particularly high risk, as in at least one other study (46). Although many authors cite skin moisture as a risk factor for pressure ulcers (42), a causal relationship has not been established. Moisture may cause maceration, resulting in vulnerability to friction-induced loss of epidermis. Given that pressure ulcers result from ischemia in the deep subcutaneous tissues and not in processes at the skin level, some experts consider urinary incontinence to be a marker for high risk for (rather than a cause of) pressure ulcers (47).

This study had several strengths. First, the sample size was large. The only existing hospital-based incidence studies with a larger sample size used either medical record review (48,49) or observations by clinical nurses trained as data collectors (3,50,51). In this study, we did not rely on hospital nurses; direct pressure ulcer assessment was performed by specially trained research nurses. Studies using record review as the source of information may significantly underestimate pressure ulcer incidence (52). Another unique contribution of this study is the fact that almost 70% of study patients were African American.

In contrast, some of the measures of patient characteristics (e.g., incontinence, mobility) may have been insensitive because they were based on a research nurse’s brief, one-time observation. This feature of the design could explain the relatively low frequency of incontinence (defined as the presence of moisture or soiling at the time of examination) in this study. More complete information on patient risk factors could be obtained by medical record review, which was beyond the scope of this phase of the study.

Also, there may have been some misclassification of hospital-acquired and preexisting pressure ulcers. It is pos-
sible that patients (especially those admitted from a nursing home or following recent hospitalization) had pressure-induced subcutaneous changes that were not visible at the time of admission or at the time of examination. Although the tool that we used to distinguish hospital-acquired from preexisting pressure ulcers had high face validity, formal validation of the tool was not possible within the constraints of this study. However, results of a secondary analysis that included only definitely hospital-acquired pressure ulcers in the definition of the outcome were similar in direction and magnitude to those of the main analysis.

Thirteen percent of pressure ulcers occurred at atypical sites, suggesting that some may not have been pressure-induced. In this study, as in other studies and in clinical settings, there may have been some uncertainty in establishing the etiology of the observed lesions.

Pressure ulcer prevention often focuses on patients experiencing long periods of immobility. This study suggests that a small but non-negligible proportion of elderly, emergently-admitted hospital patients may acquire pressure ulcers soon after their admission. Risk assessment and preventive interventions may need to be initiated early in the hospital stay, possibly even while the patient is in the Emergency Department. Given recent trends toward shorter hospital stays, the potential for breakdown of the continuity of care is high. Early intervention is, therefore, all the more challenging and all the more important.

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Address correspondence to Mona Baumgarten, PhD, Department of Epidemiology and Preventive Medicine, Division of Gerontology, University of Maryland School of Medicine, 660 West Redwood St., Suite 200, Baltimore, MD 21201. E-mail: mbaumgar@epi.umaryland.edu

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