Journal of Gerontology: MEDICAL SCIENCES
1997, Vol. 52A, No. 2, M106–M110

Effect of Pressure Ulcers on the Survival of Long-Term Care Residents

Dan R. Berlowitz,[1,2] Gary H. Brandeis,[1,3] Jennifer Anderson,[1]
Wei Du,[1,2] and Harriet Brand[1]

[1]Edith Nourse Rogers Memorial Veterans Hospital, Bedford, Massachusetts.
[2]Section of General Internal Medicine and [3]Geriatrics Section, Boston University Medical Center.

Background. Past studies have emphasized that patients with pressure ulcers are at high risk of dying. However, it remains unclear whether this increased risk is related to the ulcer or to coexisting conditions. In this study we examined the independent effect of pressure ulcers on the survival of long-term care residents.

Methods. We evaluated all 19,981 long-term care residents institutionalized in Department of Veterans Affairs (VA) long-term care facilities as of April 1, 1993. Baseline resident characteristics and survival status were obtained by merging data from five existing VA data bases. Survival experience over a 6-month period was described using a proportional hazards model.

Results. Pressure ulcers were present in 1,539 (7.7%) long-term care residents. Residents with pressure ulcers had a relative risk of 2.37 (95% CI = 2.13, 2.64) for dying as compared to those without ulcers. After adjusting for 16 other measures of clinical and functional status, the relative risk associated with pressure ulcers decreased to 1.45 (95% CI = 1.30, 1.65). No increased risk of death was noted for residents with deeper ulcers.

Conclusions. Pressure ulcers are a significant marker for long-term care residents at risk of dying. After adjusting for clinical and functional status, however, the independent risk associated with pressure ulcers declines considerably. The fact that larger ulcers are not associated with greater risk suggests that other unmeasured clinical conditions may also be contributing to the increased mortality associated with pressure ulcers.

PRESSURE ulcers are a serious medical condition that significantly affects the morbidity and mortality of long-term care residents (1). Past studies have emphasized that pressure ulcers are common in the terminal stages of disease (2) and that as many as 70% of pressure ulcer patients will die within a short time (3,4). Among residents newly admitted to a nursing home, 92% of those dying within 12 weeks had developed a pressure ulcer during the first 3 weeks of institutionalization (5). In recent work, using data from both a chronic care hospital (6) and a large nursing home chain (7), we have confirmed that pressure ulcer patients have a two- to threefold increased risk of dying compared to patients without an ulcer. Faced with this poor prognosis, clinicians may conclude that aggressive care of pressure ulcers is unlikely to result in prolonged patient benefit. For example, Bennett et al. (8) observed such high mortality among pressure ulcer patients treated with an air-fluidized bed that they recommended limiting this expensive treatment only to those patients surviving beyond 30 days of institutionalization. However, since the use of such specialized beds is effective in promoting the healing of ulcers (9,10), clinicians may be unsure how to proceed and patients may be deprived of a beneficial intervention.

Pressure ulcers are a common source of infection in the nursing home (11,12), and bacteremia resulting from a pressure ulcer is associated with a 50% mortality (13,14). This suggests a likely mechanism by which pressure ulcers may result in patient death. However, patients with pressure ulcers often have serious coexisting illnesses and are functionally dependent (15–17). We have previously suggested that these coexisting conditions, and not the pressure ulcer, may be causing this increased mortality (6). These results were limited, though, by small sample size, incomplete follow-up of discharged patients, and a lack of information on other predictors of survival. Thus, the independent effect of pressure ulcers on the survival of long-term care residents remained poorly defined. The purpose of this study is to examine the effect of pressure ulcers on survival in a national sample of long-term care residents institutionalized at Department of Veterans Affairs (VA) hospitals and nursing homes.

METHODS

Data Base Descriptions

We used information from five separate VA data bases to identify long-term care residents, determine their baseline status, and describe their survival over a 6-month time period. Our primary source of information was the Patient Assessment File (PAF) (18), an administrative data base developed for case-mix based reimbursements in long-term care, and based on Resource Utilization Groups (RUGs II) (19). PAF data, which describe individual long-term care residents, are collected by nursing staff at each VA facility semiannually on April 1 and October 1, as well as at the time of admission or transfer to a nursing home or intermediate medicine unit. The PAF documents the stage of the deepest

pressure ulcer, if present, on the evaluation date. Staging of pressure ulcers is on a 1 to 5 scale: a stage 1 ulcer consists of erythematous skin; a stage 2 ulcer consists of a superficial layer of broken or blistered skin; a stage 3 ulcer involves the subcutaneous tissues; and a stage 4 ulcer extends to muscle or bone. Stage 5 ulcers are stage 4 ulcers without a treatment plan documented in the medical record; in this study we combined stages 4 and 5.

Additional information included in the PAF are patient demographics including age and gender; specific diagnoses such as multiple sclerosis, urinary tract infection, hemiplegia, or quadriplegia; medical treatments being received such as oxygen therapy and dialysis; and activities of daily living, consisting of eating, mobility, transfer, and toileting ability, each rated on a 1 to 5 scale (20). The presence of a terminal illness, defined as a condition likely to result in death within 3 months, is also recorded in the PAF.

The Patient Treatment File (PTF) has a record for each discharge from VA inpatient care during a fiscal year (21). Included are the date of discharge, whether the patient was discharged alive, and specific ICD-9-CM codes relating to the hospitalization. Separate files exist for episodes of care at VA medical centers; episodes of non-VA care provided at military or private hospitals under contract; and extended care episodes in domiciliaries, VA nursing homes, or community contract nursing homes. No record is present, though, for long-staying patients not discharged during the fiscal year.

The Outpatient Clinic File (OPC) has a record specific to each individual visit to a VA outpatient clinic (21). Non-VA outpatient care is not captured. The Annual Census File contains information on all patients in VA hospitals and extended care facilities on September 30 of each year (21). The Beneficiary Identification and Record Locator Subsystem (BIRLS) records all veterans who are receiving benefits (21). Information about the date of death of veterans is included, as death benefits are available to surviving family members.

We merged records from these five data bases through a common social security number. As the BIRLS file uses veterans' real social security numbers, while the other data bases use scrambled social security numbers, existing conversion files were used in relating BIRLS to these other data bases.

Study Cohort

We used the PAF to identify all veterans residing in VA nursing homes or intermediate medicine units on April 1, 1993. An intermediate medical unit serves residents with a variety of needs, including short courses of rehabilitation, and long-term interventions more intensive than provided in the nursing home setting. Our study cohort consists of the resulting 19,981 long-term care residents. Characteristics of the population are described in Table 1.

Selection of Study Variables

The outcome event was resident survival over the 6-month period between April 1 and September 30, 1993. For patients dying during this time period, the date of death was recorded from the PTF or BIRLS. In the rare situation that the dates from these two files did not match, the date from the PTF was used in our analyses.

Table 1. Characteristics of the Study Population

	All Patients (N = 19,981)	With Ulcer (n = 1,539)	Without Ulcer (n = 18,442)
Age (mean ± SD)	71.2 ± 11.4	70.8 ± 11.8	71.2 ± 11.4
Male gender (%)	96.9	97.1	96.9
Dependent in mobility* (% requiring assistance)	66.7	92.6	64.6
Dependent in transferring* (% requiring assistance)	53.1	83.8	50.5
Incontinent of urine* or feces (%)	47.4	74.7	45.1
Terminal illness (%)*	5.4	12.2	4.8

*$p < .001$.

The relationship of pressure ulcers to 6-month survival was examined with pressure ulcer status on April 1, 1993 coded both dichotomously (present/not present) and by stage. As stage 1 pressure ulcers (erythematous lesions of intact skin) are difficult to recognize clinically (22), patients with only stage 1 ulcers were considered ulcer-free.

We selected 26 additional potential predictors of survival from among resident characteristics available in the PAF entry from April 1, 1993. Candidate variables included demographic items such as gender and residence in either nursing home or intermediate medicine units; variables shown in past studies to be associated with survival of nursing home residents, including age and measures of functional dependence (23,24); and variables with a clinically plausible association with survival, such as receiving dialysis or radiation therapy. These variables are listed in Table 2. Information on age and functional dependence was available on the entire study sample. All other variables were considered absent unless specifically identified as present in the data base.

Analyses

We sequentially searched these data bases for episodes of health care utilization after September 30, 1993, indicating that the resident was alive as of that date; or an indication that the resident had died between April 1 and September 30, 1993. Long-term care residents were designated as having survived the 6-month period if any of the following conditions were met: (a) a PAF entry existed between October 1, 1993 and April 1, 1994; (b) an Annual Census record existed from September 30, 1993; (c) an Outpatient Clinic File entry during the one-year period following September 30, 1993; (d) a PTF entry from either the main VA file, the non-VA hospital file, or the extended care file, indicating a hospital discharge after September 30, 1993; or (e) a BIRLS entry indicating resident death after September 30, 1993. Residents were considered to have died if there was no indication that they were alive after September 30, 1993, and either the PTF or BIRLS indicated that the patient had died during the 6 months preceding that date. Patients who could not be labeled as either dead or alive were excluded from the analyses.

Table 2. Factors From the Proportional Hazards Model That Are Independently Associated ($p < .05$) With Dying During a 6-month Follow-up Period

Variable	Relative Risk (95% Confidence Interval)
Pressure ulcer present	1.45 (1.30, 1.63)
Terminal illness	4.66 (4.21, 5.17)
Oxygen therapy*	2.76 (2.48, 3.07)
Radiation therapy*	2.07 (1.69, 2.55)
Dialysis*	1.87 (1.35, 2.58)
Blood transfusion*	1.84 (1.31, 2.60)
Male gender	1.64 (1.26, 2.15)
Residence on intermediate medical unit	1.34 (1.23, 1.45)
Dehydration	1.32 (1.14, 1.53)
Age (for each 10 years of increasing age)	1.23 (1.18, 1.28)
Dependence in transferring†	1.13 (1.06, 1.19)
Dependence in mobility†	1.13 (1.08, 1.19)
Dependence in eating†	1.07 (1.03, 1.11)
Hemiplegia	0.71 (0.63, 0.80)
Quadriplegia	0.62 (0.48, 0.79)
Tracheostomy	0.58 (0.46, 0.74)
Multiple sclerosis	0.43 (0.29, 0.66)

Note: Other variables significant on the log-rank test and entered into the model include chemotherapy, coma, gastrointestinal bleeding, urinary tract infection, incontinence, ventilator dependence, stasis ulcer, non-pressure ulcer wound care, and parenteral feeding.

*Treatment provided during the 4 weeks preceding the assessment and (for new admissions) anticipated to be provided in the future.

†Relative risk for each step on a 5-point scale.

Statistical analyses were performed using the Statistical Analysis System (SAS Institute, Cary, NC). We performed bivariate testing, including chi-square tests for categorical variables, Mantel-Haenszel chi-square tests for ordinal variables, and *t*-tests for continuous variables, to compare baseline characteristics of patients with and without pressure ulcers on April 1, 1993. The association of pressure ulcers, and the other candidate predictor variables, with survival during the 6-month period following April 1, 1993 was assessed using the log-rank test; unadjusted hazard ratios for each variable were obtained by Cox proportional hazards regression. The log-log survival curves for subjects with and without pressure ulcers were parallel, supporting the assumption of proportional hazards for these data. All candidate variables were then entered into a stepwise proportional hazards model to identify factors independently associated ($p \leq .05$) with resident survival. Separate models were examined with pressure ulcers classified as present/not present and by stage. Additionally, as the presence of an ulcer may affect whether patients are designated as having a terminal illness, modeling was repeated with this explanatory variable excluded, as well as with the inclusion of an interaction term for the presence of an ulcer in a terminally ill patient. The estimated survival curves for the no-ulcer and ulcer stage groups were plotted both with and without adjustment for the significant additional factors. The adjusted curves represent survival within groups at the mean of each adjustment factor.

RESULTS

The study sample consisted of 19,981 residents of 141 VA long-term care facilities. Pressure ulcers were present in 1,539 (7.7%) residents; 45.6% of the ulcers were stage 2, 31.5% stage 3, and 22.9% stage 4. Pressure ulcer patients were of similar age and gender than patients without an ulcer, but they were more likely to be functionally dependent or have a terminal illness.

We could not locate information on survival status in any of the data bases for 311 (1.6%) long-term care residents. For an additional 51 (0.2%) residents, we were unable to unscramble their social security numbers and use the BIRLS file. Consequently, 362 residents were excluded from the survival analyses. Excluded veterans were younger (68.0 ± 11.5 vs 71.2 ± 11.4 years), more likely to reside on an intermediate medicine unit, and less dependent in each of their activities of daily living ($p < .001$ for all analyses).

Of the remaining 19,619 residents, 2,579 (13.1%) died during the 6-month follow-up period. Among residents with a pressure ulcer, 26.0% died, compared with 12.1% of those without an ulcer ($p < .001$). The relative risk (RR) of dying for pressure ulcer patients was 2.37 (95% CI = 2.13, 2.64).

Each of the ordinal dependence in activities of daily living (ADL) variables (transferring, mobility, and eating) showed a strongly ordered association in bivariate trend testing with dying. We chose to include them parsimoniously in the modeling as if they were continuous. Stepwise proportional hazards regression using the 26 potential explanatory variables selected from the PAF, including the ADL measures, resulted in the retention of 17 variables that were significant at $p < .05$ (model $\chi^2 = 2380$) (Table 2). After adjusting for these other resident characteristics, pressure ulcers, while still significant, were a weaker predictor of dying (RR = 1.45, 95% CI = 1.30, 1.65). Among the other variables significantly associated with dying and included in the full model were the presence of a terminal illness (RR = 4.66), as well as receiving oxygen therapy (RR = 2.76), radiation therapy (RR = 2.07), dialysis (RR = 1.87), and blood transfusions (RR = 1.84) during the preceding 4 weeks. The presence of hemiplegia, quadriplegia, multiple sclerosis, and a tracheostomy were all protective in this model. Additional characteristics individually associated with dying on the log-rank test, but not significant independent predictors in the model, include receiving chemotherapy, coma, recent gastrointestinal bleeding, incontinence, and recent urinary tract infections. Excluding terminal illness from the model did not affect overall conclusions. Pressure ulcers remained a weaker, but still significant predictor of dying in this new model (RR = 1.62, 95% CI = 1.45, 1.81). In the model that included both terminal illness and the interaction of this variable with the presence of an ulcer, no additional risk was noted for residents with both characteristics.

Residents with superficial pressure ulcers were not less likely to die than residents with deeper ulcers. Using the unadjusted rates (Figure 1), the risk of dying was similar for residents with either stage 2 or stage 4 ulcers; residents with stage 3 ulcers had a lower risk ($p = .05$). The addition of indicator variables for each stage of pressure ulcers to the full risk-adjustment model increased the model chi-square marginally ($\chi^2 = 2383$). The relative risk of dying was 1.60 for residents with stage 2 ulcers, as compared to 1.34 and 1.33 for stages 3 and 4, respectively (p = n.s.) (Figure 2).

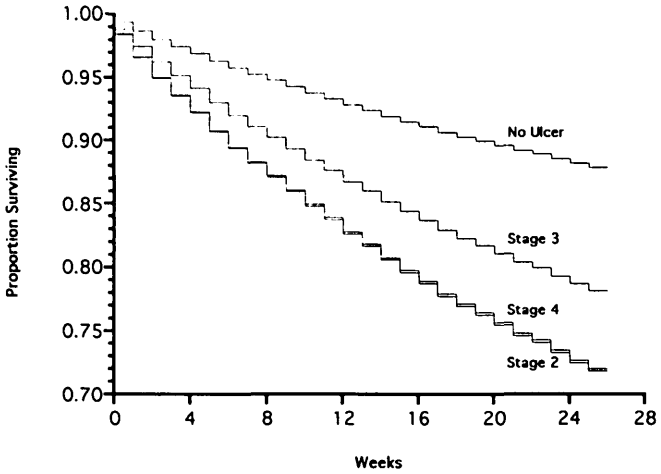

Figure 1. Proportional hazards estimates of the proportion of patients surviving, by weeks from baseline, for the no pressure ulcer and the ulcer stages 2, 3, and 4 subject groups, *without* adjustment for other factors.

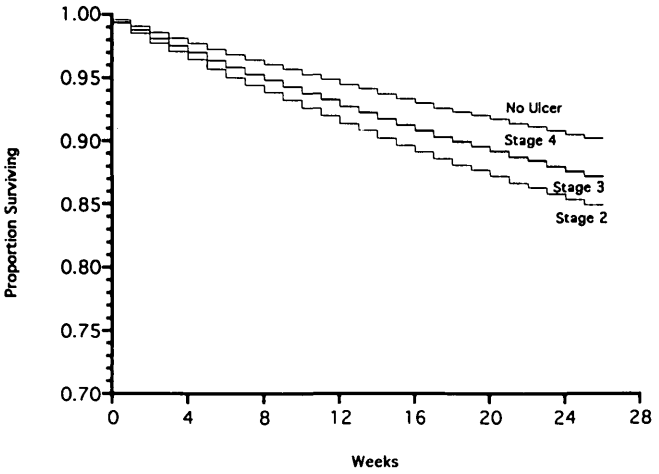

Figure 2. Proportional hazards estimates of the proportion of patients surviving, by weeks from baseline, for the no pressure ulcer and the ulcer stages 2, 3, and 4 subject groups, *after* adjustment for other factors.

DISCUSSION

Patients with pressure ulcers have a markedly increased risk of dying. This poor prognosis has resulted in recommendations to temporarily limit the use of air-fluidized beds, an effective intervention for promoting ulcer healing (8). Other effective but expensive interventions may be similarly withheld. However, it remains uncertain whether the increased mortality is a direct result of the pressure ulcer or is explained by coexisting conditions. We have therefore made use of the extensive information available from VA data bases to examine this association between pressure ulcers and survival of long-term care residents.

Pressure ulcers are a significant marker of death during a 6-month follow-up period. The unadjusted relative risk of dying for pressure ulcer patients was 2.37 in the present study, results similar to those we reported in past studies. For example, among new admissions to a chronic care hospital, we previously noted a relative risk of 1.9 (6). Among a national sample of predominantly female nursing home residents, 38.8% of residents with a pressure ulcer, and 15.4% of those without an ulcer, died over one year (7), as compared to 6-month rates of 26.0% and 12.1%, respectively, in the present study.

By using VA administrative data bases to obtain detailed information on residents' clinical and functional status that was lacking in these previous studies, we have been able to examine the independent effect of pressure ulcers on survival. Pressure ulcers are a weaker predictor of dying after adjusting for the presence of these other conditions. The relative risk associated with the presence of an ulcer decreased from the unadjusted value of 2.37, to 1.45 in the full model. Other variables included in the model, such as functional status and age, have been shown to be important predictors in previous studies of survival in nursing home residents (23,24); or, as for dialysis, radiation therapy, or oxygen, are clinically plausible predictors of dying. We are unsure why the presence of multiple sclerosis, hemiplegia, quadriplegia, and tracheostomy were associated with increased survival in this model.

Stage 4 ulcers, which are deeper and likely more prone to serious infections that could result in death, were not associated with an increased risk of dying when compared to stage 2 and 3 ulcers in the proportional hazards model. This suggests that the presence of a pressure ulcer may be a marker for other unmeasured clinical factors that are not included in our model. Inclusion of these factors in the model could result in a further lowering of the relative risk associated with the presence of an ulcer.

Strengths of this study should be emphasized. First, the large sample size obtained by using all VA long-term care residents allowed us to calculate stable estimates of the relative risk associated with pressure ulcers with narrow 95% confidence intervals. Second, detailed information on the clinical status of long-term care residents, including functional status, specific diagnoses, and therapies, was available from the PAF. Third, information on survival was available on nearly all veterans. Even though long-term care residents may be lost to follow-up through discharges home, transfers to acute care settings, or placement on contract in private nursing homes, the application of different data bases allowed follow-up information on 98.2% of our sample. Residents for whom no follow-up information was available tended to be younger and less functionally dependent, suggesting that they may have been discharged from long-term care and not required subsequent VA outpatient care.

Limitations should also be noted. Administrative data, as used in this study, may contain errors. Studies evaluating the different data bases used in this study have been limited. For the PAF, a study at three VA nursing homes indicated that pairs of registered nurses have a Pearson reliability coefficient of greater than 0.90 when evaluating residents on their wards (25). Errors in the date of discharge and whether patients died during the admission are infrequent in the PTF (21).

This study has important clinical implications. Decisions regarding the use of diagnostic and therapeutic interventions in long-term care patients should be guided by their overall medical condition, as well as patient preferences, and should not be based on simple criteria such as whether the patient

has a pressure ulcer and on the stage of the ulcer. This emphasizes the need for comprehensive assessments of these complex patients.

We have demonstrated that while patients with pressure ulcers are more likely to die, this increased risk is largely related to their frailty and high disease burden, and not a direct result of the ulcer. These results do not imply that pressure ulcers may be ignored. Rather, our results demonstrate that with usual care, pressure ulcers have at most a modest independent effect on resident survival.

ACKNOWLEDGMENTS

This project was supported by the Department of Veterans Affairs HSR&D Service, grant 92-053. Dr. Berlowitz was supported by a Department of Veterans Affairs HSR&D Career Development Award. Dr. Brandeis was supported by a Clinical Investigator Award from the National Institute on Aging.

The authors wish to thank Dr. Gene Stollerman and Dr. Mark Moskowitz for their helpful comments during preparation of the manuscript.

Address correspondence and reprint requests to Dr. Dan Berlowitz, HSR&D Field Program, Bedford VA Medical Center, Bedford, MA 01730.

REFERENCES

1. Allman RM. Pressure ulcers among the elderly. N Engl J Med 1989;320:850–3.
2. Howell TH. Some terminal aspects of disease in old age: a clinical study of 300 patients. J Am Geriatr Soc 1969;17:1034–7.
3. Michocki RJ, Lamy PP. The problem of pressure sores in a nursing home population: statistical data. J Am Geriatr Soc 1976;24:323–8.
4. Reed JW. Pressure ulcers in the elderly: prevention and treatment utilizing the team approach. Maryland State Med J 1981;30:45–50.
5. Bergstrom N, Braden B. A prospective study of pressure sore risk among institutionalized elderly. J Am Geriatr Soc 1992;40:747–58.
6. Berlowitz DR, Wilking SVB. The short-term outcome of pressure sores. J Am Geriatr Soc 1990;38:748–52.
7. Brandeis GH, Morris JN, Nash DJ, Lipsitz LA. The epidemiology and natural history of pressure ulcers in elderly nursing home residents. JAMA 1990;264:2905–9.
8. Bennett RG, Bellantoni MF, Ouslander JG. Air-fluidized bed treatment of nursing home patients with pressure sores. J Am Geriatr Soc 1989;37:235–42.
9. Ferrell BA, Osterweil D, Christenson P. A randomized trial of low-air-loss beds for treatment of pressure ulcers. JAMA 1993;269:494–7.
10. Allman RM, Walker JM, Hart MK, et al. Air-fluidized beds or conventional therapy for pressure sores. Ann Intern Med 1987; 107:641–8.
11. Scheckler WE, Peterson PJ. Infections and infection control among residents of eight rural Wisconsin nursing homes. Arch Intern Med 1986;146:1981–4.
12. Garibaldi RA, Brodine S, Matsumiya S. Infections among patients in nursing homes. N Engl J Med 1981;305:731–5.
13. Bryan CS, Dew CE, Reynolds KL. Bacteremia associated with decubitus ulcers. Arch Intern Med 1983;143:2093–5.
14. Galpin J, Ghow A, Bayer A, Guze L. Sepsis associated with decubitus ulcers. Am J Med 1976;61:346–50.
15. Allman RM, Laprade CA, Noel LB, et al. Pressure sores among hospitalized patients. Ann Intern Med 1986;105:337–42.
16. Berlowitz DR, Wilking SVB. Risk factors for pressure sores: a comparison of cross-sectional and cohort-derived data. J Am Geriatr Soc 1989;37:1043–50.
17. Spector WD, Kapp MC, Tucker RJ, Sternberg J. Factors associated with presence of decubitus ulcers at admission to nursing homes. Gerontologist 1988;28:830–4.
18. Rudman D, Abbasi AA, Tourky GM, Rudman IW, Mattson DE. Easily measurable adverse outcome indicators in a Veterans Affairs nursing home. QRB 1990;16:257–63.
19. Schneider DP, Fries BE, Foley WJ, Desmond M, Gormely WJ. Case mix for nursing home payment: Resource Utilization Groups, version II. Health Care Financing Rev 1988;10(Suppl):39–52.
20. Rudman D, McCormack J, Cuisinier M, Mattson DE. A simple method to quantify the changes in activities of daily living of long-stay nursing home populations. Am J Phys Med Rehabil 1993;72:276–80.
21. Beattie MC, Swindle RW, Tomko LA. Department of Veterans Affairs databases resource guide. Palo Alto, CA: HSR&D Center for Health Care Evaluation, 1993.
22. National Pressure Ulcer Advisory Panel. Pressure ulcers' prevalence, cost, and risk assessment: consensus development conference statement. Decubitus 1989;2:24–8.
23. Lewis MA, Kane RL, Cretin S, Clark V. The immediate and subsequent outcomes of nursing home care. Am J Public Health 1985;75:758–62.
24. Lichtenstein MJ, Federspiel CF, Schaffner W. Factors associated with early demise in nursing home residents. J Am Geriatr Soc 1985;33:315–9.
25. Rudman D, Slater EJ, Richardson TJ, Mattson DE. The occurrence of pressure ulcers in three nursing homes. J Gen Intern Med 1993;8:653–8.

Received March 15, 1996
Accepted July 27, 1996