Persons age 65 years and older represent 18% of the Italian population but account for 45.5% of hospital admissions. Pressure ulcers are commonly found among older people and are a result of many different causes such as malnutrition, immobilization or poor mobilization, and trauma. Malnutrition is an often underestimated problem that affects elderly patients both at home and in the hospital. Protein energy malnutrition has been reported in up to 15% of community dwelling and in 62% of hospitalized elderly individuals. Several factors have been cited as influencing and determining malnutrition in the elderly, the most important of which are functional and cognitive impairment, numerous medication prescriptions,
and depression; these factors all play an important role in limiting appetite and reducing food intake.

Furthermore, malnutrition is an important factor involved in the onset of pressure ulcers. Several clinical trials have shown an increase in pressure ulcers among malnourished subjects or subjects who experience a decrease in protein and energy intake. It is well known how pressure ulcers negatively influence the health status of elderly people. The European Pressure Ulcer Advisory Panel (EPUAP) defined pressure ulcers as, “an area of localized damage to the skin and underlying tissue caused by pressure, shear, friction, and/or a combination of these things.”

Pressure ulcers seem to be more frequent in long-term facilities with a prevalence of 27.7% and an incidence of 23.9% among admitted patients. Sari and colleagues reported a pressure ulcer incidence of 3.8% for patients age 75 years or younger; however, this number greatly increases for patients older than 75 years. Moreover, pressure ulcers represent a significant cost to public health and adversely affect patients’ quality of life.

The link between poor protein intake and skin damage involves reduced nutrient availability for tissue maintenance and repair, which reduces skin resistance. Suboptimal dietary intake negatively affects wound healing and wound strength, collagen synthesis, skin elasticity, and cellular turnover. These factors create highly vulnerable skin especially in poorly mobilized elderly patients. Hip fractures, for example, are significantly involved in spurring a cascade of negative events. Furthermore, malnutrition is often associated with underlying diseases and it is not always easily differentiated. Consequences could be local and/or systemic infections, which can prolong hospitalization and increase the risk of death. Furthermore, ulcer onset usually occurs quickly, but their repair requires significant time.

The primary aim of this study was to describe and report the experience of a hospital-at-home service treating elderly patients with pressure ulcers. Hospital-at-home service represents one of the few services treating at-home, acute care patients admitted from the emergency department, other hospital wards, or general practitioners.

**Materials and Methods**

Patients admitted from January 2000 to December 2001 to the Geriatric Hospital at Home Service (GHHS) of the San Giovanni Battista Hospital (Torino, Italy) were enrolled into this observational study.

GHHS has been extensively described in previous research and has proved to be as effective as traditional hospitalization for selected patients with acute pathologies. The GHHS provides substitutive hospital-at-home care in a “clinical unit” model. The GHHS multidisciplinary team consists of 3 geriatricians, 13 nurses, 2 physiotherapists, 1 social worker, and 1 counselor. The team operates 7 days a week and cares for 25 patients per day.

Patients who were admitted to the GHHS during the study period were screened for pressure ulcers, except for patients with leg edema and N-terminal pro-Brain Natriuretic Peptide (NT proBNP) greater than 2000 pg/mL. The NT proBNP value is commonly considered as an indicator for acute heart failure that could increase vascular permeability. Pressure ulcer screening was performed at baseline and every day thereafter until discharge.

Patients were divided into two groups: without pressure ulcers and with pressure ulcers. The with pressure ulcer group was sub-divided into patients with a pressure ulcer(s) present upon admission and patients who developed a pressure ulcer(s) during hospitalization.

Age, gender, nutritional status (body mass index, albumin, and hemoglobin), reduction of feeding, presence of pressure ulcers according to stage, functional status (Activities of Daily Living [ADL], Instrumental Activities of Daily Living [IADL], cognitive status (Short Portable Mental Status Questionnaire [SPMSQ]), diagnosis on admission, comorbidities, and medications were recorded for each patient by a physician interviewer with at least 5 years’ experience in conducting research-related interviews with the elderly. The interviewer was not aware of the study objectives and did not have a role in the intervention. The physician interviewer obtained informed consent for study participation from the patients or from a proxy for those patients with substantial cognitive impairment.

Diagnosis of malnutrition was made on the basis of a reported reduction of feeding during the last 6 months. Moreover, each patient’s weight was compared to standardized charts. The grading system and definitions for pressure ulcers are shown in Table 1. It was agreed that necrotic ulcers were to be recorded as deep ulcers (Stage 4). In cases where multiple ulcers of the same stage were present, the pressure ulcer that was recorded was the one, which in the judgment of the nurse, had the greatest impact on the patient and quality of life.

**Statistical Analysis**

All data collected in the database were analyzed with
SPSS version 16.0. Data are presented as mean ± SD (95% confidence intervals [CI]) or as percentages in the corresponding categories. Paired and unpaired t-tests were used to compare data within and between the groups, respectively, for parametric data; chi-squared tests were used for non-parametric data. A separate multivariate, stepwise logistic regression was used to determine the contribution of significant results.

Results

Four hundred sixty-six patients (207 men [44.4%] and 259 women [55.6%]) were evaluated. Seventy nine (16.9%) patients presented with a pressure ulcer upon admission, while 387 did not. Of the 387, 12 (2.5%) developed pressure ulcers during hospitalization. Mean age of the entire sample was 80.6 ± 9.7 years and mean length of stay was 34.7 ± 40 days.

On average, patients were functionally impaired with mean ADL functions lost of 3.73 ± 2.36 and a mean IADL score of 4.42 ± 4.71.

The foremost illnesses that resulted in hospitalization were: advanced cancer (n = 129, 27.7%), heart disease (n = 76, 16.3%), dementia (n = 49, 10.5%), and pneumonia (n = 30, 6.4%). Patients were often affected by more than one illness; each patient was treated for 1.81 ± 0.72 illnesses.

Body Mass Index (BMI) measurements showed that 36.7% of the sample was underweight, while 16.7% was overweight. The following BMI ranges were applied: underweight < 18.5; normal = 18.5–24.9; overweight = 25–29.9; obese: ≥ 30.

The 79 patients who presented with a pressure ulcer(s) upon admission were divided in the following manner: Stage I (n = 23, 29.1%); Stage II (n = 30, 38%); Stage III (n = 14, 17.7%); Stage IV (n = 12, 15.2%). Patients with pressure ulcers on admission were more functionally or cognitively impaired and had significantly worse albumin levels and BMI (Table 2) compared to the other group. Anorexia and asthenia were significantly higher in patients with pressure ulcers (P < 0.001). Prevalence of constipation and dysphagia was significantly different between the two groups (P < 0.05).

### Table 1. Definitions and stages of pressure ulcers.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>Non-blanchable erythema of intact skin. Discoloration of the skin, warmth, edema, induration or hardness may also be used as indicators, particularly on individuals with darker skin.</td>
</tr>
<tr>
<td>II</td>
<td>Partial thickness skin loss involving epidermis, dermis, or both. The ulcer is superficial and presents clinically as an abrasion or blister.</td>
</tr>
<tr>
<td>III</td>
<td>Full-thickness skin loss involving damage to or necrosis of subcutaneous tissue that may extend down, but not through the underlying fascia.</td>
</tr>
<tr>
<td>IV</td>
<td>Extensive destruction, tissue necrosis, or damage to muscle, bone, or supporting structures with or without full-thickness skin loss.</td>
</tr>
</tbody>
</table>

### Table 2. Functional, cognitive, and nutritional characteristics of patients with and without pressure ulcers.

<table>
<thead>
<tr>
<th></th>
<th>Patients with pressure ulcers</th>
<th>Patients without pressure ulcers</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADL (functions lost)</td>
<td>5.35 ± 1.35</td>
<td>3.40 ± 2.39</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>IADL (functions maintained)</td>
<td>1.34 ± 2.68</td>
<td>5.05 ± 4.78</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>SPMSQ</td>
<td>7.32 ± 3.59</td>
<td>4.42 ± 3.76</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Albumin (g/dL)</td>
<td>3.17 ± 0.61</td>
<td>3.63 ± 0.63</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>underweight</td>
<td>40</td>
<td>131</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>normal weight</td>
<td>31</td>
<td>186</td>
<td>ns</td>
</tr>
<tr>
<td>overweight/obese</td>
<td>8</td>
<td>70</td>
<td>ns</td>
</tr>
</tbody>
</table>

ADL: Activities of Daily Living  
IADL: Instrumental Activities of Daily Living  
SPMSQ: Short Portable Mental State Questionnaire  
BMI: Body Mass Index  
ns: not significant
Mean length of stay for subjects with ulcers on admission was significantly longer than for controls (43.8 ± 45.7 versus 32.8 ± 38.5 days; \( P < 0.05 \)).

The mortality rate for patients with pressure ulcers at admission was higher than for patients without ulcers (\( n = 32, 40.5\% \) versus \( n = 69, 17.8\%; P < 0.001 \))—16 (20.3\%) of these patients had more than three illnesses compared to 45 (11.6\%) of those without pressure ulcers (\( P < 0.05 \)).

Twelve subjects out of 387 without pressure ulcers on admission developed new pressure ulcers during hospitalization in GHHS: Stage I (\( n = 5, 38\% \)); Stage II (\( n = 7, 62\% \)). Serum albumin level of these patients is significantly lower compared to subjects without ulcers (3.19 ± 0.56 versus 3.65 ± 0.63; \( P < 0.05 \)). Patients developing new pressure ulcers, during GHHS stay, showed higher fecal (\( n = 3, 25\% \)) and double (\( n = 5, 41.7\% \)) incontinence compared to those who did not develop ulcers (\( P < 0.001 \)) and presented higher comorbidity (2.33 ± 0.78 versus 1.77 ± 0.69; \( P < 0.01 \)). They were younger (80.4 ± 9.62 versus 73.9 ± 12.49; \( P = 0.023 \)) but more functionally (ADL: 3.34 ± 2.4 versus 5.25 ± 1.14; \( P = 0.006 \); IADL: 5.15 ± 4.81 versus 1.92 ± 2.50; \( P = 0.021 \)) and cognitively (4.35 ± 3.72 versus 6.67 ± 4.4; \( P = 0.035 \)) compromised. The mortality rate for patients who developed a pressure ulcer(s) during hospital at home care was 66.6% higher than those patients without wounds on admission (\( P < 0.001 \)).

The multivariate analysis showed that the relative risk of new pressure ulcer onset during hospitalization was significantly linked to age (1.09, CI 95% 1.02–1.15), the number of functions lost (1.79, CI 95% 1.15–2.78), and to comorbidity (2.79, CI 95% 1.26–6.18). Moreover, the logistical regression showed that the presence of pressure ulcers was significantly linked to death (1.59, CI 95% 1.23–2.05).

**Discussion**

Pressure ulcers cause considerable patient morbidity, are costly to healthcare facilities, and their prevalence is usually considered an indicator of quality clinical care. These points should be sufficient to consider pressure ulcers as a real problem, especially for elderly people who are more vulnerable.

Even if multiple causes have been identified, malnutrition has been recognized as one of the most important risk factors for the onset and perpetuation of pressure ulcers. Criteria for malnutrition in elderly subjects include: weight loss ≥ 5% in 3 months or ≥ 10% in 6 months, BMI < 21 Kg/m, serum albumin < 35 g/L, or a Mini Nutritional Assessment (MNA) score < 17.21.

As the nutritional status of elderly individuals is often difficult to estimate, malnutrition is often unrecognized and untreated during hospitalization.\(^2\) The reduction in appetite and physical activity in addition to clinical problems, and functional and cognitive impairments, can determine malnutrition among older persons.

The present results coincide with other studies reporting that nutritional status is involved in the development of pressure ulcers. Among the biochemical markers of malnutrition that were previously considered the most commonly suggested is albumin. Albumin is usually considered a nutritional indicator. BMI and poor albumin levels before hospital admission can predict the pressure ulcer onset. Hypoalbuminemia is linked to protein malnutrition because the liver reduces albumin production in favor of more important plasma proteins. The Prognostic Inflammatory and Nutritional Index (PINI) based on measurement of albumin, α1-acid glycoprotein, C-reactive protein, and pre-albumin has been valuable in estimating the prognosis of patients with pressure ulcers.\(^3\)

Moreover, malnutrition has been identified as an independent risk factor for death in elderly hospitalized patients after controlling for functional status, and socio-demographic and medical factors. The present results agree in part with Raynaud-Simon and colleagues\(^4\) who reported that low albumin and BMI are significantly associated with the risk of death. We did not find a direct association between low albumin and risk of death, but the present results demonstrate that mortality is significantly increased in patients with low BMI.

Another previous study showed that thinner subjects with a lower BMI are more exposed to pressure ulcers than patients with a higher BMI.\(^5\) The authors demonstrated that the peak seat interface pressure was increased in patients with a less than desirable BMI (20–24.9 kg/m\(^2\)). Patients with lower BMI and poor mobility may be at a greater risk to develop a pressure ulcer. Greater peak seat interface pressure from lower BMI measurements can be explained by the formula: (pressure = force/area).

The incidence of pressure ulcers in the present sample was low compared to other studies and was lower than expected in a hospitalized geriatric population. A possible explanation could be that patients who are at home could continue to be followed not only by a specific physician-nurse team taking care of acute illnesses,
but can also rely on the presence of a constant caregiver, who if appropriately educated by the geriatric team, can provide specific and ongoing care.

Controversy remains over the extent to which ulcers can be associated with increased mortality. One study reported that pressure ulcers cannot cause a significant increase of death after adjusting for the effects of confounding variables, while other authors reported associations between pressure ulcers and mortality. The present data show a relative risk of death for those patients with pressure ulcers who are older and experiencing functional decline. Although the present results cannot be used to prove the extent to which pressure ulcers may have resulted in increased mortality, one can assume that pressure ulcers are independent risk factors for death.

The present study was limited since it was non-randomized, even if the main aim of the present work was to demonstrate that treating acute patients with pressure ulcers at home is feasible, although they present multiple morbidities and require acute medical care. Another limitation is that the sample number is not sufficient to allow generalization. Concerning length of hospitalization, the present results are affected both by the small sample and the longer length of stay typically seen in hospital-at-home patients. Previous studies have reported that hospital-at-home has longer lengths of stay than traditional wards. The Mini Nutritional Assessment for detecting malnutrition was not used. The mortality rate of patients who developed new wounds during hospitalization is most likely due to the severity of clinical conditions—most whom were in the terminal or pre-terminal phase. Pressure ulcers are most likely not directly involved in the increased risk of death, but surely represent an important factor that caregivers should not underestimate.

**Conclusion**

The present study reports the experience of a hospital-at-home service treating elderly patients with pressure ulcers. Although the results seem promising, especially regarding incidence of ulcers during GHHS, these data could not be generalized. The present study only facilitated reporting an experience, which could be developed and expanded in the future to randomized studies that could evaluate the differences between traditional wards and GHHS in terms of pressure ulcer onset or resolution.

**References**


