Delirium in elderly home-treated patients: a prospective study with 6-month follow-up

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Abstract Delirium usually occurs during hospitalisation. The aims of this study were to evaluate the incidence of delirium in “hospital-at-home” compared to a traditional hospital ward and to assess mortality, hospital readmissions and institutionalisation rates at 6-month follow-up in elderly patients with intermediate/high risk for delirium at baseline according to the criteria of Inouye. We performed a prospective, non-randomised, observational study with 6-month follow-up on 144 subjects aged 75 years and older consecutively admitted to the hospital for an acute illness and followed in a geriatric hospital ward (GHW) or in a geriatric home hospitalisation service (GHHS). Baseline socio-demographic information, clinical data, functional, cognitive, nutritional status, mood, quality of life, and caregiver’s stress scores

were collected. Of the 144 participants, 14 (9.7%) had delirium during their initial hospitalisation: 4 were treated by GHHS and 10 in a GHW. The incidence of delirium was 16.6% in GHW and 4.7% in GHHS. All delirious patients were very old, with a high risk for delirium at baseline of 60%, according to the criteria of Inouye. In GHW, the onset of delirium occurred significantly earlier and the mean duration of the episode was significantly longer. The severity of delirium tended to be higher in GHW compared to GHHS. At 6-month follow-up, mortality was significantly higher among patients who suffered from an episode of delirium. Moreover, they showed a trend towards a greater institutionalisation rate. GHHS may represent a protective environment for delirium onset in acutely ill elderly patients.

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Introduction

Delirium, also known as acute confusion state, is a common, serious and potentially preventable source of morbidity and mortality among hospitalised older patients. The estimated prevalence of this condition at hospital admission ranges from 10% to 40%, whereas incident cases of delirium during hospitalisation occur

in 25% to 56% of patients, but this is a conservative estimate because many cases of delirium go unrecognised (McAvay et al. 2007; Inouye et al. 2005; Rockwood 1989). Patients with delirium usually exhibit increased length of stay, increased mortality and increased risk of institutional placement. Moreover, hospital mortality rates of delirious patients range from 6% to 18% (McCusker et al. 2002, 2003a, 2003b; Marcantonio et al. 2002). These factors have been shown to increase the need for hospital and institutional days, and to produce substantial costs for health and social care services (Inouye et al. 1999; Rizzo et al. 2001).

Sudden onset and fluctuating course, inattention, altered level of consciousness, disorganised thinking and speech, disorientation, and, often, behavioural disturbances are the most important characteristics of delirium. Its clinical presentation has hyperactive and hypoactive forms. The second group is common among the elderly and often goes unrecognised. The aetiology of delirium is multi-factorial and the development of delirium involves the complex interrelationship between a vulnerable patient and exposure to precipitating factors or noxious insults (Inouye 2006; Rolfson 2002).

Delirium can be triggered by a wide range of conditions, treatments and procedures, as well as by certain environments. It is recognised that the hospital surroundings may play an important role in causing delirium in elderly patients. To avoid delirium, older patients should be cared for in a pleasant sensory environment, with the least possible intrusion into the patients' daily routine, with a reality orientation approach and involving a multidisciplinary team (Rizzo et al. 2001; Inouye 2006; Marcantonio et al. 2001). It has been previously reported that care at home results in a lower incidence of confusion. In an Australian randomised controlled trial (RCT), older patients who required hospital care were randomised to receive appropriate treatment (all pharmacological and non-pharmacological interventions usually adopted in a traditional geriatric ward for patients with acute medical conditions) either at home or in the hospital: confusion was less common in those treated at home, although these findings were based on a clinical records review (Caplan et al. 1999). In a more recent RCT, the same authors demonstrated that home rehabilitation for frail elderly after acute hospitalisation is associated with a lower risk of delirium

(Caplan et al. 2006). According to these studies, we can assume that home treatment should offer some advantages in preventing delirium, especially for frail elderly patients.

In this paper we compare home care with in-hospital care for elderly patients admitted to an emergency department (ED) for an acute illness and prospectively tested for delirium using the Confusion Assessment Method (CAM).

This study is part of a project that enrolled subjects with high risk of delirium in different settings of care with the aim of improving prevention of delirium onset. To our knowledge, the impact of some environmental supportive measures for preventing delirium at home has not yet been fully investigated.

Materials and methods

The aim of this prospective, non-randomised, observational study was to compare the incidence of delirium in two settings of care for elderly patients requiring hospital admission: the geriatric home hospitalisation service (GHHS) and the traditional geriatric hospital ward (GHW).

The GHHS and GHW in this study are affiliated to the Geriatric Care Unit of San Giovanni Battista Hospital, a University teaching and tertiary-care hospital. GHHS has been extensively described in previous papers and has proven as effective as traditional hospitalisation for selected patients with acute pathologies (Aimonino Ricauda et al. 2004, 2005, 2008). GHHS provides substitutive hospital-at-home care in a "clinical unit" model. The care is delivered by a multidisciplinary team consisting of three geriatricians, 13 nurses, two physiotherapists, one social worker and one counsellor. The team operates 7 days a week and looks after 25 patients a day on average. Every year, a mean of 450 patients is treated at home. About 60% of our patients are referred from the ED, 25% from hospital wards and 15% from specialists or general practitioners in the community. Medical consultation with other hospital specialists is possible in the hospital or at the patient's home. From an administrative, legal, and financial standpoint, hospital-at-home patients are considered hospital inpatients until discharge.

Community dwelling patients, aged 75 years or older, consecutively admitted from the ED to GHHS

or GHW from February through April 2007, were considered eligible. Six-month post-discharge follow-up interviews were completed in October 2007.

Inclusion criteria were: absence of probable or definite delirium at enrolment, according to CAM (Inouye et al. 1990), and intermediate or high risk for delirium, according to the criteria of Inouye. The risk model created by Inouye and colleagues is based on four risk factors—vision impairment, severe illness, pre-existing cognitive impairment, and dehydration—and includes three levels of risk: low-risk (no risk factors present), intermediate-risk (1 to 2 factors present), high-risk (3 to 4 factors present) (Inouye et al. 1993).

Exclusion criteria were: absence of a caregiver, inability to undergo interviewing, severe dementia that made administration of “Mini Mental State Examination” (MMSE) unfeasible, coma, aphasia or intubation, presence of a terminal illness (expected survival time < 6 months).

The primary outcomes in the two settings of care were mortality and incidence of delirium among acutely ill elderly patients, nursing home placement, hospital readmissions and mortality at 6 months after discharge. Secondary outcomes were: psychoactive drug use, complications, caregiver’s stress, cost analyses.

Functional and cognitive status 6 months after discharge in the delirious patients were considered as a secondary outcomes.

All enrolled patients were first assessed in the ED with a baseline standard clinical evaluation: blood tests, 12-lead electrocardiography, chest radiograms. Further investigations were performed according to the clinical judgment of the ED physician. After ED evaluation, patients were transferred either home or to the GHW.

The physician interviewers, who had at least 5 years experience in conducting research-related interviews in the elderly, were unaware of the objectives of the study and who had no role in the intervention, conducted the investigation, which consisted of: medical history, demographic and socio-economic characteristics, reason for hospital admission, severity of illness (Acute Physiology And Chronic Health Evaluation—APACHE II; Knaus et al. 1985), co-morbidity (Cumulative Illness Rating Scale—CIRS; Conwell et al. 1993), sight and hearing problems (graded from 0=normal to 3=

serious impairment), functional status (Activities of Daily Living—DL, Instrumental Activities of Daily Living—IADL; Katz et al. 1963; Lawton and Brody 1969), cognitive status (MMSE; Folstein et al. 1975), nutritional status (Mini Nutritional Assessment—MNA; Guigoz et al. 1996), quality of life (Nottingham Health Profile—NHP; Hunt et al. 1985), and affective condition (Geriatric Depression Scale—GDS; Yesavage et al. 1982). Drugs used by patients prior to hospitalisation were recorded, especially medications bearing high risk for delirium, including benzodiazepines, anti-cholinergics, antidepressants and anti-Parkinsonians. Predisposing factors for delirium (age > 65 years, male gender, depression, previous history of delirium, protracted immobilisation, previous falls, recent trauma or bone fracture, vision or hearing loss, malnutrition, drinking habit, use of more than five drugs, use of psychotropic drugs, terminal illnesses) were also described.

For each patient, cognitive status (MMSE) and possible onset of acute delirium (CAM) were evaluated by physicians interviewers every 48 h or earlier, if patients were recognised as being confused, until discharge or death. Whenever an episode of delirium occurred, a standardised pre-coded form, describing duration and severity of delirium (Delirium Rating Scale—DRS; Trzepacz et al. 1988), possible triggers, non-pharmacological and pharmacological treatments, was filled out.

Non-pharmacological treatment strategies to prevent and treat delirium were adopted in both care settings: reorientation techniques (board with names of care-team members calendars, clocks...), environmental modifications to prevent cognitive deprivation (discussion of current events, word games and other cognitively stimulating activities twice daily), daily mobilisation to avert immobilisation (at least three times daily), prevention of sleep deprivation (warm drinks, relaxation tapes, back massage, unit-wide noise-reduction strategies, scheduling of medications and procedures to avoid interrupting sleep of patients), prevention of malnutrition and dehydration (encouragement of oral intake of food and fluids, cleaning of the oral cavity, maintenance of food habits, frequent administration of small meals and fluid, patients socialisation during meals, and nutritional education for patients or their proxy).

Caregiver’s characteristics and level of stress at baseline, at time of discharge and 6 months after

discharge (Relatives' Stress Scale—RRS; Greene et al. 1982) were also recorded.

Length of hospital stay and location of patient (home or nursing home) were recorded on discharge. Mortality, institutionalisation, hospital readmissions, functional, cognitive and depressive status in delirious patients were assessed by patient and caregiver interviews and by review of medical records 6 months after discharge. Finally, GHHS and GHW costs of care were compared.

Consent to participate was approved by the Ethical Committee of the University Hospital of Turin. It was administered to the patient or to a proxy in the ED by a physician before the patient was admitted to the GHW or to the GHHS and included information about the methods and the aims of the present study.

Statistical analysis

Data are presented as means $\pm$ SD (95% confidence intervals; CI) or as percentages in the corresponding categories. We used paired and unpaired *t*-tests to compare data within and between the groups, respectively, for parametric data, and χ^2 tests for non-parametric data. The Kaplan-Meier method was used to evaluate cumulative proportion survival at 6-month follow-up. The log-rank test was used to compare the survival curves among the patients with and without delirium. Survival time was defined as length of time between date of discharge and date of the follow-up study interview at 6 months or (in the case of death) the date of death.

Results were interpreted using the real probability. A *P* value < 0.05 was considered significant. For nonparametric tests, the real probability was interpreted using CI. Data were analysed with SPSS for Windows version 11.5.

Economic analysis

Costs of patient management were calculated by comparing the direct health costs of GHHS interventions with those of GHW care. The costs were calculated in Euros and converted to United States dollars using an exchange rate of 1 Euro = US\$ 1.546. The daily GHHS costs included costs for geriatricians, nurses, counsellors, dietitians, and social workers, calculated according to the amount of time spent with patients and including a cost for noncontact time.

Data on hospital costs were collected from the official hospital medical cost database, including direct medical costs for beds, staff, examinations, medications, rehabilitation, and miscellaneous expenses. Data on costs for hospital-at-home patients were obtained in a similar manner, except that costs for hospital-at-home patients did not include costs for food, laundry, heating, or lighting. Costs for ED care were included for both patient groups.

Results

From February through April 2007, 2,930 patients aged 75 and older were consecutively admitted to the ED of our hospital for different acute illnesses. Of these, 46.7% ($n=1,370$) needed hospital level care and 360 were admitted to the Geriatric Care Unit. Among them, 144 were eligible for this study: 84 were treated in GHHS and 60 in GHW. Of the 216 patients excluded, 69 did not have a caregiver, 10 had a terminal illness, 53 were unable to undergo interviewing because of profound dementia ($n=37$), coma ($n=6$), aphasia ($n=4$) or intubation ($n=4$). The remaining 84 eligible patients refused to give consent.

The baseline characteristics of patients admitted to GHHS and GHW are shown in Table 1. All patients were Caucasian and elderly. The two samples were homogenous by gender, level of education, marital status, and drug consumption at home. According to Inouye's criteria, 62% of GHHS patients and 60% of GHW patients were at high risk for delirium. GHHS patients showed higher levels of clinical and functional impairment in CIRS, APACHE II and ADL scores, and a more severe cognitive impairment at MMSE examination.

The main reasons for hospital admissions were similar in the two groups and included infections, and heart and blood diseases.

During hospital stay, the incidence of delirium in the total sample was 9.7%, affecting 4.7% of the patients in GHHS and 16.6% of those admitted to GHW ($P=0.023$), with a relative risk of 3.8 (CI 8–13.72). Delirious patients were 57.4% males, with a mean age of 82 years. About 43% of the sample was at high risk of developing delirium according to Inouye's criteria. Hyperactive delirium accounted for 57.1% of the episodes. The onset of delirium occurred earlier after hospital admission in GHW as compared

Table 1 Baseline characteristics of the study population. *GHHS* Geriatric home hospitalisation service, *GHW* Geriatric hospital ward. Assessments: *ADL* Activities of Daily Living, *IADL* Instrumental Activities of Daily Living, *MMSE* Mini Mental State Examination, *MNA* Mini Nutritional Assessment, *GDS* Geriatric Depression Scale, *NHP* Nottingham Health Profile, *CIRS* Cumulative Illness Rating Scale, *APACHE II* Acute Physiology And Chronic Health Examination

Characteristic	GHHS (n=84)	GHW (n=60)	P-value
Age (years) (mean ± SD)	86.1±5.8	84.7±4.9	0.11
Gender, male, n (%)	20 (23.8)	18 (30)	0.41
Married, n (%)	36 (42.8)	16 (43.3)	0.22
Living alone, n (%)	0 (0)	4 (6.7)	0.07
Number of medications at enrolment (mean ± SD)	5.8±2.6	4.3±2.7	0.14
Risk for delirium			
Moderate	52 (62)	36 (60)	0.98
High	32 (38)	24 (40)	0.99
ADL (mean ± SD) ^a	2.±2.0	3.4±3.5	0.01
IADL (mean ± SD) ^b	5.4±4.1	6.1±4.0	0.23
MMSE (mean ± SD) ^c	18.1±7.5	21.6±5.0	0.05
MNA (mean ± SD) ^d	15.7±3.3	14.4±4.1	0.04
GDS, mean ± SD) ^e	13.2±6.1	13.3±4.5	0.91
NHP (mean ± SD) ^f	18.1±8.7	21.3±6.7	0.06
CIRS (mean ± SD) ^g			
Comorbidity index	2.1±1.3	0.9±0.7	0.00
Severity index	0.9±0.4	0.7±0.3	0.00
APACHE II (mean ± SD) ^h	19.8±3.8	18.6±3.1	0.04
Patients with hearing impairment, n (%)	34 (40.5)	22 (36.6)	0.64
Patients with sight impairment, n (%)	36 (42.8)	28 (46.6)	0.65
Blood urea nitrogen/creatinine ratio (mean ± SD)	51.9±17.7	57.6±20.3	0.07

^a 0=no functions lost; 6=all functions lost

^b 0=complete inability to perform daily activities; 14=all abilities preserved

^c 0=completely cognitively impaired; 30 not cognitively impaired

^d 0=malnourished; 30=absence of risk of malnutrition

^e 0=absence of depression; 30=severe depression

^f 0=good quality of life; 100=bad quality of life

^g Comorbidity index (0=absence of comorbidity; 13=highest comorbidity), severity index (1=lowest severity; 5=highest severity)

^h 0=lowest risk of death; 71=highest risk of death

to GHHS (1.8±0.8 days vs 5.5±1.3 days, $P<0.001$). The mean duration of the episode was longer in GHW than in GHHS (7.2±17.3 days versus 1.1±5.1 days, $P<0.001$). No differences were detected in the severity of delirium evaluated by DRS, although patients

admitted in GHW reported a higher mean score (2.5±5.9 in GHW, 0.79±3.6 in GHHS, $P=0.06$). The multivariate analysis model showed that the setting of care was the only factor significantly associated with delirium onset. In fact, risk of developing delirium was 3.84 times higher in GHW as compared to GHHS (Table 2).

Non-pharmacological treatment strategies (reorientation techniques, environmental modifications to prevent cognitive deprivation, daily mobilisation to avert immobilisation, interventions to prevent sleeplessness, malnutrition and dehydration) were adopted in both settings of care. However, the mean number of psychoactive drugs used for the acute episode in GHHS was 0.7±0.34 and in GHW 1.7±0.7 ($P=0.02$).

Length of stay in the whole sample was significantly longer in GHHS (19.1±9.5 days) than in GHW (14.1±16.2 days) ($P<0.001$). Nonetheless, GHHS patients who developed delirium had the same length of stay as those who did not (19.5±4.0 vs 19.3±9.7, $P=0.44$) while GHW patients with a delirium episode stayed longer than those who did not develop delirium (25.8±38.7 vs 11.8±5.3, $P=0.01$). The mean number of complications (mainly urinary and respiratory infections) was 0.8±1.0 in GHW and 0.5±0.6 in GHHS ($P=0.02$).

Only 9.5% ($n=8$) of the home-treated patients needed an admission to long-term facilities, compared to 11.5% ($n=22$) of GHW patients ($P<0.001$).

Three patients in the GHHS group (3.5%) and two GHW patients (3.3%) died during admission. The mortality rate was similar in the two groups (3.4% of the total sample). No delirious patients died or were institutionalised at the end of hospital stay.

The baseline characteristics of caregivers were comparable in the two groups. In more than 80% of cases, the caregiver was a child or spouse, 70% were

Table 2 Relative risk of developing delirium according to setting of care, previous history of delirium and gender (logistic regression analysis). β Regression coefficient, *CI* confidence interval, *SE* standard error, *RR* relative risk

	β	S.E.	RR (CI)	P-value
GHW vs GHHS	1.35	0.65	3.84 (1.8–3.7)	0.04
Previous history of delirium: positive vs negative	1.53	1.04	4.64 (0.6–35.7)	0.14
Gender: male vs female	1.02	0.61	2.77 (0.8–9.1)	2.77

female, 78% were married, about 35% had a working activity and 54% a good level of education (>5 years). For patients admitted to GHW, caregiver's stress increased significantly on discharge as compared to admission (25.8 ± 6.3 vs 30.8 ± 7.7 , $P < .001$), while in GHHS, the relative's stress decreased (22.6 ± 7.7 on admission, 20.6 ± 11.1 on discharge, $P = 0.18$).

At 6-month follow-up, out of 139 discharged subjects, 18 (12.5%) were dead, 21 (19.0%) were institutionalised and 10 (6.9%) were lost to follow-up (three in GHHS and seven in GHW). During the 6-month follow-up, the major causes of death were pulmonary illnesses (50%), cardiovascular illnesses (44.4%) and gastrointestinal illnesses (5.6%). More than 75% of survivors were women; 81% of women were still living at home at time of follow-up.

The mortality rate was significantly higher among patients who showed an episode of delirium than in patients who were never delirious (42.9% vs 9.6%, $P < 0.001$). In delirious patients, Kaplan-Meier survival decreased rapidly during the first 2 months after the episode ($P < 0.001$) (Fig. 1). We found a trend to a greater institutionalisation rate (HR 3.45, CI: 0.94–12.57) but no significant differences in hospital readmission rates in patients who developed delirium.

Fig. 1 Kaplan-Meier survival curves for individuals with and without delirium, 6 months after discharge

At 6-month follow-up, MMSE scores decreased significantly only among patients who suffered from an episode of delirium (change in MMSE score 3.8 ± 4.3 , $P = 0.04$). Similar results were found in ADL functions: delirious patients lost more functions (2.8 ± 2.2) than those who did not develop delirium during hospitalisation (0.7 ± 0.6) ($P < .001$).

The cost of management for each patient in the ED was, on average, \$349.4, and it was the same for patients in both settings. This cost included physician visit, chest radiogram, electrocardiogram and blood sampling.

The total mean cost was \$3,802.4 for each patient treated at home and \$9,350.3 for patients treated in the hospital. On a cost per patient per day basis, GHHS costs were \$199.1, compared with \$663.1 for GHW patients ($P < 0.001$). Moreover, delirious patients admitted to GHW had a longer mean hospital stay, which further increased hospital costs.

Discussion

Despite the fact that more than half of our patients were at high risk for delirium at baseline, the incidence of delirium in both settings of care was low, especially in GHHS, compared to other previously published data from the literature (Inouye 2006). It is likely that the multidimensional approach to care of the elderly patient and the adoption of specific strategies to prevent confusion are important in lowering the risk of delirium.

It is well known that frail elderly patients admitted to hospital are at risk of developing severe physical and psychological failure due to the stress of being in an unusual environment, to bed rest, and to iatrogenic diseases that can lead to a decline in functional and cognitive status. The acute stress of changing environment may produce symptoms of depression and/or anxiety and promote the onset of confusion and delirium, even in the absence of previous cognitive disturbance (Creditor 1993).

Data from the literature support the need for a specific type of hospital environment as well as a devoted staff for patients at risk of delirium. A multi-component targeted intervention, the Elder Life Program—a risk-factor intervention strategy adopted by Inouye and colleagues—resulted in a significant reduction in the number and duration of episodes of

delirium in hospitalised older patients (Inouye et al. 1999). More recently, Flaherty and colleagues demonstrated that the treatment of delirious patients in specific wards (“delirium rooms”) can reduce functional impairment and mortality without extending the length of stay in hospital (Flaherty et al. 2003). In Italy, such delirium rooms are not yet widely operative in the national healthcare system. However, we think that the geriatric approach usually adopted for frail old patients (multi-dimensional assessment, attention to sensory inputs, specific care of geriatric problems) can be an effective model of care for delirious patients.

Delirium is a serious health problem needing quick diagnosis and hospital-level treatment. Our GHHS is a physician-led clinical unit model that provides an intensity of care similar to that delivered in the hospital.

Treatment of old patients in their homes helps them to maintain a reassuring environment with usual time and space references and protection of their privacy. While admitted in GHHS, the old person still belongs to his/her family, maintains close relations with relatives, friends, and neighbours, maintains his/her habits and lifestyles (Leff and Montalto 2006). As demonstrated by this study, these conditions are highly protective against delirium.

Our results are even more significant if we consider that, on admission, GHHS patients, with a higher level of physical, cognitive and functional impairment, were more vulnerable to this condition.

Non-pharmacological treatments of a delirium episode are more difficult to adopt in the traditional hospital setting: although the GHW was prepared to treat elderly patients at risk for confusion episodes with early mobilisation and interventions to avert cognitive deprivations, the use of psychotropic drugs during an acute episode was more intensive also because it is not easy to recreate the patient’s home atmosphere within the hospital. This suggests that exposure to the hospital environment itself could be a significant risk factor for delirium.

In elderly subjects, an up to three-fold increase in the risk of developing nosocomial infections is detected compared to the general population (Creditor 1993). Inter-current illnesses act as an important precipitating factor that can contribute to delirium (Inouye 2006). In our study, the number of medical complications, especially urinary and respiratory

infections, was lower in patients treated at home by GHHS, and this factor could also contribute to explaining the lower rate of delirium at home.

Delirium did not prolong the length of stay in GHHS as was the case in GHW. In fact, we noticed a slightly higher mean severity of episodes in GHW, which could also account for the longer duration of the episode in the hospital context.

The management of delirious patients at home can be very distressing. Nevertheless, we observed that caregivers’ stress on discharge was significantly increased only in the GHW group, with a trend towards decrease in the GHHS group. The GHHS caregivers were encouraged to actively participate in the care of their “beloved”, adopting strategies to avoid delirium. Individual counselling was offered to caregivers if needed.

Education and psychological support are important to achieve good health outcomes. Families benefit from knowing that delirium is a possibility and from understanding what delirium entails (Meagher 2001).

Delirious patients are more likely to experience adverse outcomes during and after hospitalisation, including increased mortality and residential placement (McAvay et al. 2006; McCusker et al. 2003a, 2003b), but in our sample we did not find increased mortality or institutionalisation rate on discharge. Patients with delirium had the same chance of being discharged to their usual accommodation: a possible explanation could be found in the small sample size or in the relative’s hope of being able to keep the patient at home. Our study provides new evidence of the impact of delirium as a prognostic indicator for mortality 6 months after discharge.

It has been recognised that, although delirium is generally understood as a transient reversible condition, recovery is often incomplete in older patients (Inouye et al. 1998; Adamis et al. 2006), and an association between delirium and consequent cognitive and functional impairment has emerged from clinical studies (Marcantonio et al. 2003; Jackson et al. 2004). In our study, patients with delirium showed a significant cognitive and functional decline at 6-month follow-up.

The present study has some limitations. The small sample size limits the power of the study. Nonetheless, the study group was drawn from a larger sample representative of older patients admitted to an acute care hospital. Patients were not randomly assigned to

treatment and differences between the two groups may be attributable to selection bias. The evaluators were not blinded to the patients' group allocation, which may have allowed unconscious biases on the scores.

The study was conducted at only one centre specialised in the care of elderly patients and by an operationally mature hospital-at-home model; therefore, the generalisation of our results may be questioned.

Although several studies have been published on delirium in in-patients, few data are available on the incidence of delirium in patients treated at home.

Previous RCTs that have investigated the effects of a home-based care setting in delirium prevention differ from our study in that they were not specifically designed to detect incident delirium (Caplan et al. 1999) or to report data of patients undergoing a rehabilitation program at home, and thus patients were not acutely ill in the earlier studies (Caplan et al. 2006). To our knowledge, this is the first study to identify delirium episodes in hospital-at-home patients constantly throughout the study period. Therefore, we cannot compare our data with similar findings from the literature.

In conclusion, we can assume that substitutive hospital-at-home care for acutely ill frail elderly patients taken from the ED should offer some health outcome advantages. Moreover, the lower incidence of delirium among the patients treated at home can be ascribed to the delivery of high-quality treatment in a protected environment. For old patients at high risk of developing delirium, GHHS could represent a protective environment against the onset of acute confusion. Since delirium is recognised as a predictor of morbidity and mortality, our results gain further clinical significance. Although our results are promising, there is a need for further studies comparing delirium incidence in hospital-at-home and traditional hospital wards. Such studies should enroll a larger number of patients and, possibly, have a randomised design.

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