

Research

# Hospital in the home: a randomised controlled trial

Gideon A Caplan, John A Ward, Nicholas J Brennan, Janis Coconis, Neville Board and Ann Brown

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## Abstract

**Objectives:** To compare treatment of acute illness at home and in hospital, assessing safety, effect on geriatric complications, and patient/carer satisfaction.

**Design:** Randomised controlled trial.

**Setting:** A tertiary referral hospital affiliated with the University of New South Wales.

**Participants:** 100 patients (69% older than 65 years) with a variety of acute conditions, who were assessed in the emergency department as requiring admission to hospital.

**Interventions:** Patients were allocated at random to be treated by a hospital-in-the-home (HIH) service in their usual residence or to be admitted to hospital.

**Main outcome measures:** Geriatric complications (confusion, falls, urinary incontinence or retention, faecal incontinence or constipation, phlebitis and pressure areas), patient/carer satisfaction, adverse events, and death.

**Results:** There was a lower incidence of confusion (0 v. 20.4% [95% CI, 9.1%-31.7%]; $P = 0.0005$), urinary complications (incontinence or retention) (2.0% [95% CI, -1.8%, 5.8%] v. 16.3% [95% CI, 6.0%, 26.6%]; $P = 0.01$), and bowel complications (incontinence or constipation) (0 v. 22.5% [95% CI, 10.7%, 34.1%]; $P = 0.0003$) among HIH-treated patients. No significant difference in number of adverse events and deaths (to 28 days after discharge) in the two groups was found (although numbers were small). Patient and carer satisfaction was significantly higher in the HIH group.

**Conclusions:** Home treatment appears to provide a safe alternative to hospitalisation for selected patients, and may be preferable for some older patients. We found high levels of both patient and carer satisfaction with home treatment.

## Introduction

Acute care of patients at home is one of the fastest-growing healthcare sectors in the United States[1-3] and is gaining acceptance in many

countries.[4] Although there have been randomised controlled trials of patients receiving home versus hospital treatment for deep venous thrombosis,[5] there are few data from trials involving other conditions, or assessing the safety of acute care at home, especially for older patients. It is these patients who occupy an increasing proportion of hospital beds and may derive most benefit from home treatment.[6,7]

Recent studies characterising hospital-associated adverse events[8,9] make home treatment more attractive,[10] especially for elderly patients who are known to suffer a higher incidence of complications in hospital.[11] When treated at home, patients do not have to change their environment or routine, they are not exposed to nosocomial infection, and they do not need to adapt to the sociological culture of the hospital. On the other hand, the incidence and severity of intrinsic complications in older patients can be minimised by round-the-clock supervision by expert staff in hospital. However, there is inadequate evidence to support the popular belief that programs which transfer care to the home result in a worse outcome for the patients.[12,13]

We have conducted a randomised controlled trial of a hospital-in-the-home (HIH) program targeting older patients. We selected conditions which were amenable to home treatment, but tried to include a variety of diagnostic groups. To accentuate the difference between the two groups, the HIH patients were taken home on the day of presentation to the emergency department, or on the following morning if they presented at night. We studied the safety, efficacy and patient/carer satisfaction of home treatment compared with hospital treatment.

## Methods

### *Patients and randomisation*

One hundred patients requiring admission to hospital and meeting criteria for study inclusion were randomised to HIH treatment (intervention group) or treatment in hospital (control group). We targeted patients older than 65 years, including those living in nursing homes, but also accepted younger patients. Patients were accepted only if they had been assessed as requiring admission by the relevant medical or surgical team. The medical, surgical and emergency department staff were encouraged to refer patients with acute (pneumonia, urinary tract infections and cellulitis) and subacute (endocarditis and osteomyelitis) infections requiring treatment with intravenous antibiotics, deep venous thrombosis (DVT), minor cerebrovascular accidents (not affecting mobility or swallowing), and cardiac failure.

Patients were excluded from the study

- if they had evidence of shock (systolic blood pressure < 100 mmHg);
- if they required oxygen ($Pao_2$ < 60 mmHg);
- if they were judged too unwell by the study team;

- if they had no available carer;
- if they lived outside the local area; or
- if their home was unsuitable for home treatment (lack of running water, electricity or an inside toilet, concerns about safety, or dangerous pets).

If any doubts about home suitability arose during the emergency department assessment, a study nurse visited the home before randomisation.

After informed consent was obtained from the patient (written) and the patient's carer (verbal), randomisation (stratified according to whether the patient lived at home or in a nursing home, or had DVT) was achieved by computer-generated random numbers coded into sealed envelopes.

The study protocol required that patients in the HIH group be discharged from hospital within 24 hours of diagnosis. HIH patients receiving intravenous antibiotics were given the first dose in hospital. The study protocol was approved by the hospital's Research Ethics Committee.

***Data collection***

For all study patients, study nurses completed a Barthel Index of Activities of Daily Living,[14] a modified Instrumental Activities of Daily Living Index[15] and a Mental Status Questionnaire[16] on admission and discharge. Baseline demographic data on current medical diagnoses, a detailed social history, physical function, medications and allergies were also recorded.

***Hospital treatment***

Hospital patients (control group) were admitted under the appropriate physician or surgeon of the day and treated in accordance with standard regimens without the intervention of the study team. The hospital team treating the patient was notified that the patient had been included in the trial.

***HIH treatment***

HIH patients (intervention group) were treated according to the presenting diagnosis by the hospital community outreach team. The range of treatments in the study protocol included administration of parenteral antibiotics and other medications, and blood transfusions. Infections were generally treated with once-daily intravenous antibiotics such as ceftriaxone, gentamicin or vancomycin, as appropriate, according to the result of bacteriological tests (if positive) or by diagnosis. Intravenous access was usually via cannulas inserted by study nurses. Owing to safety concerns, some patients with dementia did not have cannulas left *in situ*, and were cannulated daily with butterfly cannulas. Patients requiring long term treatment or with difficult venous access were treated via a peripherally inserted central cannula. Patients with DVT were treated with daily subcutaneous enoxaparin injections (1.5 mg/kg) and oral warfarin until their international normalised ratio was 2.0 or above.

### *GP involvement*

Before the study, we conducted an educational program consisting of an evening lecture and a question-and-answer session for the local division of general practice. Study nurses also visited general practitioners (GPs) and nursing homes to explain the program. Our preference was for the patient's own GP to be the primary medical manager, and we therefore sought the agreement of the patient's GP before entering the patient in the trial. If GPs declined to participate, the hospital provided medical support.

### *Follow-up*

After discharge, an unmarked satisfaction survey based on the principles outlined by Draper and Hill,[17] colour coded to differentiate between responses from HIH and hospital treatment, was sent to patients, carers and GPs. This was followed by a phone call to encourage response. Patients were asked "How would you rate your treatment overall?" and offered a four-point scale of answers: excellent (1), good (2), fair (3), and poor (4). A similar question about satisfaction with the patient's care was asked of the carer and GP. Patients were recontacted by telephone at one and six months after discharge to ascertain their health status.

### *Complications*

Complications were assessed by two methods. Study personnel performed a systematic medical record review, focusing on the more common geriatric syndromes, as recorded in the patients' notes. The geriatric syndromes[18] include confusion, falls, incontinence of bladder and bowel, constipation, urinary retention, and pressure ulcers. These are not specific to older patients, but occur more commonly in frail elderly patients (geriatric patients).

The medical records were also assessed according to the validated method of counting adverse events developed for the Harvard Medical Practice Study[8] and refined in the Quality in Australian Health Care Study (QAHCS). This was done by independent reviewers engaged from the team of the Australian study.[9] This method records an adverse event -- unintended injury or complication -- only if it results in disability, death or prolonged hospital stay and is caused by healthcare management. The reviewers were a doctor and a nurse with extensive experience of QAHCS procedures. Reliability assessments were undertaken by a senior member of the QAHCS study team. The only difference from the standard technique was that the reviewers were instructed only to seek adverse events arising after randomisation, whereas the original study also sought those which had caused the admission.

### *Statistical analyses*

The study had a power of 80%, assuming $\alpha = 0.05$, to find a difference of about 20% in the occurrence of complications. All analyses were performed on the basis of intention to treat, using the SPSS for Windows and Epi Info statistical packages.[19,20] Continuous data are expressed as means and 95% confidence intervals (95% CI) and were compared by *t* tests. Satisfaction scores were compared by the Mann-Whitney *U* test. Fisher's exact test was used to compare proportions. All statistical tests were two-tailed.

## Results

Between October 1995 and February 1997, 129 patients requiring admission to hospital were assessed for participation in the study. Reasons for exclusion before randomisation were: patient too unwell for home treatment (12 patients), patient declined (6), carer refused or no carer available (9), and patient lived too far from the hospital (2). One hundred patients were enrolled; 51 were allocated at random to HIH treatment and 49 to hospital treatment. The two groups were comparable in characteristics and diagnoses (Tables 1 and 2). A quarter of the patients lived in nursing homes and 69% were 65 years of age or older. For 92 of the patients their GP agreed before randomisation to assist in their care. Four patients had no GP, one GP was not interested and three patients' GPs could not be contacted before randomisation.

### *Adverse events and complications*

The proportion of adverse events was similar in the HIH group and the control (hospital) group (11.8% [95% CI, 3.0%, 20.6%] v. 16.3% [95% CI, 6.0%, 26.6%]). However, there was a significantly lower occurrence in the HIH group of confusion, urinary (either incontinence or retention) complications, and bowel (either constipation or faecal incontinence) complications (Table 3).

### *Home visits*

On average, patients in the HIH group were seen, at home, on 9.0 occasions by the study nurse, 0.8 times by their GP, 0.9 times by a doctor from the hospital, 0.2 times by a physiotherapist, and 0.1 times by an occupational therapist. This translates to one visit per day by the nurse, given that each patient was also seen by a study nurse in the emergency department.

### *Outcomes*

Treatment failed in four of the 51 patients in the HIH group and they were admitted to hospital. Three and five patients in the HIH group and the hospital-treated group, respectively, were recorded as having an unplanned readmision within 28 days of discharge.

There was one death in each of the HIH- and hospital-treated groups during the admission. Total deaths up to 28 days after discharge were three in the HIH group and four in the hospital-treated group, and at six months after discharge six and seven deaths, respectively, had occurred. There were no significant differences between the two groups in these outcomes.

### *Patient, carer and GP satisfaction*

The response rates for the satisfaction surveys were (HIH v. control): patients 78% v. 40%, carers 55% v. 27%, and GPs 63% v. 37%. There was significantly greater satisfaction with overall HIH treatment among both patients ($P < 0.0001$) and their carers ($P = 0.0001$). Despite the increased workload and despite having to deal with more severely ill patients than usual, GPs were equally satisfied by home and hospital treatment (Table 4).

## Discussion

In our study, treatment of a range of acute infections and other diseases at

home was as safe as treatment in hospital. Previous studies which claimed to have demonstrated safety documented so few complications that risk appeared to have been eliminated by patient selection.[1-3] Our study group's 7% mortality up to 28 days after discharge (compared with zero mortality in previous studies[1-3]) establishes our patients' illness severity.

The most significant finding resulting from our inclusion of geriatric complications was the higher incidence of confusion in hospital-treated patients. The role of the hospital environment in the aetiology of delirium has long been recognised,[21] although this is not universally accepted.[22] For some of the patients in our study recorded as having confusion, all of the features of delirium according to the *Diagnostic and statistical manual of mental disorders* (DSM-IV)[23] were not present. Our aim was to be as inclusive as possible of geriatric complications, so that if a problem was noted by ward staff or carers it was included even if study personnel had not observed it. These complications were not always serious clinically and often did not have a great impact, but we valued the perspective of patients, families and hospital staff. Similarly, the occurrence of urinary and bowel complications reflects the difficulty of caring for frail elderly patients[24] (especially those from nursing homes) in an acute hospital ward. Patients with mobility or communication problems require carers attuned to their routines and signals to maintain continence.

Because of small numbers our study was limited in its power to draw conclusions about the difference between HIH and hospital treatment as far as adverse events and deaths were concerned. As there have been no previous studies addressing this question, it was not possible to estimate the size of the expected difference. Another limitation of our study was that, although we did not directly inform the adverse event reviewers about which patients were in each group, we were not able to completely blind them to the status of each group because of stylistic differences between the patient records of the hospital- and the HIH-treated patients.

Few similar comparative studies have been published. As reports and discussions entitled "home hospitalisation" or "hospital at home", for example, may include few or no acute patients, the home treatment of acute illness is obscured in the medical literature.[25,26] Our study included only patients who met the criterion of requiring admission to hospital because of illness. By bringing the hospital care to the patient's home, we substituted completely for hospital facilities. There is a need for more studies of patients with illness of this severity treated at home.

A number of factors may explain the greater satisfaction with treatment at home. In their own homes, patients are in their familiar environment, their privacy is protected, their sleep less interrupted, and they can eat their usual food.[27,28] As an example, for an elderly patient with limited cognitive function and/or decreased visual acuity, finding the bathroom at night in hospital may be impossible. Moreover, elderly patients may be unable to get out of bed because of rails on the sides of the bed. These difficulties may have contributed to the higher incidence of incontinence in our hospital-treated group. At home, patients are more active

participants, often partners, in their care. All these factors invariably translate into greater satisfaction with home treatment.[29]

Frail, older patients -- because of their atypical disease presentations, more rapid deterioration when ill and greater prevalence of disease -- need hospital-level services more frequently than younger patients. However, admission to hospital, like any medical intervention, has side effects as well as benefits.[8] Elderly patients have more to gain from many treatments (eg, thrombolytic therapy) because of their higher underlying mortality rates,[30] but they also suffer from a much greater occurrence of iatrogenic complications.[10] Although many of these complications may be explained by an interaction between their underlying frailty and their disease process,[8] we were able to detect a measurable effect attributable to a change of environment.

The results of this study do not imply that older patients should never be admitted to hospital. On the contrary, the elderly as a group have more need for the technical expertise of the acute hospital than younger people. However, if such technical expertise can be delivered at home, this alternative should at least be evaluated. On the other hand, our study does not imply that treatment which can be delivered at home should always be delivered at home. Successful home treatment depends on careful patient and home selection, as the necessary minimum level of sanitation, facilities and support from carers is not universally available.[4] However, where it is feasible, we have demonstrated that home treatment of acute illness, even for frail elderly patients, can be effective, safe and more satisfying for the patient and their families.

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Authors' details

**Post Acute Care Services, Prince of Wales Hospital, Sydney, NSW.**
**Gideon A Caplan,** MB BS, FRACP, Director; and Lecturer, University of New South Wales, Sydney, NSW; **Nicholas J Brennan,** MB BS, FRACP, Senior Registrar;
**Janis Coconis,** RN, Clinical Nurse Specialist;
**Neville Board,** RN, BA, Research Assistant;
**Ann Brown,** RN, Nurse Manager.

**Community Health Services and Programs, South Eastern Sydney Area Health Service, Sydney, NSW.**
**John A Ward,** MB BS, MSc, FRACP, Community Geriatrician; and Lecturer, University of New South Wales, Sydney, NSW.

**Reprints:** Dr G A Caplan, Post Acute Care Services, Prince of Wales Hospital, Randwick, NSW 2031.
**Email:** g.caplanATunsw.edu.au

**1: Characteristics of the 100 patients entered into the trial. Values are means with 95% confidence intervals unless stated otherwise**

| | Hospital in the home ($n$=51) | Hospital ($n$=49) |
|---|---|---|
| Age in years (median, range) | 73, 17–111 | 79, 22–97 |
| Number (%) of patients ≥ 65 years | 36 (70.6%) | 33 (67.3%) |
| Male:female ratio | 21:30 | 24:25 |
| Time in emergency department (h) | 7.8 (5.9, 9.7) | 12.2 (10.1, 14.3) |
| Length of stay (days) | 10.1 (7.7, 12.5) | 7.4 (6.0, 8.8) |
| Function measures | | |
| Barthel Index (maximum score = 20) | 15.2 (13.3, 17.1) | 14.8 (12.8, 16.8) |
| Instrumental Activities of Daily Living (maximum score = 12) | 6.8 (5.5, 8.1) | 6.2 (4.7, 7.7) |
| Mental Status Questionnaire (maximum score = 10) | 7.1 (6.1, 8.1) | 6.9 (5.8, 8.0) |
| Creatinine level (mmol/L) | 0.10 (0.08, 0.12) | 0.11 (0.10, 0.12) |
| Type of residence (number [%] patients) | | |
| Home | 37 (72.5%) | 33 (67.3%) |
| Nursing home | 12 (23.5%) | 13 (26.5%) |
| Hostel | 2 (3.9%) | 3 (6.1%) |
| Intravenous antibiotics group | $n$=37 | $n$=34 |
| White cell count (x $10^9$/L) | 10.2 (8.6, 11.8) | 11.8 (10.0, 13.6) |
| Temperature (°C) | 37.1 (36.9, 37.3) | 37.5 (37.3, 37.7) |
| Number (%) patients with positive cultures | 13 (35.1%) | 12 (35.3%) |

* Differences between patients treated at home and those treated in hospital are not significant, except for time spent in the emergency department ($P$<0.003).

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**2: Principal diagnoses of study patients**

| Diagnosis | HIH | Hospital |
|---|---|---|
| Pneumonia | 10 | 11 |
| Cellulitis | 20 | 17 |
| Urinary tract infection | 5 | 6 |
| Osteomyelitis | 2 | 0 |
| Deep vein thrombosis | 9 | 8 |
| Other* | 5 | 7 |
| Total | 51 | 49 |

* Included congestive cardiac failure (4), acute back pain (2), faecal impaction (2), acute myocardial infarct (1), shingles (1), anaemia (1) and cerebrovascular accident (1).
HIH=hospital in the home.

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**3: Geriatric complications – number (%) of patients and 95% confidence intervals**

| | Hospital in the home | Hospital | *P* |
|---|---|---|---|
| Confusion | 0 | 10 (20.4%)<br>9.1%, 31.7% | 0.0005 |
| Falls | 1 (2.0%)<br>−1.8%, 5.8% | 2 (4.1%)<br>−1.4%, 9.6% | ns |
| All bowel complications | 0 | 11 (22.5%)<br>10.7%, 34.1% | 0.0003 |
| Constipation | 0 | 7 (14.3%)<br>4.5%, 24.1% | 0.013 |
| Faecal incontinence | 0 | 4 (8.2%)<br>0.5%, 15.9% | ns |
| All urinary complications | 1 (2.0%)<br>−1.8%, 5.8% | 8 (16.3%)<br>6.0%, 26.6% | 0.01 |
| Urinary incontinence | 1 (2.0%)<br>−1.8%, 5.8% | 6 (12.2%)<br>3.0%, 21.4% | ns |
| Urinary retention | 0 | 2 (4.1%)<br>−1.4%, 9.6% | ns |
| Phlebitis | 2 (3.9%)<br>−1.4%, 9.2% | 3 (6.1%)<br>−0.6%, 12.8% | ns |
| Pressure area/skin tear | 1 (2.0%)<br>−1.8%, 5.8% | 3 (6.1%)<br>−0.6%, 12.8% | ns |

ns = not significant.

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**4: Satisfaction survey – mean responses and 95% confidence intervals**

| | Hospital in the home (*n* = 51) | Hospital (*n* = 49) | *P* |
|---|---|---|---|
| Patient | | | |
| Mean score‡ | 1.1 | 2.0 | <0.0001 |
| 95% CI | 1.0, 1.2 | 1.7, 2.3 | |
| Carer | | | |
| Mean score‡ | 1.1 | 1.9 | 0.0001 |
| 95% CI | 1.0, 1.2 | 1.4, 2.4 | |
| General practitioner | | | |
| Mean score‡ | 1.7 | 1.8 | ns |
| 95% CI | 1.4, 2.0 | 1.4, 2.2 | |

‡Satisfaction was rated on a 4-point scale: 1 = Excellent; 2 = Good; 3 = Fair; 4 = Poor. na = not applicable.

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