Substitution of a nursing-led inpatient unit for acute services: randomized controlled trial of outcomes and cost of nursing-led intermediate care

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Abstract

Objectives: to evaluate the outcome and cost of transfer to a nursing-led inpatient unit for ‘intermediate care’. The unit was designed to replace a period of care in acute hospital wards and promote recovery before discharge to the community.

Design: randomized controlled trial comparing outcomes of care on a nursing-led inpatient unit with the system of consultant-managed care on a range of acute hospital wards.


Subjects: 175 patients assessed to be medically stable but requiring further inpatient care, referred to the unit from acute wards.

Intervention: 89 patients were randomly allocated to care on the unit (nursing-led care with no routine medical intervention) and 86 to usual hospital care.

Main outcome measures: length of hospital stay, discharge destination, functional dependence (Barthel index) and direct healthcare costs.

Results: care in the unit had no significant impact on discharge destination or dependence. Length of inpatient stay was significantly increased for the treatment group (P = 0.036; 95% confidence interval 1.1 – 20.7 days). The daily cost of care was lower on the unit, but the mean total cost was £1044 higher—although the difference from the control was not significant (P = 0.150; 95% confidence interval –£382 to £2471).

Conclusions: the nursing-led inpatient unit led to longer hospital stays. Since length of stay is the main driver of costs, this model of care—at least as implemented here—may be more costly. However, since the unit may substitute for both secondary and primary care, longer-term follow-up is needed to determine whether patients are better prepared for discharge under this model of care, resulting in reduced primary-care costs.

Keywords: intermediate care, length of stay, nurse clinicians, randomized controlled trials, skilled nursing facilities, sub-acute care

Introduction

Recently, the United Kingdom government proposed a plan to create 5000 intermediate-care beds in nursing homes and designated wards of acute hospitals [1]. Here, we describe a randomized controlled trial to evaluate the effectiveness and cost of intermediate care in a nursing-led inpatient unit (NLIU) situated in an inner-city general hospital.

The NLIU is an inpatient facility offering rehabilitative nursing care where case mix is based on nursing need [2]. It is a frequently discussed model of intermediate care [3–7]. The NLIU stay is intended to replace part of the time that the patient spends in acute
hospital care in order to maximize recovery before discharge. This approach has been used to care for patients who have had strokes and hip fractures and for post-acute/sub-acute general medical patients [8, 9]. Although it is not an age-related service, older people are regarded as the main recipients of intermediate care [1, 7, 10].

Several reports suggest that NLIUs effectively prepare patients for discharge [8, 11, 12], but limitations in these studies have resulted in a lack of sound evidence [2]. A recent study identified increased costs of care with no evidence of benefit [9]. Here, we aimed to test the hypothesis that NLIUs can replace acute care and deliver improved outcomes for a group of patients identified as suitable by their hospital doctors, without increasing costs.

Methods

Intervention

The NLIU is a 19-bed ward in a medium-sized district general hospital. Patients are referred from acute wards in the same hospital. The patient's need for medical care must be stable and of low intensity. Stability is defined as having had no major patho-physiological changes for at least 24 h, having no changes in medical management anticipated and having no major tests or investigations planned or awaiting results. In addition, patients must have 'active nursing needs'—a problem requiring nursing care with potential for improvement. Both unit nurses and referring doctors assess suitability. Nurses have authority to admit and discharge patients.

Patient care is managed by one of three nurse practitioners (F-grade). Nurses lead the multi-disciplinary clinical team. Nursing is regarded as the main therapy. The nurse–patient ratio of 0.84 nurses per patient over 24 h is comparable to the mean of 0.81 for other wards. Sixty-three percent of nurses on the unit were qualified, compared with 61% on other wards. Other therapies are provided on referral. Non-urgent medical input is provided on nursing staff's referral by a general practitioner during four 2-h sessions per week. Emergency care is provided by the usual hospital service.

Protocol and concealment

This randomized controlled trial compared patients in a treatment group (plan to transfer to the NLIU) with those in a control group (remain under 'usual' medically managed inpatient care in general hospital wards). Eligible patients were all those referred to the unit and assessed by nursing and medical staff as suitable. Patients were recruited immediately after they were assessed as suitable. Consenting patients were randomized using sequentially numbered sealed envelopes containing random allocations. Allocation was fully concealed until after recruitment.

Subjects

Patients were excluded if they had previously participated in the study, were not identified as stable, had no nursing needs or had an anticipated stay of less than 4 days. During the 20 months of data collection, 350 suitable patients were referred to the unit out of 585 in total. Of these, 176 were able and willing to consent to the study. Eighty-nine were randomized to the unit and 87 to usual care. One control patient withdrew. Details of recruitment, randomization and follow-up are shown in Figure 1.

No statistically significant differences were found between those who consented and those who did not in terms of age, sex, diagnosis, dependence or time from admission to referral.

Measures

Outcomes assessed were length of inpatient stay, functional dependence at discharge (measured by a 20-point Barthel index, where 0=maximum dependence [13]), place of discharge and readmission. Baseline assessment was within 24 h of referral, and outcomes were assessed in the 48 h before discharge. Researchers who were independent of the clinical team collected all data. Blinding was not possible because of the nature of the intervention.

Figure 1. Recruitment, randomization and follow-up rates for comparison of nurse-led inpatient unit (NLIU) and usual care. *Place of discharge and length of stay data only.
We collected unit cost data from service providers and from the literature [14]. We determined use of tests and investigations from patient records. For occupational therapists, speech and language therapists, and physiotherapists, input was determined from therapist’s records of length of time spent on a case. We noted contacts with doctors from the patient record and used them to make weighted attributions of medical cost. For other professional inputs, costs were based on a 30 min consultation.

Costs were attributed to a patient for each day of their stay on a ward rather than on a speciality basis. Since it is unlikely that the resources available within wards are used equally for all patients, three estimates of additional cost per inpatient day were employed.

The first used a bottom-up design: all patients referred over a 6-month period of the study were observed on two occasions to identify the amount of time that nurses spent, broken down by grade of nurse, with patients in each group (39 control, 36 NLIU). The cost of medical cover was then apportioned to each group, weighted according to the number of medical contacts on the unit compared with the control wards. The control wards were attributed an additional cost (£2.98 per day, approximately 10%) for routine medical ward rounds.

A second estimate reduced the cost of nursing in the first estimate by discounting the effect of unproductive time (4.9% overall, 4.1% for the NLIU). A basic cost per day was added to both these estimates, which included overheads such as estates and laundry. These estimates are sensitive to differences in the amount of nursing and medical care delivered to individual patients in the study.

The third estimate simply used the cost per bed day (including overheads) from the year-end accounts for each ward (excluding the costs of resources measured directly such as laboratory tests). This method assumes that medical and nursing resources are used equally for all patients on a ward. It is least sensitive to differences between individuals but less dependent upon the accuracy of estimates based on observation and patient records. We calculated daily cost per patient by dividing the total cost by the number of inpatient days.

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As an additional check on the validity of using the t-test, bootstrapping was performed on the cost data, and 95% confidence intervals calculated around the observed and bootstrapped means. Bootstrapping allows the estimation of population measures without making assumptions about the distribution [18].

We used data from a previous study [12] to estimate the required sample size [19]. We had aimed to recruit 260 patients in order to detect medium to small effects ($\alpha=0.05$, power=0.8). As we failed to achieve this sample, we recalculated the power based on data within the study. This study was able to identify medium effect sizes (approximately 0.4): a difference of 1.5 points on the Barthel index and 10 days of hospital stay ($\alpha=0.05$, power=0.8).

**Results**

**Subjects**

The mean time from admission to referral was 15.2 days (range 1–171). At baseline, the groups varied no more than might be expected by chance (Table 1). Patients had a mean age of 78.3 years. One hundred and twenty-five patients (71%) were aged 75 or over and 95 (54%) were aged 80 or over; 67% were women. They were very dependent in activities of daily living, as indicated by a mean Barthel index of 12.3 (median 13).

Musculo-skeletal disorders other than hip fractures were present in 23% of the sample. Twenty percent presented with some functional deterioration for which no medical reason was identified. Cardiac disorders, genito-urinary disorders and gastro-intestinal diagnoses were all common (Table 1). Half of the patients came from general medicine and only 14% from geriatric medicine. Four control patients were transferred to the geriatric medicine service after entry into the study. No patients were discharged to alternative intermediate-care settings (such as a cottage hospital).

**Statistical analysis**

Analysis was conducted on an intention-to-treat basis. Significance tests were two-tailed. Two-by-two contingency tables were analysed using Fisher’s exact test and confidence intervals for differences between proportions [15]. Other contingency tables were analysed using $\chi^2$. For the Barthel index, the pre-test score was used as a covariate for ANCOVA on ranked data [16], performed because the data were not normally distributed. Other means were compared using the separate variances t-test, as the sample size was sufficiently large for the test to be robust to non-normality [17].

**Outcomes**

The Barthel index score improved by a mean of 3.1 points during the study (Table 2). Care on the NLIU had no significant effect on the Barthel index at discharge (Table 3; $P=0.115$). There was no significant difference between the groups in discharge destination or in readmissions (Table 4). Overall, 83% of patients returned to an independent (non-institutional) form of accommodation (95% confidence intervals for the difference between NLIU and usual care 6.5 to −10.5%), 7% were discharged to institutional (residential or nursing home) accommodation (95% confidence intervals for difference 7.3 to −7.8%) and
Table 1. Nursing-led inpatient unit (NLIU) and usual care: baseline patient characteristics

<table>
<thead>
<tr>
<th>Care</th>
<th>NLIU (n=89)</th>
<th>Usual (n=86)</th>
<th>All (n=175)</th>
<th>Test</th>
<th>Difference&lt;sup&gt;a&lt;/sup&gt; (95% confidence intervals)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Barthel index (and SD)</td>
<td>12.0 (4.3)</td>
<td>12.6 (4.7)</td>
<td>12.3 (4.5)</td>
<td>t = 0.91; d.f. = 173; P = 0.37</td>
<td>-1.96 to 0.73</td>
</tr>
<tr>
<td>Mean age (and SD)</td>
<td>77.6 (10.7)</td>
<td>79.0 (12.4)</td>
<td>78.3 (11.6)</td>
<td>t = -0.80; d.f. = 173; P = 0.45</td>
<td>-4.8 to 2.1</td>
</tr>
<tr>
<td>No. (and %) of men</td>
<td>52 (36%)</td>
<td>25 (29%)</td>
<td>57 (33%)</td>
<td>Fisher’s exact; P = 0.34</td>
<td>21% to -6%</td>
</tr>
<tr>
<td>No. (and %) in most frequent diagnostic groups&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Musculo-skeletal injury (excluding hip)</td>
<td>23 (26%)</td>
<td>18 (21%)</td>
<td>41 (23%)</td>
<td>Fisher’s exact; P = 0.48</td>
</tr>
<tr>
<td></td>
<td>Functional deterioration&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18 (20%)</td>
<td>17 (20%)</td>
<td>35 (20%)</td>
<td>Fisher’s exact; P = 0.99</td>
</tr>
<tr>
<td></td>
<td>Gastro-intestinal</td>
<td>15 (17%)</td>
<td>13 (15%)</td>
<td>28 (16%)</td>
<td>Fisher’s exact; P = 0.84</td>
</tr>
<tr>
<td></td>
<td>Cardiac</td>
<td>14 (16%)</td>
<td>12 (14%)</td>
<td>26 (15%)</td>
<td>Fisher’s exact; P = 0.83</td>
</tr>
<tr>
<td></td>
<td>Genito-urinary</td>
<td>13 (15%)</td>
<td>12 (14%)</td>
<td>25 (14%)</td>
<td>Fisher’s exact; P = 0.99</td>
</tr>
<tr>
<td>No. (and %) by medical specialty&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Elderly care</td>
<td>15 (17%)</td>
<td>10 (12%)</td>
<td>25 (14%)</td>
<td>( \chi^2 = 2.963; d.f. = 3; P = 0.397 )</td>
</tr>
<tr>
<td></td>
<td>General medicine</td>
<td>47 (53%)</td>
<td>40 (47%)</td>
<td>87 (50%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orthopaedics</td>
<td>19 (21%)</td>
<td>27 (31%)</td>
<td>46 (26%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Surgery</td>
<td>8 (9%)</td>
<td>9 (10%)</td>
<td>17 (10%)</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Value under nursing-led unit care minus value under usual care.
<sup>b</sup>Some patients had more than one diagnosis.
<sup>c</sup>No identified medical reason.
<sup>d</sup>At discharge from medically managed care.

Table 2. Outcomes following nursing-led inpatient unit (NLIU) and usual care: change in Barthel index from baseline to discharge

<table>
<thead>
<tr>
<th>Care</th>
<th>n</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>NLIU</td>
<td>79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3.6</td>
<td>3</td>
<td>3.29</td>
<td>2.86 to 4.34</td>
</tr>
<tr>
<td>Usual</td>
<td>79&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.6</td>
<td>2</td>
<td>3.38</td>
<td>1.84 to 3.36</td>
</tr>
<tr>
<td>All</td>
<td>158</td>
<td>3.1</td>
<td>3</td>
<td>3.39</td>
<td>2.56 to 3.64</td>
</tr>
</tbody>
</table>

<sup>a</sup>10 missing; nine patients died, one was discharged suddenly.
<sup>b</sup>Seven missing patients died.

Table 3. ANCOVA (ranked) for Barthel index at discharge

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>d.f.</th>
<th>Sums of squares</th>
<th>Mean square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>1</td>
<td>562</td>
<td>3243</td>
<td>2.51</td>
<td>0.115</td>
</tr>
<tr>
<td>Baseline (covariate)</td>
<td>1</td>
<td>124 131</td>
<td>124 131</td>
<td>96.09</td>
<td>0.000</td>
</tr>
<tr>
<td>Error</td>
<td>155</td>
<td>200 234</td>
<td>1292</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>324 926</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Approximate 95% confidence interval for the difference between unit care and usual care (value under nursing-led unit care minus value under usual care) = -0.35 to 1.17 (based on t-test on fitted values from raw score version of the test).

9% died before discharge (95% confidence intervals for difference 10.5 to -6.5%).

There was a large and significant difference (\(P = 0.036\)) in the length of stay (Table 5), with patients allocated to the unit staying a mean of 10.9 days longer than those in usual care (95% confidence interval 1.1–20.7 days). The mean length of stay for the treatment group was 36.9 days (35.9 for those discharged from the NLIU). For the control group, the mean stay was 26 days.

The mean hospital cost per stay was £5144 for the NLIU and £4100 for usual care, although the difference (£1044) was not significant (\(t = 1.445; d.f. = 174; P = 0.150\)). The 95% confidence interval around the bootstrapped difference was −£306 to £2518 (bias-corrected, 1000 replications). The mean daily cost for the treatment group was £139 compared with a daily cost of £158 for usual care.

Patients had a mean of 14 entries made by doctors in their medical records. There were significantly fewer entries for the NLIU group than for those receiving usual care (mean difference 6.3; \(t = -2.62; d.f. = 122; P = 0.01\)). There were no significant differences in input from other therapies. The greatest non-nursing inputs were from occupational therapy (mean time per patient 184 min, mean difference –31 min; \(t = -0.89; d.f. = 168; P = 0.37\)).

Sensitivity analysis

Total inpatient cost is primarily a product of length of stay and cost per day. Varying length of stay leads to equalization of costs when the mean treatment group stay is 29.4 days—a 20.3% reduction from that observed. Varying the method used for estimating cost had no significant impact. Discounting the effect of unproductive nursing time had little impact on either the mean patient cost in each group (£4938 versus £3919) or the mean difference between the groups (£1018,
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Table 4. Discharge destination and readmissions following nursing-led inpatient unit (NLIU) and usual care

<table>
<thead>
<tr>
<th>Place of discharge</th>
<th>No. (and %) of group, by care</th>
<th>Test</th>
</tr>
</thead>
</table>
|                    | NLIU (n=89) | Usual (n=86) | All (n=175) | \( \chi^2 = 0.205; \text{df} = 2; P = 0.451 \)
| Independent        | 74 (83%) | 73 (85%) | 147 (84%) | |
| Institutional      | 6 (7%)   | 6 (7%)   | 12 (7%)   | |
| Dued               | 9 (10%)  | 7 (8%)   | 16 (9%)   | |
| Readmission following discharge | | |
| Within 7 days     | 2 (3%)   | 5 (6%)   | 7 (4%)   | Fisher's exact; \( P = 0.28^a \) |
| Within 28 days    | 6 (8%)   | 6 (8%)   | 12 (8%)  | Fisher's exact; \( P = 0.99^a \) |

Confidence interval for the difference between unit care and usual care: readmission within 7 days, 2.5% to −10%; readmission within 28 days, 8% to −8%.

Table 5. Length of stay with nursing-led inpatient unit (NLIU) and usual care

<table>
<thead>
<tr>
<th>Care</th>
<th>#</th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>NLIU</td>
<td>89</td>
<td>36.9</td>
<td>27.0</td>
<td>36.2</td>
<td>29.3 to 44.5</td>
</tr>
<tr>
<td>Usual</td>
<td>86</td>
<td>26.0</td>
<td>15.5</td>
<td>29.0</td>
<td>19.8 to 32.2</td>
</tr>
<tr>
<td>All</td>
<td>175</td>
<td>31.5</td>
<td>21.0</td>
<td>33.2</td>
<td>26.5 to 36.5</td>
</tr>
</tbody>
</table>

Difference: \( df = 167; \) mean = 10.9; \( t = 2.20; P = 0.036; 95\% \) confidence interval = 1.1 to 20.7.

\( t = 1.474, P = 0.142 \). Using speciality-based costs increased the mean difference to £1607 (\( t = 1.973, P = 0.050 \)). Varying the costs of tests and therapy using a factor of ±50% had minimal impact on the mean differences.

Discussion

The absence of negative outcomes suggests potential for the NLIU to substitute for acute services. However, the extended stay associated with the unit suggests that it may also substitute for a period of primary or community care, which increases inpatient costs. The difference in cost was not statistically significant but we conclude from the confidence intervals and sensitivity analysis that it is very unlikely that the NLIU could yield cost savings and it may be more costly than usual acute care.

Substitution for community care was not anticipated and so this evaluation was unable to account fully for possible costs or benefits in this area. The cost of additional community care for the usual care group was not considered; however, previous studies in similar settings suggest that this would be much less than inpatient care for these patients [20]. Patients may benefit from a longer inpatient stay, but we found no evidence in terms of greater independence or lower probability of readmission. Patient discharge may simply be delayed. However, the limited time frame of follow-up should be extended in future research to assess the possibility that the model delivers secondary benefits or cost savings which may constitute value for money. Furthermore, much of the attraction of this model of care derives from its potential to reduce the requirement to use acute hospital staff such as consultants, junior doctors and resources such as beds. Since staff and resources are scarce and costly, the reduced opportunity costs associated with intermediate care should be considered when formulating service developments.

Particular aspects of the NLIU in this study raise a number of issues. In previous reports where positive outcomes were reported, there was a strong emphasis on delivery of direct nursing care by registered nurses, whereas this NLIU differed little from usual care. The bed management arrangements were such that it was isolated from pressure to accommodate acute admissions from accident and emergency in the hospital. A change in clinical leadership on the NLIU early in the study may also have impeded the development of nurses’ skills and confidence in making the difficult decision to discharge patients. The relative instability of senior nursing leadership contrasts with the stability of consultant-led medical teams and is an often-cited problem in attempts to develop innovative nursing services [21].

These considerations will apply to models of intermediate care other than the one tested here. Intermediate care in nursing homes, as currently proposed in the UK, may be associated with fewer qualified nurses and a greater isolation from pressure to discharge and rehabilitate because of location and funding mechanisms [22]. Examination of the factors influencing length of stay is imperative in future studies in order to determine whether increased inpatient stay is intrinsic to this model of service delivery or appropriately reflects patient need.

Key points

- Intermediate care in a nursing-led inpatient unit was associated with increased total hospital stay.
- No benefits appeared to be gained from this additional stay.
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- The total cost of inpatient care was higher than usual hospital care.
- More research is needed into the reasons for increased stay and possible post-discharge benefits.
- It is unlikely that intermediate care in an inpatient environment will result in cost reductions.

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References


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