

## **Health and Social Factors Associated with a Delayed Discharge Amongst Inpatients on Acute Geriatric Wards: A Retrospective Observational Study**

Shortened Title: Frailty and Delayed Discharge

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## **Abstract:**

### *Aim:*

In the English National Health Service (NHS) there is an increasing interest in understanding the factors associated with delayed discharges in older hospitalised adults. This study sought to analyse whether clinical frailty was a significant and independent risk factor for having a delayed discharge when the data were controlled for potential health and social confounders.

### *Methods:*

This was a retrospective observational study in an English NHS teaching hospital. We analysed all first hospitalisation episodes to the Department of Medicine for the Elderly between 1st May 2016 and 31st July 2016. A delayed discharge was operationally defined as a patient being discharged more than 24 hours after his/her last recorded clinically fit date.

### *Results:*

924 cases were analysed. The independent risk factors for having a delayed discharge were: needing a new package of care (Odds Ratio [OR]=4.05, 95% CI: 2.68-6.10), new institutionalisation (OR=2.78, 95% CI: 1.67-4.62), living alone

(OR=1.98, 95% CI: 1.40-2.81), delirium (OR=1.79, 95% CI: 1.17-2.74), and frailty (i.e. 5 or more on the Clinical Frailty Scale, OR=1.74, 95% CI: 1.15-2.63).

Conclusion:

Our results are consistent with previous reports that delayed discharges in older hospitalised patients are mainly related to new formal social care requirements in survivors of acute illness. Frailty was an independent risk factor for delay, but its effect may have been confounded by the unmeasured variable of informal care requirements. Our operational definition of delayed discharge does not mirror the legal definition of delayed transfer of care in England and results are not externally valid.

Key Words:

Frail older adults

Hospital medicine

Informal care

Patient discharge

Social service

## **Introduction:**

As people age they accumulate deficits to their physiological systems. Frailty is a state of vulnerability to poor resolution of homeostasis after a stressor event and is a consequence of this cumulative decline in physiological systems over the course of a lifetime.<sup>1</sup> For frail older people minor stresses can result in a medical decompensation necessitating acute hospital-based interventions.<sup>2</sup> After surviving an acute illness frail older patients often experience a decline in function compared to their pre-admission baseline.<sup>3,4</sup>

In the care of older people there is frequent need for both health and social care input into the management of patients.<sup>5</sup> As the populations of many economically developed countries have aged their various systems of care have been challenged to accommodate the increasing demand for services from an increasing number of frail older people. The increase in demand for social care has led to delayed discharges becoming a more prevalent issue for older patients as they often need to wait in hospital whilst necessary formal social supports are implemented.<sup>6</sup> In England, concerns have been raised over both the ability of social care budgets to provide necessary support and the impact that strains in social care are having on delayed discharges in the English NHS.<sup>7</sup>

It may be beneficial for patients and hospitals to identify the older patients that are most at risk of delay so that resources can be allocated towards speeding up, where possible, the discharge process for these patients.<sup>8</sup> Previous studies have

identified a number of risk factors for prolonged hospital length of stay including the severity of a patient's frailty.<sup>9</sup> Few however have considered more holistic, social and health, predictors of delayed discharge in older inpatients. The purpose of this study was to determine whether frailty remains a significant independent predictor for delay when the data are adjusted for both social and health variables. This information may help to guide potential policies aimed at alleviating delays on acute geriatric wards.

## **Methods:**

### *Study Design and Setting:*

This was a retrospective observational study (service evaluation) conducted in the Department of Medicine for the Elderly (DME) in Addenbrooke's hospital, Cambridge, United Kingdom (UK). All DME wards routinely practice Comprehensive Geriatric Assessment (CGA). Additional information on the centre and setting can be found elsewhere.<sup>4,10</sup>

### *Measures:*

All measures were collected during routine clinical care. Values for the following variables were obtained from the hospital's electronic information system:

- Age.
- Sex.
- Charlson Comorbidity Index (CCI).<sup>11</sup>
- Clinical frailty level prior to admission, as measured by the 9-point Clinical Frailty Scale (CFS).<sup>12</sup> Routine collection of the CFS has been in operation in our centre since 2013.<sup>9</sup>
- Acute illness severity as measured by the Modified Early Warning Score in the Emergency Department (ED-MEWS).<sup>13</sup>
- Living alone prior to admission (Yes/No).
- Admitted from own home (Yes/No).

- Receiving a formal package of care prior to admission and what type of care package. Packages of care involve the delivery of social care within patients' own homes. They range in size from those that involve one carer visiting a patient at home once a day to those that involve two carers visiting a patient at home four times a day, or even live-in carers.
- Admitted from a residential home (Yes/No).
- Admitted from a nursing home (Yes/No).
- Admitted from a local county (Cambridgeshire) postcode (Yes/No).
- Discharged to own home (Yes/No).
- Needed a package of care on discharge, and what type of care package was required.
- Discharged to a residential home (Yes/No).
- Discharged to a nursing home (Yes/No).
- Discharged to a Cambridgeshire postcode (Yes/No).
- Acute cognitive impairment or a delirium evident at any point during stay in hospital (Yes/No).<sup>10</sup>
- Recorded history of chronic cognitive impairment or dementia prior to admission to hospital (Yes/No).<sup>10</sup>
- Mobility on discharge as measured by the Elderly Mobility Scale (EMS) score. This is routinely collected by the DME physiotherapy team.
- Last clinically fit date (CFD). The clinically fit date is used in NHS hospitals to denote the day by which the medical team believe that a patient's acute medical problem will have resolved. It is therefore used as estimation for when the patients can be discharged. Throughout a stay in hospital a patient can improve either more quickly or slowly than the medical team

first predicted. Consequently, the clinically fit date is subject to change. To accommodate for variations in in-hospital events that can postpone the clinically fit date this study uses the last date that was set by the medical team for our operationalisation as to whether a patient was delayed or not.

- Number of clinically fit dates during the admission.
- Date of discharge.

The above information was then used to derive the values for additional variables of interest. These were:

- New package of care (Yes/No). This variable contained all patients that were discharged with a package of care that they did not have upon admission. This did not only include those patients that were discharged with a care package having previously not had one at all, but also those who needed an increase of their care package.
- New institutionalisation (Yes/No). This variable contained all patients who were discharged to new a long-term care facility. This did not only include those patients who were discharged to a care home having previously lived in their own home but also those who needed to be discharged to a nursing home having previously lived in a residential home.
- Discharged to the usual place of residence (Yes/No).
- Delayed discharge (Yes/No). In this study delayed discharge was operationally defined as when a patient continued to occupy a hospital

bed more than 24 hours beyond his/her last recorded clinically fit date. This operational definition differs from the legal definition of Delayed Transfer Of Care (DTC) which relates to the time of submission by the hospital of the official discharge notifications to the local authority.<sup>14,15</sup> The latter forms the basis of the external reporting of delayed transfers of care in the English NHS. The determination that a patient is medically optimised (“clinically fit for discharge”) is from a medical perspective only and often patients need further multidisciplinary team (MDT) actions and decisions before their delay past their CFD becomes officially reportable.<sup>16</sup>

- Length of delay measured in days. Operationally defined as the time between the last clinically fit date and the date of discharge.

#### Participants:

Data were gathered on all patients admitted and discharged to any DME ward at Addenbrooke’s hospital between 1<sup>st</sup> May 2016 and 31<sup>st</sup> July 2016. Only first admission episodes were considered.

#### Statistical Analysis:

All data were anonymised, and analysed using IBM® SPSS® Statistics Version 23. Descriptive statistics were generated as percentage, mean with standard deviation (SD), or median with interquartile range (IQR), as appropriate. Bivariate tests were conducted to determine whether there were any

associations between various social and health measures listed above and a patient having a delayed discharge or not. The Kolmogorov-Smirnov test was used to test the normality of the distribution of continuous variables. For normally distributed continuous variables, mean bivariate differences between two groups (i.e. delayed and non-delayed) were conducted with the student t-test; and for non-normally distributed continuous variables, median differences were compared with the Mann-Whitney U test. Bivariate comparisons between dichotomous variables were conducted with the Chi-squared test.

A multivariate binary logistic regression model was then generated to assess the independent effect of clinical frailty (i.e. CFS of 5 or more points) on delayed discharge, when adjusted for demographics (age and sex) and other health and social variables of interest. Non-normally distributed continuous variables were dichotomised before being entered into the model. Patients who died during the hospital admission were excluded from the analysis. We aimed to produce a model that did not contain heavily interrelated variables. The method used for variable selection was backward stepwise (likelihood ratio).

Finally the same variables that were used in the multivariate regression model were fed into a classification tree analysis. The classification tree algorithm identifies the most efficient predictors that split an initial group into more homogeneous subgroups with high and low risk of the given outcome i.e. delayed discharge. This study used the exhaustive  $\chi^2$  automatic interaction detection (CHAID) method. CHAID at each step chooses the independent predictor variable that has the strongest interaction with the dependent variable. The classification

tree was restricted to three levels of data stratification. Another example of this technique can be found in a previous publication.<sup>17</sup>

A sensitivity analysis was conducted considering an alternative operational definition of delayed discharge; namely 7 or more days after the last recorded clinically fit date.

*Ethics Approval:*

This Service Evaluation Audit was registered with our centre's Safety and Quality Support Department (Project Register Number 4814/6751).

## **Results:**

During the three-month period, there were 1020 admission episodes to DME wards of which 926 were first episodes. Discharge dates were missing for two of the 926 primary cases leaving the database with 924 individual data points. Of these 924 cases 493 (53.4%) patients had no delay according to our operational definition whilst 431 (46.6%) patients had their discharge delayed by at least 24 hours. The median number of days that delayed patients stayed beyond their last clinically fit date was 5 days.

The results of the bivariate analyses are displayed in **Table 1**. Older age, higher CFS, living alone, delirium, dementia, lower (i.e. more impaired) discharge EMS, being discharged to a nursing home, needing a new package of care and new institutionalisation were all significantly associated with a delayed discharge of at least 24 hours. Conversely being discharged home, not needing a package of care on discharge and being discharged to the usual place of residence were all significantly associated with not being delayed. **Table 1** also depicts the data on inpatient mortality. The 10.3% mortality of non-delayed patients depicts those who died whilst still acutely unwell, and therefore those who never reached their clinically fit date. However, the 4.4% mortality of delayed patients mostly captures those patients that were considered medically optimised but were nonetheless on terminal pathways and died whilst awaiting discharge for end of life care elsewhere.

The variables selected for multivariate regression were: age 85 years or more, sex (0=male; 1=female), CCI 3 or more, discharge EMS 14 or more; CFS 5 or more, ED-MEWS 4 or more, dementia, delirium, lives alone, discharged to a Cambridgeshire postcode, new institutionalisation, new package of care. The results of the multivariate regression model are shown in **Table 2**.

The outcomes of the classification tree analysis are displayed in **Figure 1**. The results of the sensitivity analysis with the alternative operational definition of delayed discharge (7 or more days) are shown in **Appendix I: sensitivity testing**, Table S1: multivariate regression model to identify independent predictors of delayed discharge (7 or more days) and Figure S1: decision tree diagram to identify the relative importance of the predictors of delayed discharge (7 or more days).

## **Discussion:**

This retrospective observational study investigated health and social predictors of delayed discharge (according to an operational definition) in older people hospitalised in Geriatric Medicine wards. The variables with the strongest independent associations were the requirement of a new package of care at home and new institutionalisation. These findings underline how important social care factors are in influencing the course of the hospital discharge process, and are completely in line with our local<sup>18</sup> and national pictures.<sup>7,19</sup> In particular our study underscores the critical role of functional decline in delayed discharge from acute geriatric units.<sup>20</sup> As theorised in other papers, when older patients experience a functional decline after surviving an acute illness, they may reach a point where they are no longer able to independently manage with their pre-existing level of support and require new care arrangements to be made.<sup>21</sup> Some of this delay may be due to the need to wait for financial social care assessments.<sup>19</sup>

The main contribution of our study is that, even in the presence of social care factors, clinical frailty remained a significant independent predictor of delayed discharge. A possible explanation is that frailty affects the treatment response and time to recovery of mobility in acutely ill older adults admitted to hospital and is associated with greater functional decline in survivors of acute illness.<sup>22,23</sup> Another potential confounder could be the amount of informal care that frail older people receive from friends, family or voluntary organisations as opposed to professional carers. It is known that poor social networks are often associated

with frailty<sup>24</sup> and the breakdown of 'frail' social networks often requires time for informal care arrangements to be rebuilt or created *de novo* around the person. Indeed many informal carers need time to help welcome frail older patients into their own homes e.g. by organising home cleaning, food provisions, heating, meals on wheels etc. Of course this is merely a hypothesis and requires more vigorous analysis. Informal care forms a significant proportion of overall care for older people in the UK so is likely to be an important variable in determining hospital outcomes for this patient group.<sup>7</sup>

The above rationale may also help explain why delirium and living alone were also significant independent predictors of delay. Older people who live alone may have to wait longer for informal carers to make preparations for their discharge than those who live with a partner or other relatives. Additionally delirium and other cognitive impairments have been shown to be associated with functional decline in hospitalised older people<sup>25</sup>. Cognitively impaired survivors who lose function post-acute illnesses often need to wait beyond their clinically fit date for formal or informal care to be organised.

Interestingly all of the significant and independent risk factors stood up to sensitivity testing (considering delay as 7 or more days). This suggests that these factors are important in determining both shorter (more than 24 hours) and longer (7 or more days) delays. However, as the results of the classification trees suggest, new institutionalisation may be a stronger predictor of longer delays whereas a new package of care at home may be a relatively stronger predictor of shorter delays. This may be due to the fact that the processes involved in a new

institutionalisation are often more complex than those involved in sourcing a home care package. In addition, patients requiring new institutionalisation are often more medically complex and dependent than those able to go home with a care package.

Comparing these findings to those of other studies is challenging. Most other studies have sought to measure length of stay as a whole rather than length of stay beyond the last clinically fit date. A number of previous studies have reported frailty and delirium as potential determinants of length of stay in hospital.<sup>9,21</sup> Our study illustrates the importance and usefulness to record the clinically fit date as well as the discharge date in the hospital records.

Our study has several key limitations. Firstly its retrospective single-centre design and secondly that data were only collected during a non-winter three-month window. Causality cannot therefore be proven from our results and our relatively small dataset may be susceptible to regional and seasonal biases. Our results are not necessarily externally valid. Furthermore, despite the fact that the study contained numerous key social variables, it did not measure the amount of informal care that patients received, differentiate between those who privately funded care or those who relied on social care funding.

Our study was based on routinely collected hospital data and our hospital does not routinely collect any other measures of frailty other than the CFS.<sup>18</sup> Thus we cannot compare the performance of the CFS against other measures of frailty (such as the frailty index or the physical frailty phenotype) in their association

with delayed discharges. Addressing this question would require a research protocol and would fall outside the scope of clinical audit.

Another important limitation is that our operational definition of delayed discharge purely based on medical criteria does not necessarily correspond with the legal definition of DTOC as per English legislation.<sup>15</sup> The prevalences of delayed discharge according to our operational definition are not externally valid.

Our study was conducted on specialist Geriatric Medicine wards that routinely practice multidisciplinary comprehensive geriatric assessment (CGA). There is evidence to suggest that a coordinated CGA approach may help reduce the length of stay of older people in hospital.<sup>26</sup> Given the increasing numbers of frail older people admitted to hospitals it is important to maximise the provision of CGA within inpatient services.<sup>27</sup> Crucially all hospital staff need to be aware of the effect of the stress involved for older people who are 'stranded' in hospital after surviving an illness. These patients may not be as 'fit' as they were before admission and must never be labeled as 'bed blockers'.<sup>28</sup>

Solutions to the issue of delayed discharges also need to be sought out of hospital. In the UK, increases in social care funding are on the policy agenda, including more joint working between health and social services.<sup>29,30</sup>

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No funding was required for this study.

Disclosure Statement:

The authors declare no conflict of interest.

**References:**

1. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet* 2013; **381**(9868): 752-62.
2. Kojima G. Frailty as a predictor of hospitalisation among community-dwelling older people: a systematic review and meta-analysis. *J Epidemiol Community Health* 2016; **70**(7): 722-9.
3. Zisberg A, Shadmi E, Gur-Yaish N, Tonkikh O, Sinoff G. Hospital-associated functional decline: the role of hospitalization processes beyond individual risk factors. *J Am Geriatr Soc* 2015; **63**(1): 55-62.
4. Hartley P, Adamson J, Cunningham C, Embleton G, Romero-Ortuno R. Clinical frailty and functional trajectories in hospitalized older adults: A retrospective observational study. *Geriatr Gerontol Int* 2016.
5. Holmas TH, Islam MK, Kjerstad E. Interdependency between social care and hospital care: the case of hospital length of stay. *Eur J Public Health* 2013; **23**(6): 927-33.
6. Moore A. Delayed discharge at the heart of the NHS crisis. *Nurs Stand* 2017; **31**(29): 22-4.
7. Humphries R, Hall P, Charles A, Thorlby R, Holder H. Social Care for Older People: Home Truths. London: The King's Fund, 2016.
8. Gaughan J, Gravelle H, Siciliani L. Testing the bed-blocking hypothesis: does higher supply of nursing and care homes reduce delayed hospital discharges? York: Centre for Health Economics, University of York Department of Economics and Related Studies, University of York 2014.
9. Wallis SJ, Wall J, Biram RW, Romero-Ortuno R. Association of the clinical frailty scale with hospital outcomes. *QJM* 2015; **108**(12): 943-9.

10. Romero-Ortuno R, Forsyth DR, Wilson KJ, et al. The Association of Geriatric Syndromes with Hospital Outcomes. *J Hosp Med* 2017; **12**(2): 83-9.
11. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987; **40**(5): 373-83.
12. Rockwood K, Song X, MacKnight C, et al. A global clinical measure of fitness and frailty in elderly people. *CMAJ* 2005; **173**(5): 489-95.
13. Romero-Ortuno R, Wallis S, Biram R, Keevil V. Clinical frailty adds to acute illness severity in predicting mortality in hospitalized older adults: An observational study. *Eur J Intern Med* 2016; **35**: 24-34.
14. Scotland NNS. Delayed Discharges Definitions and Data Recording Manual. Edinburgh: Information Services Division NHS National Services Scotland Publications; 2012.
15. Legislation.gov.uk. The Care and Support (Discharge of Hospital Patients) Regulations 2014. Available online: <https://www.legislation.gov.uk/uksi/2014/2823/contents/made>.
16. NHS England. Delayed Transfers of Care, data and guidance. Available online: <https://www.england.nhs.uk/statistics/statistical-work-areas/delayed-transfers-of-care/>.
17. Romero-Ortuno R, O'Shea D, Silke B. Predicting the in-patient outcomes of acute medical admissions from the nursing home: the experience of St James's Hospital, Dublin, 2002-2010. *Geriatr Gerontol Int* 2012; **12**(4): 703-13.
18. CUH. Cambridge University Hospitals NHS Foundation Trust: Annual Report and Accounts 2016/2017. Available online:

[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/634098/CAMBRIDGE\\_Annual\\_Report\\_and\\_Accounts\\_2016-17.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/634098/CAMBRIDGE_Annual_Report_and_Accounts_2016-17.pdf); 2017.

19. NAO. National Audit Office Report: Discharging older patients from hospital. Available online: <https://www.nao.org.uk/report/discharging-older-patients-from-hospital/>; 2016.

20. Chin JJ, Sahadevan S, Tan CY, Ho SC, Choo PW. Critical role of functional decline in delayed discharge from an acute geriatric unit. *Ann Acad Med Singapore* 2001; **30**(6): 593-9.

21. Bo M, Fonte G, Pivaro F, et al. Prevalence of and factors associated with prolonged length of stay in older hospitalized medical patients. *Geriatr Gerontol Int* 2016; **16**(3): 314-21.

22. Hatheway OL, Mitnitski A, Rockwood K. Frailty affects the initial treatment response and time to recovery of mobility in acutely ill older adults admitted to hospital. *Age Ageing* 2017.

23. Baztan JJ, De la Puente M, Socorro A. Frailty, functional decline and mortality in hospitalized older adults. *Geriatr Gerontol Int* 2017; **17**(4): 664-6.

24. Vaingankar JA, Chong SA, Abdin E, et al. Prevalence of frailty and its association with sociodemographic and clinical characteristics, and resource utilization in a population of Singaporean older adults. *Geriatr Gerontol Int* 2016.

25. Hartley P, Gibbins N, Saunders A, et al. The association between cognitive impairment and functional outcome in hospitalised older patients: a systematic review and meta-analysis. *Age Ageing* 2017.

26. Soejono CH. The impact of 'comprehensive geriatric assessment (CGA)' implementation on the effectiveness and cost (CEA) of healthcare in an acute geriatric ward. *Acta Med Indones* 2008; **40**(1): 3-10.

27. Challis D, Hughes J, Xie C, Jolley D. An examination of factors influencing delayed discharge of older people from hospital. *Int J Geriatr Psychiatry* 2014; **29**(2): 160-8.
28. Kydd A. The patient experience of being a delayed discharge. *J Nurs Manag* 2008; **16**(2): 121-6.
29. Bryan K. Policies for reducing delayed discharge from hospital. *Br Med Bull* 2010; **95**: 33-46.
30. Morse SA. Health and social care integration. London: National Audit Office; 2017.

**Figure Legends:**

Figure 1: Decision tree diagram to identify the relative importance of predictors of delayed discharge operationally defined as discharge occurring 24 hours or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTC).

**Supplementary Information Legend:**

Appendix I: Sensitivity testing.

Table S1. Multivariate Regression Model to Identify Independent Predictors of Delayed Discharge (7 or more days). Delayed discharge was operationally defined as discharge occurring 7 days or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTC).

Figure S1. Decision tree diagram to identify the relative importance of predictors of delayed discharge operationally defined as discharge occurring 7 days or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTC).

**Tables:****Table 1: Bivariate Comparisons between Delayed and Non-delayed groups.**

Delayed discharge was operationally defined as discharge occurring 24 hours or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTC).

	Not delayed (N=493)	Delayed (N=431)	Significance of the difference (p)
Median age, years (IQR)	85.0 (9.0)	87.0 (9.0)	0.003†
Age 85 years or more (%)	55.2	63.8	0.008‡
Female sex (%)	54.4	59.6	0.107‡
Median CCI (IQR)	2.0 (2.0)	2.0 (2.0)	0.783†
CCI 3 or more (%)	34.4	37.6	0.311‡
Median CFS score (IQR)	6.0 (2.0)	6.0 (1.0)	0.003†
CFS 5 (mildly frail) or more (%)	71.1	83.7	<0.001‡
Median ED-MEWS (IQR)	2.0 (2.0)	3.0 (1.0)	0.760†
ED-MEWS 4 or more (%)	29.7	24.8	0.098‡
Lives alone prior to admission (%)	35.6	44.3	0.007‡
Formal POC prior to admission (%)	46.1	50.6	0.177‡
Admitted from home (%)	82.4	86.9	0.058‡
Admitted from RH (%)	12.7	9.1	0.083‡
Admitted from NH (%)	4.9	4.0	0.489‡
Admitted from local postcode (%)	83.8	82.8	0.701‡
Discharged to local postcode (%)	83.8	82.8	0.701‡
Delirium (%)	14.3	25.1	<0.001‡
Dementia (%)	26.1	32.1	0.044‡
Median EMS on discharge (IQR)	14.0 (12.0)	13.0 (11.0)	<0.001†
Discharge EMS 14 or more (%)	54.8	44.0	0.002‡
Discharged home (%)	71.6	60.8	0.001‡
Discharge to RH (%)	10.3	12.5	0.297‡
Discharge to NH (%)	5.1	11.6	<0.001‡
No POC on discharge (%)	49.2	15.2	<0.001‡
New POC on discharge (%)	10.3	36.4	<0.001‡
New institutionalisation (%)	6.6	21.8	<0.001‡
Discharge to usual place of residence (%)	81.0	63.8	<0.001‡
Median LOS, days (IQR)	4.1 (6.4)	14.9 (19.6)	<0.001†
LOS 7 or more days (%)	30.0	82.4	<0.001‡

Median number of clinically fit dates (IQR)	2.0 (2.0)	3.0 (3.0)	<0.001†
Two or more clinically fit dates (%)	60.5	84.9	<0.001‡
Inpatient death (%)	10.3	4.4	0.001‡

†Independent samples Mann-Whitney U test.

‡ 2-sided Chi-square test.

IQR = interquartile range, CCI = Charlson Comorbidity Index, CFS = Clinical Frailty Scale, ED-MEWS = Emergency Department Modified Early Warning Score, POC = Package of Care, RH = Residential Home, NH = Nursing Home, EMS = Elderly Mobility Scale, LOS = Length of Stay.

**Table 2: Multivariate Regression Model to Identify Independent Predictors of Delayed Discharge.** Delayed discharge was operationally defined as discharge occurring 24 hours or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTCOC).

	B	S.E.	p	OR	95% C.I. for OR	
					Lower	Upper
Discharge EMS 14 or more	-0.33	0.18	0.075	0.72	0.50	1.03
CFS 5 or more	0.55	0.21	0.009	1.74	1.15	2.63
Delirium	0.58	0.22	0.008	1.79	1.17	2.74
Lives alone	0.68	0.18	<0.001	1.98	1.40	2.81
New institutionalisation	1.02	0.26	<0.001	2.78	1.67	4.62
New package of care	1.40	0.21	<0.001	4.05	2.68	6.10

Inpatient deaths were excluded from the model. Regression method: backward stepwise selection (likelihood ratio). The model converged in 7 steps. Predictors entered on step 1: age 85 years or more, sex (0=male; 1=female), CCI 3 or more, discharge EMS 14 or more; CFS 5 or more, ED-MEWS 4 or more, dementia, delirium, lives alone, discharged to a Cambridge postcode, new institutionalisation, new package of care.

B = Correlation Coefficient, S.E = Standard Error, OR = Odds ratio, CI= Confidence Intervals, CCI = Charlson Comorbidity Index, EMS = Elderly Mobility Scale, CFS = Clinical Frailty Scale, ED-MEWS = Emergency Department Modified Early Warning Score.

Delayed discharge

■ no  
■ yes

Node 0		
Category	%	n
no	53.4	493
yes	46.6	431
Total	100.0	924

New package of care  
Adj. P-value=0.000, Chi-square=89.682, df=1

no

yes

Node 1		
Category	%	n
no	61.7	442
yes	38.3	274
Total	77.5	716

Node 2		
Category	%	n
no	24.5	51
yes	75.5	157
Total	22.5	208

New institutionalisation  
Adj. P-value=0.000, Chi-square=42.517, df=1

no; <missing>

yes

Node 3		
Category	%	n
no	66.1	416
yes	33.9	213
Total	68.1	629

Node 4		
Category	%	n
no	29.9	26
yes	70.1	61
Total	9.4	87

Clinical Frailty Scale 5 or more  
Adj. P-value=0.000, Chi-square=26.450, df=1

no; <missing>

yes

Node 5		
Category	%	n
no	80.4	160
yes	19.6	39
Total	21.5	199

Node 6		
Category	%	n
no	59.5	256
yes	40.5	174
Total	46.5	430

## **Appendix I: Sensitivity Testing:**

The multivariate and decision tree analyses were rerun with the operational definition of a delayed discharge now being changed to when a patient continues to occupy a hospital bed for seven days or more after his/her last recorded clinically fit date.

Of 924 patients, 208 (22.5%) were delayed for 7 or more days.

**Table S1. Multivariate Regression Model to Identify Independent Predictors of Delayed Discharge (7 or more days).** Delayed discharge was operationally defined as discharge occurring 7 days or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTOC).

	B	S.E.	p	OR	95% C.I. for OR	
					Lower	Upper
CFS 5 or more	0.56	0.27	0.043	1.74	1.02	2.98
Delirium	0.71	0.24	0.003	2.03	1.27	3.25
Lives alone	0.62	0.22	0.004	1.86	1.22	2.83
New institutionalisation	1.69	0.25	<0.001	5.40	3.30	8.85
New package of care	1.24	0.22	<0.001	3.47	2.26	5.33

Inpatient deaths were excluded from the model. Regression method: backward stepwise selection (likelihood ratio). The model converged in 8 steps. Predictors entered on step 1: age 85 years or more, sex (0=male; 1=female), CCI 3 or more, discharge EMS 14 or more; CFS 5 or more, ED-MEWS 4 or more, dementia, delirium, lives alone, discharged to a Cambridge postcode, new institutionalisation, new package of care.

B = Correlation Coefficient, S.E = Standard Error, OR = Odds ratio, CI= Confidence Intervals, p = p value, CCI = Charlson Comorbidity Index, EMS = Elderly Mobility Scale, CFS = Clinical Frailty Scale, ED-MEWS = Emergency Department Modified Early Warning Score.

**Figure S1. Decision Tree Diagram to Identify the Relative Importance of the Predictors of Delayed Discharge (7 or more days).** Delayed discharge was operationally defined as discharge occurring 7 days or more after the last recorded clinically fit date. The operational definition does not equate to the legal definition of delayed transfer of care (DTC).

