Research

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Outcomes of hospital admissions among frail older people:

a 2-year cohort study

Abstract

Background
'Frailty crises' are a common cause of hospital admission among older people and there is significant focus on admission avoidance. However, identifying frailty before a crisis occurs is challenging, making it difficult to effectively target community services. Better longer-term outcome data are needed if services are to reflect the needs of the growing population of older people with frailty.

Aim
To determine long-term outcomes of older people discharged from hospital following short (<72 hours) and longer hospital admissions compared by frailty status.

Design and setting
Two populations aged ≥70 years discharged from hospital units: those following short 'ambulatory' admissions (<72 hours) and those following longer inpatient stays.

Method
Data for 2-year mortality and hospital use were compared using frailty measures derived from clinical and hospital data.

Results
Mortality after 2 years was increased for frail compared with non-frail individuals in both cohorts. Patients in the ambulatory cohort classified as frail had increased mortality (Rockwood hazard ratio 2.3 [95% confidence interval {CI} = 1.5 to 3.4]) and hospital use (Rockwood rate ratio 2.1 [95% CI = 1.7 to 2.6]) compared with those patients classified as non-frail.

Conclusion
Individuals with frailty who are discharged from hospital experience increased mortality and resource use, even after short 'ambulatory' admissions. This is an easily identifiable group that is at increased risk of poor outcomes. Health and social care systems might wish to examine their current care response for frail older people discharged from hospital. There may be value in a 'secondary prevention' approach to frailty crises targeting individuals who are discharged from hospital.

Keywords
ambulatory care; frailty; geriatric assessment; hospitalisation; intermediate care; primary care.

INTRODUCTION

Frailty is a distinctive health state related to ageing, characterised by impaired homeostasis and decreased physiological reserve across multiple body systems, and resulting in increased vulnerability to adverse outcomes from apparently minor stressor events.[1,2] These individuals are at increased risk of 'frailty crises', which are a common cause of acute health service use. Several scoring systems have been developed to quantify frailty and stratify risk in individuals and populations. The UK General Medical Services (GMS) contract introduced new frailty requirements in 2017/2018 that require GP practices to use an appropriate tool (for example, Electronic Frailty Index) to identify potential frailty in their populations[3,4] and offer clinical assessments to those at risk of moderate or severe frailty.

Despite the increasing range of community-based services geared towards admission avoidance in frail older people, there has been an inexorable rise in acute hospital admissions in this group.[5] Facing significant pressures, hospital services are often configured to promote early discharge[6,7] with the tacit assumption that longer-term problems will be addressed later. However, there is growing concern about the safety and effectiveness of this approach in frail older people. The risk is that, in pursuit of early discharge, overall patient outcomes are not necessarily being improved, leading to a vicious cycle of readmission, functional decline, institutionalisation, and death.[8]

Better longer-term outcome data are needed if services are to reflect the needs of the growing population of older people with frailty. Previous studies have identified poor short-term outcomes in older people who are rapidly discharged from acute medical units, including high readmission rates.[9,10] This article provides longer-term (2-year) follow-up data from two cohorts of older people: one discharged within 72 hours (referred to as the 'ambulatory cohort') and another with longer hospital admissions (the 'inpatient cohort').

METHOD

Settings
The ambulatory cohort was recruited in Nottingham and Leicester. Both hospitals serve a large, mixed urban and rural setting of approximately 1.1 million people with single, co-located emergency departments and acute medical services. The inpatient cohort was recruited in Southampton; this is a broadly similar hospital setting but with a slightly increased age profile and less ethnic diversity.

Data sources
A clinical dataset for each cohort capturing frailty in hospitalised older people was linked

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How this fits in

Primary care services have an increasing role in caring for frail older people. This study shows poor outcomes for frail older people discharged from hospital, even after just a 'short stay' or 'ambulatory care' admission. This group is easily identifiable and may benefit from a more holistic assessment and tailored community support following discharge. This could define a 'secondary prevention' approach to admission avoidance (targeting those identified as frail who have already been admitted to hospital) to focus resource-intensive community support in a more impactful way to improve outcomes and prevent future inappropriate hospitalisation.

to Hospital Episode Statistics and Office for National Statistics death registrations by NHS Digital to allow follow-up over 2 years. The first covered 674 patients (57.4% female) aged ≥70 years who were discharged within 72 hours of attending large teaching hospitals in Leicester and Nottingham between January 2009 and November 2010; these patients were a subset of a cohort recruited for the Acute Medical Outcomes Study.[11] The second dataset contained 246 female patients aged ≥70 years who had been admitted for inpatient care in Medicine for Older People wards in Southampton between November 2009 and February 2012;[12] these patients had been recruited for a female-only study on nutritional intervention in hospital. These datasets were used for the 'ambulatory' and 'inpatient' populations, respectively. Both cohorts were carefully phenotyped for frailty according to different assessment scales using items collected by trained research assistants including height, weight, grip strength, and the geriatric depression scale.

Frailty characterisation

As frailty assessment tools perform differently depending on the population and setting,[13] four commonly used frailty tools validated in acute care settings were tested: Fried,[14] Rothman,[15] Rockwood,[16] and the Hospital Frailty Risk Score (HFRS).[17] The method used to calculate the clinical frailty measures (Fried, Rothman, and Rockwood) for the ambulatory care patients has been described elsewhere.[10] In this study, the Fried score is presented as a two- (rather than three-) category scale due to small subgroup sizes in the acute inpatient data, with those classified as 'robust' or 'pre-frail' grouped into a single category.

Full details of how the Fried and Rothman frailty measures were constructed for the acute inpatient data are available from the authors on request. Mobility and physical activity measures were adapted from data collected in the original study.[12] Mobility was assessed by ability to walk independently according to the Barthel Activities of Daily Living Questionnaire,[18] and physical activity was assessed by ability to transfer independently. The HFRS was also constructed for the two cohorts. This score is based on ICD-10 diagnoses coded in an individual's hospital admissions over the previous 2 years (including the index admission). Its development and construction have been described in detail elsewhere.[17] Individuals were classified as 'frail' if they had HFRS >5.

Missing data items prevented the calculation of clinical frailty scales for some individuals in both cohorts. Information on the inclusion and exclusion of participants is available from the authors on request. The main data item missing in the ambulatory cohort was body mass index. In the inpatient cohort, grip strength measurements and the Geriatric Depression Scale were missing as only a subgroup of participants in the original study were included in the detailed frailty measurements.

Outcome measures

Two-year survival time was calculated as the number of whole days between the admission date on recruitment and the date of death. Where date of death was missing, or was after the 2-year follow-up period, then full-study survival time (730 days) was recorded.

In contrast to many previous studies, bed-days were used as a measure of hospital use (rather than number of emergency admissions). This gives a better overall indication of time spent in hospital. Bed-days were calculated as the number of whole days between the admission and discharge dates. The day of admission was included to give those admitted and discharged on the same day a count of 1 day. Bed-days from all admissions within the 2-year period were summed to give a total figure for each individual. If the discharge for an admission occurred after the follow-up period, then only the days spent in hospital within the 2 years were included.

Statistical analysis

Cox's proportional hazards regression models were used to quantify the relationship between frailty and survival

Characteristic for difference	Ambulatory cohort	Inpatient cohort	P-value
Location	Leicester and Nottingham	Southampton	–
Recruitment date range	21 Jan 2009–26 Nov 2010	29 Nov 2009–19 Jan 2012	–
N	674	246	–
Female, %	57.4	100.0	<0.001
Age, years (SD)	80.2 (6.7)	85.9 (4.7)	<0.001
Index admission length of stay, days (SD)	1.0 (0.7)	20.5 (18.0)	<0.001
Hospital admissions,[b] n (SD)	3.5 (4.1)	4.1 (7.0)	0.040
Charlson Comorbidity Index ≥3,[b] %	31.9	43.1	0.002
Frailty scale by measure (sample size),[c] %			
Fried (n = 494)	23.7	80.0 (140)	–
Rothman (n = 503)	23.2	48.4 (192)	–
Rockwood (n = 489)	30.5	–	–
HFRS (n = 674)	40.2	67.1 (246)	–

[a]Figures are % for binary variables and means with standard deviation for continuous variables. [b]Based on past 2 years and including present admission. [c]Sample sizes vary as not all individuals had the data items needed to calculate the relevant frailty measure. HFRS = Hospital Frailty Risk Score. SD = standard deviation.

time. An overall summary of hospital use during follow-up compared mean emergency department attendances, organised outpatient appointments, and elective and non-elective admissions. Differences in descriptive characteristics and summary hospital use were tested with Kruskal–Wallis (means) as the data were non-normal, or Pearson χ^2 (percentages). Total bed-days were modelled using negative binomial regression, as the data were over-dispersed. Two versions of this model were produced; the first did not take into account differing survival times and the second included survival time as an offset term.

The models were adjusted for age and sex in the ambulatory care cohort and just age for the inpatient cohort, as all participants were female. A sensitivity analysis was conducted with the female patients from the ambulatory cohort to establish the generalisability of the inpatient cohort results. Models were also adjusted for Charlson Comorbidity Index and number of past admissions, but as the results were similar in terms of effect size and statistical significance these data are not presented.[19]

All analyses were conducted using SAS (version 9.4).

RESULTS
Baseline characteristics
As might be expected, the ambulatory cohort was younger, had lower previous hospital use, and lower Charlson Comorbidity Index and frailty measures than the inpatient cohort (Table 1). Dependent on the scale used, 23.2–40.2% of the ambulatory cohort and 48.4–80.0% of the inpatient cohort were identified as frail.

Survival
A smaller proportion of the inpatient cohort (57%) survived the 2-year follow-up period compared with the ambulatory cohort (78%). Dependent on the measure used, 32.2–36.8% of individuals classified as frail in the ambulatory cohort died during follow-up compared with 42.4–52.7% in the inpatient cohort (Table 2). Frail patients in the ambulatory cohort (classified by any scale) were around twice as likely to die within 2 years compared with the non-frail, even after adjustment for age and sex (hazard ratio [HR] Rockwood 2.3 [95% CI = 1.5 to 3.4], Fried 2.0 [95% CI = 1.3 to 3.0]). There was a lesser effect in the inpatient cohort with frailty classified by the Rothman measure (HR 1.6 [95% CI = 1.0 to 2.6].

Hospital use
Frail patients in the ambulatory cohort were more likely to have emergency department attendances (Rothman, Rockwood, and HFRS) and emergency admissions (all), and less likely to have elective admissions (Rothman, Rockwood, and HFRS) than the non-frail patients in the ambulatory cohort (Table 3). In the inpatient cohort there was little evidence of differing hospital use by frailty, with the exception of outpatient attendances where frail individuals had fewer on average. After adjustment, individuals classified as frail in the ambulatory cohort had between 1.5

Table 2. Two-year survival by frailty status in the two cohorts

Frailty scale (sample size)	Mortality percentage, % (95% CI)		Hazard ratios (95% CI)	
	Non-frail	Frail	Unadjusted	Adjusted[a]
Ambulatory cohort				
Fried (n = 494)	14.9 (11.2 to 18.5)	34.2 (25.5 to 42.9)	2.6[b] (1.7 to 3.8)	2.0[c] (1.3 to 3.0)
Rothman (n = 503)	14.3 (10.7 to 17.8)	36.8 (27.9 to 45.6)	2.9[b] (2.0 to 4.4)	3.5[b] (1.6 to 3.7)
Rockwood (n = 489)	13.5 (9.9 to 17.2)	32.2 (24.6 to 39.8)	2.6[b] (1.7, to 3.9)	2.3[b] (1.5 to 3.4)
HFRS (n = 674)	14.4 (11.0 to 17.8)	32.5 (26.9 to 38.1)	2.5[b] (1.8 to 3.4)	2.1[b] (1.5 to 3.0)
Inpatient cohort				
Fried (n = 140)	21.4 (5.2 to 37.6)	46.4 (37.0 to 55.8)	2.6[c] (1.1 to 6.1)	2.3 (1.0 to 5.4)
Rothman (n = 192)	31.3 (22.0 to 40.6)	52.7 (42.3 to 63.0)	2.0[c] (1.3 to 3.1)	1.6[c] (1.0 to 2.6)
HFRS (n = 246)	43.2 (32.1 to 54.2)	42.4 (34.8 to 50.0)	1.0 (0.7 to 1.6)	1.1 (0.7 to 1.6)

[a]Adjusted for age and sex; however, Southampton analysis adjusted for age only (female-only cohort). [b]Statistically significant at 0.1% level (P<0.001). [c]Statistically significant at 5% level (P<0.05). HFRS = Hospital Frailty Risk Score.

Table 3. Hospital use over 2-year follow-up period by frailty scale and cohort with differences tested using Kruskal–Wallis

	Ambulatory cohort			Inpatient cohort		
Frailty scale	Non-frail	Frail	*P*-value	Non-frail	Frail	*P*-value
Mean number of emergency department attendances per person (SD)						
Fried	1.7 (2.2)	2.4 (3.0)	0.060	3.5 (4.1)	1.8 (2.1)	0.070
Rothman	1.6 (2.2)	2.4 (2.9)	0.007	2.7 (3.2)	1.7 (2.2)	0.020
Rockwood	1.5 (2.0)	2.5 (2.9)	<0.001	–	–	–
HFRS	1.3 (1.8)	2.5 (2.8)	<0.001	2.0 (2.8)	2.1 (2.5)	0.390
Mean number of non-elective admissions per person (SD)						
Fried	1.5 (2.1)	2.2 (2.7)	0.020	2.9 (2.7)	1.9 (2.1)	0.080
Rothman	1.5 (2.1)	2.2 (2.6)	<0.001	2.5 (2.5)	1.8 (2.0)	0.080
Rockwood	1.3 (1.9)	2.5 (2.6)	<0.001	–	–	–
HFRS	1.2 (1.6)	2.4 (2.6)	<0.001	2.0 (2.3)	2.2 (2.2)	0.320
Mean number of elective admissions per person (SD)						
Fried	1.0 (1.8)	1.0 (2.0)	0.520	1.5 (2.2)	0.8 (1.4)	0.200
Rothman	1.1 (1.9)	0.8 (1.7)	0.020	1.1 (1.8)	0.7 (1.2)	0.180
Rockwood	1.1 (2.0)	0.8 (1.6)	0.040	–	–	–
HFRS	1.1 (1.9)	0.8 (1.7)	0.020	0.8 (1.3)	1.0 (1.6)	0.220
Mean number of outpatient appointments per person (SD)						
Fried	11.9 (10.6)	12.4 (12.6)	0.940	10.5 (8.2)	5.7 (6.7)	0.002
Rothman	12.2 (10.8)	11.2 (11.9)	0.110	8.3 (8.1)	4.7 (6.2)	<0.001
Rockwood	11.7 (10.4)	12.7 (12.5)	0.970	–	–	–
HFRS	11.3 (10.1)	12.4 (12.4)	0.760	7.6 (8.6)	6.0 (6.5)	0.350

SD = standard deviation. P<0.05 statistically significant.

and 2.1 times more bed-days than those classified as non-frail, depending on the scale used (Table 4). In contrast, there was no significant difference in the amount of bed-days between the frail and non-frail groups for the inpatient cohort.

When hospital use was assessed as a percentage of survival time, there was some evidence of higher hospital use for those in the inpatient cohort classified as frail by Rothman (rate ratio [RR] 1.4 [95% CI = 1.0 to 1.9] and HFRS (RR 1.7 [95% CI = 1.3 to

Table 4. Intensity of hospital use over 2 years measured in bed-days

	Mean bed-days per person (SD)		Rate ratios for rate of use over 2-year period (95% CI)	
Frailty scale (sample size)	Non-frail	Frail	Unadjusted	Adjusted[a]
Ambulatory cohort				
Fried (*n* = 494)	17.5 (26.4)	27.5 (38.1)	1.7[b] (1.3 to 2.1)	1.5[c] (1.2 to 1.9)
Rothman (*n* = 503)	17.1 (27.1)	28.7 (35.5)	1.7[b] (1.4 to 2.2)	1.6[b] (1.2 to 2.0)
Rockwood (*n* = 489)	14.5 (22.7)	30.9 (38.8)	2.2[b] (1.8 to 2.8)	2.1[b] (1.7 to 2.6)
HFRS (*n* = 674)	14.9 (22.9)	29.6 (35.6)	2.0[b] (1.7 to 2.4)	1.9[b] (1.6 to 2.3)
Inpatient cohort				
Fried (*n* = 140)	64.3 (56.6)	55.8 (39.4)	0.9 (0.6 to 1.2)	0.9 (0.6 to 1.2)
Rothman (*n* = 192)	57.2 (50.7)	58.2 (35.8)	1.0 (0.8 to 1.3)	1.0 (0.8 to 1.3)
HFRS (*n* = 246)	53.1 (47.2)	65.2 (45.3)	1.2[c] (1.0 to 1.5)	1.2 (1.0 to 1.5)

[a]Adjusted for age and sex; however, Southampton analysis adjusted for age only (female-only cohort). [b]Statistically significant at 0.1% level (P<0.001). [c]Statistically significant at 5% level (P<0.05). CI = confidence interval. HFRS = Hospital Frailty Risk Score. SD = standard deviation.

2.2]). This suggests that the shorter survival times among frail people in this cohort are restricting the number of bed-days that can be accumulated relative to the longer survival times of the non-frail (further details are available from the authors on request).

DISCUSSION
Summary
Frailty is associated with increased 2-year mortality in patients discharged from hospital after both short ambulatory (<72 hours) and longer inpatient admissions. This analysis demonstrates that frail individuals are at high risk of poor outcomes after hospital discharge and suggests that current services do not adequately meet their needs.

Strengths and limitations
Whereas previous studies have used short follow-up periods or relied on self-reported outcomes,[20–22] this study provides longer-term data (2-year follow-up) after hospital admission. The analyses presented here used 'bed-days' (rather than number of readmissions) to measure subsequent resource use. This is important as people with frailty typically have longer hospital admissions[23,24] and therefore the number of readmissions only provides a partial indicator of subsequent resource use.

The cohorts were recruited in different hospitals and regional- or hospital-level differences are possible. Caution is therefore needed in making inter-cohort comparisons. The clinical datasets were designed for different studies so available variables from which to calculate frailty scores differed. There were missing data in some variables required to calculate frailty scores, so some patients had to be excluded. Despite this, those included for each scale had similar characteristics such as age and sex, and frailty was identified in similar proportions. The applicability of the scales for the inpatient cohort emerged as an issue during the study: those classified by Fried were mainly identified as frail and the cohort spent a lot of time in hospital including during the index admission, which directly affects the number of diagnoses recorded for the HFRS. This means that there is little differentiation in outcomes between the frail and non-frail for these scales.

Institutionalisation is an important outcome for older people and, although there were data available at baseline for both cohorts, the numbers were too small to present. There were no long-term follow-up data on institutionalisation for either

Ethical approval
Ethical approval was provided by Essex NRES Committee (East of England), reference: 15/EE/024.

Provenance
Freely submitted; externally peer reviewed.

Competing interests
The authors have declared no competing interests.

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cohort over the study period. Overall, the inpatient cohort was a small sample and almost 50% of those identified as frail by any of the scales died in the 2-year follow-up. Accounting for survival time increased the differentiation in hospital use between frail and non-frail, particularly for the clinical frailty scales. As well as being a relatively small sample, the inpatient group was also all female, which limits the generalisability of the findings from this cohort. A sensitivity analysis was conducted using female patients in the ambulatory cohort, which showed that many of the main findings from the mixed cohort remained (further details available from the authors on request).

Recruitment took place some years ago, but it is unlikely that this invalidates the main findings or messages of this study, which should therefore be generalisable to current practice.

Comparison with existing literature
The data presented here demonstrate poor outcomes and subsequent increased resource use even after brief (<72 hours) hospital admissions. Direct comparisons with the few previous studies that have reported mortality outcomes are difficult, as most acute hospital-based studies only look at short-term mortality (30–90 days). However, the 2-year mortality rates of 32.2–52.7% with associated confidence limits presented have some overlap with other studies that report inpatient mortality rates of 11–33% for older people with Clinical Frailty Scale scores of 7–9 (severely frail).[24–26] This study adds to a growing body of evidence relating to the value of frailty as a predictor of mortality risk across a range of populations and settings.[23,27–32]

Implications for research and practice
There are compelling reasons to avoid unnecessary hospitalisation in older people, including the risks of deconditioning and iatrogenic harm.[8] However, the data presented in this study demonstrate poor outcomes even among frail older people discharged from hospital after brief (<72 hours) stays, suggesting that early discharge is not (on its own) sufficient to meet the needs of these patients. Indeed, there is a danger that the current focus on 'admission avoidance' places too much emphasis on relieving service pressures and risks constructing frail older people as burdensome and problematic. A more

positive and person-centred definition of what services are trying to achieve is perhaps needed.

Most hospital admissions in frail older people relate to actual or impending 'frailty crises' (such as, sudden loss of mobility, delirium, or falls). With respect to frailty crises, services can be divided into those which seek to prevent (such as, proactive care), offer increased support during (such as, intensive community support), or promote recovery following frailty crises (such as, community rehabilitation).

'Primary prevention' of frailty crises is challenging because evolving frailty often goes unrecognised until a crisis occurs, making it difficult to target resource-intensive community services in an impactful way. By contrast, individuals who have had a frailty crisis are easily identifiable and, with increasing evidence of poor outcomes, are likely to benefit from services such as proactive care, enhanced community support, and advance care planning.[33–35] This could define a 'secondary prevention' approach to frailty crises (targeting those identified as frail who have already been admitted to hospital or received intensive community support).

This would require a systematic and inter-organisational approach to identifying patients with frailty on hospital discharge and providing an individually tailored response. Although challenging, this is increasingly plausible with the greater (albeit still imperfect) interoperability of healthcare informatics and the development of accountable care organisations that are responsible for managing the whole patient journey. Examples of evidence-based interventions that might be used for secondary prevention include hospital at home,[33] advance care planning,[34] and comprehensive geriatric assessment (although there is a need for comprehensive geriatric assessment to be tailored to community settings).[35]

Further research is required to define and evaluate interventions that might be used as part of a 'secondary prevention' approach and to optimise the performance of frailty assessment tools that could be used to identify patients. Furthermore, implementation would require a joined-up approach across primary, community, and acute care services, so that assessments and interventions take place at the most appropriate stage of the patient journey.

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