The impact of frailty on healthcare resource use: a longitudinal analysis using the Clinical Practice Research Datalink in England

Abstract

Background

Routine frailty identification and management is national policy in England, but there remains a lack of evidence on the impact of frailty on healthcare resource use. We evaluated the impact of frailty on the use and costs of general practice and hospital care.

Methods

Retrospective longitudinal analysis using linked routine primary care records for 95,863 patients aged 65-95 years registered with 125 UK general practices between 2003 and 2014. Baseline frailty was measured using the electronic Frailty Index (eFI) and classified in four categories (non, mild, moderate, severe). Negative binomial regressions and ordinary least squares regressions with multilevel mixed effects were applied on the use and costs of general practice and hospital care.

Results

Compared with non-frail status, annual general practitioner consultation incidence rate ratios (IRRs) were 1.24 (95% CI: 1.21-1.27) for mild, 1.41 (95% CI: 1.35-1.47) for moderate, and 1.52 (95% CI: 1.42-1.62) for severe frailty. For emergency hospital admissions, the respective IRRs were 1.64 (95% CI 1.60-1.68), 2.45 (95% CI 2.37-2.53) and 3.16 (95% CI: 3.00-3.33). Compared with non-frail people the IRR for inpatient days was 7.26 (95% CI 6.61-7.97) for severe frailty. Using 2013/14 reference costs, extra annual cost to the healthcare system per person was £561.05 for mild, £1208.60 for moderate and £2108.20 for severe frailty. This equates to a total additional cost of £5.8 billion per year across the UK.

Conclusions

Increasing frailty is associated with substantial increases in healthcare costs, driven by increased hospital admissions, longer inpatient stay, and increased general practice consultations.

Introduction

Frailty is a common condition characterised by loss of biological reserves and vulnerability to adverse outcomes. It is independently associated with increased risk of falls, disability, hospitalisation and mortality [1]. These outcomes are important from the perspective of older people, their families, and health and social care systems internationally. In light of this, frailty is gaining increasing prominence as a key health policy issue and there is growing recognition that healthcare systems need to adapt to more closely meet the needs of older people living with frailty [2]. A notable recent development has been the inclusion of the identification and management of frailty in the 2017/18 General Medical Services contract, which is the national contractual agreement between general practitioners (GPs) and the NHS in England [3].

Available evidence indicates that frailty is associated with increased risk of contact with healthcare services. However, studies that have investigated healthcare resource use and costs have typically been relatively small, single site studies [4] or based on cohorts that are not generalisable to the wider community-dwelling older population [5]. There has been a notable absence of research to investigate resource impact of frailty at the population level. This is problematic because the absence of this key information is a major impediment to population-level planning, delivery and evaluation of services. Furthermore, detailed understanding of the impact of frailty on healthcare resource use is important for informing robust national health policy and appropriate resource allocation. In this study, we aimed to evaluate the association between frailty and healthcare resource use at population-level by analysing linked primary care electronic patient records (EPRs).

Study design

Data sources

Retrospective longitudinal analysis of EPRs in the Clinical Practice Research Datalink (CPRD), a database containing routinely collected primary care EPRs from approximately 6.9% of the UK population registered with 674 practices [6]. Individual patient data is linked to external data sources including NHS Hospital Episode Statistics (HES) for hospital admissions [7], the Index of Multiple Deprivation (IMD) score [8], and the Office of National Statistics (ONS) mortality records [9].

Our sampling frame was 125 general practices in England, broadly nationally representative for social deprivation and list size. Patients with at least one of eighteen long-term conditions (LTCs) included in the Quality and Outcomes Framework (QOF; a national primary care pay-for-performance scheme [10]) were eligible, and up to 2,500 eligible patients were randomly sampled from study practices.

For healthcare costs, we extracted information from Unit Costs of Health and Social Care [11], the NHS national tariffs [12] and Department of Health Reference Costs [13].

Variables and method

We identified 11 annual cohorts from our sample patients from 1st April 2003 to 31st March 2014. Patients were included in the index cohort if they were: i) aged 65-95 at baseline; ii) registered with a sample practices; and iii) had continuous medical records up to research standard for at least 180 days [6].

General practice service use in the index year was measured by consultations with general practitioners (GPs) and nurses (practice nurses, community nurses, health visitors). Hospital care was measured by hospital admissions and inpatient days, by emergency and elective admissions. We analysed costs in 2013/14, the most recent year in our study.

Our exposure variable was the baseline frailty level, identified using the electronic Frailty Index (eFI) incorporating 36 health deficits [14]. Previously defined frailty categories were used: non-frail (eFI 0-0.12); mild frailty (0.12-0.24); moderate frailty (0.24-0.36); severe frailty (>0.36) [14].

By extraction criteria, our sample patients have at least one of the LTCs in the QOF, most of which are included in the eFI. We identified five LTCs not included in the eFI: epilepsy, learning disability, serious mental illness, cancer and depression and included dummy variables in our analyses to indicate the presence of these conditions at baseline.

We adjusted for patient demographics using baseline age, gender and ethnicity. Deprivation was measured by 2015 IMD rank quintiles with the first quintile representing the least deprived neighbourhoods [15].

General practice consultations and hospital admissions were analysed as count variables using two-level negative binomial models. We stacked the 11 cohorts to create a longitudinal dataset, increasing sample size and statistical power. As this may introduce correlation among observations of the same patients, we estimated these models with patient-level random intercepts and applied standard errors robust to autocorrelation. We included year dummies to account for unobserved-year fixed effects. We reported the incident rate ratios (IRR) for relative adjusted impact of frailty on healthcare use. We then predicted outcomes using these models for the absolute differences between frailty levels.

Estimating healthcare costs

We used reference costs of 2013/14 because the unit costs of general practice care and hospital admissions are calculated yearly to reflect inflation and the varying market factors. Additionally, Healthcare Resource Group (HRG) codes, a standard grouping of clinically similar treatments using common level of healthcare resource are constantly updated to better incorporate patient complexity [16].

We extracted from PSSRU (2014): i) the unit costs of GPs and practice nurses in 2013/14; and ii) the average consultation length to calculate the average cost per consultation. We multiplied the average costs by our predicted consultation levels to calculate the costs by frailty categories. GP consultations, on average, lasted for 11.7 minutes for surgery consultations, 17.2 minutes for clinic consultations, 7.1 minutes for telephone consultations and 23.4 minutes for home visits (including 12 minutes travel time) [11]. GP consultation costed £234 per hour in 2013/14, including costs of direct care staff and medical education and training, giving an average cost of £57.9 per GP consultation, with the duration calculated as the mean of four consultation types. Additionally, there was an average prescription cost of £40.7 making the total cost £98.6 per GP consultation. The average duration was 15.5 minutes per surgery consultation with practice nurses, whose unit cost was £34 per hour in 2013/14. Therefore, a practice nurse visit costed an average of £8.8.

For the costs of hospital admissions, we categorised admissions in 2013/14 into four groups: day case, elective spell, non-elective short stay (less than 2 days) and non-elective spell. We linked the grouped

admissions to the 2013/14 national tariffs using HRG codes [12]. 42,146 (99.7%) admissions were linked to HRG codes and 39,708 (93.9%) were matched to the national tariffs. Of the admissions without a matched national tariff, 182 were linked to the 2013/14 national reference costs. For spells with length of stay exceeding the HRG-specific trim points, we adjusted the tariffs using the excessive inpatient days and the unit long stay payment. By emergency and elective admissions, we estimated two-level linear regressions with practice-level random intercepts for the impact of frailty on the annual cost of hospital admissions, taking into account correlated standard errors.

Results

Descriptive statistics

There were 566,101 year-specific observations across the study period, with repeated measures for 95,863 patients. Of the total observations, 245,294 (43.3%) had a baseline status of non-frail, 216,354 (38.2%) mild frailty, 82,187 (14.5%) moderate frailty, and 22,266 (3.9%) severe frailty (**table 1**). There was a social gradient in frailty: 22.4% of patients with severe frailty were from the most deprived neighbourhoods, compared with 12.1% in the non-frail group.

The use of general practice and hospital care increased with frailty. On average, patients with severe frailty had 22.4 GP consultations and 7.3 practice nurse contacts annually, compared with 7.6 GP consultations and 2.9 practice nurses visits for the non-frail population. Patients with mild and moderate frailty also had more consultations than non-frail population. GP consultations increased by 64.5% and 127.6% respectively (12.5 for mild frailty and 17.3 for moderate frailty), and practice nurses consultations increased by 55.2 % and 106.9% respectively (4.5 for mild frailty and 6.0 for moderate frailty).

Hospital admissions also increased with frailty. Compared to non-frail patients, patients with severe frailty required more emergency admissions (mean 0.1 and 0.7 annually respectively), more inpatient bed days following emergency admission (mean 1.0 and 7.8 respectively), and more elective admissions (0.3 and 0.7 annually respectively).

Table 1 Descriptive statistics 2003/04 - 2013/14

	Non frail	Mild frailty	Moderate frailty	Severe frailty
Observation, n (%)	245,294 (43.33%)	216,354 (38.22%)	82,187 (14.52%)	22,266 (3.93%)
Age, mean (SD)	73.02 (6.47)	76.23 (7.25)	79.64 (7.38)	82.44 (7.01)
Gender, n (%)				
Male	117,127 (47.75%)	93,205 (43.08%)	30,165 (36.70%)	6,670 (29.96%)
Female	128,167 (52.25%)	123,149 (56.92%)	52,022 (63.30%)	15,596 (70.04%)
Ethnicity, n (%)				
White	166,590 (67.91%)	150,002 (69.33%)	57,004 (69.36%)	15,519 (69.70%)
Asian	3,620 (1.48%)	4,008 (1.85%)	1,434 (1.74%)	279 (1.25%)
Black	2,360 (0.94%)	2,209 (1.02%)	710 (0.86%)	158 (0.71%)
Mixed	461 (0.19%)	418 (0.19%)	156 (0.19%)	57 (0.26%)
Other or not stated	5,684 (2.32%)	4,553 (2.10%)	1,482 (1.80%)	259 (1.16%)
Missing	66,633 (27.16%)	55,164 (25.50%)	21,401 (26.04%)	5,994 (26.92%)
Deprivation, n (%)				
1st category - least deprived	64,396 (26.25%)	53,099 (24.54%)	18,864 (22.95%)	4,886 (21.94%)
2nd category	59,988 (24.46%)	48,220 (22.29%)	17,273 (21.02%)	4,149 (18.63%)
3rd category	50,133 (20.44%)	43,823 (20.26%)	15,381 (18.71%)	4,070 (18.28%)
4th category	40,641 (16.57%)	38,144 (17.63%)	15,034 (18.29%)	4,137 (18.58%)
5th category	29,601 (12.07%)	32,533 (15.04%)	15,509 (18.87%)	4,993 (22.42%)
Missing	535 (0.22%)	535 (0.25)	126 (0.15%)	31 (0.14%)
LTCs not included in eFI, n (%)				
Cancer	33,691 (13.73%)	37,064 (17.13%)	16,790 (20.43%)	5,117 (22.98%)
Depression	34,703 (14.15%)	45,096 (20.84%)	24,639 (29.98%)	9,526 (42.78%)
Epilepsy	3,031 (1.24%)	3,783 (1.75%)	1,936 (2.36%)	684 (3.07%)
SMI	2,605 (1.06%)	2,527 (1.17%)	1,350 (1.64%)	566 (2.54%)

Learning disability	246 (0.10%)	277 (0.13%)	148 (0.18%)	44 (0.20%)
No. of consultations per person, mean (SD)				
GPs	7.60 (7.54)	12.53 (10.30)	17.29 (13.32)	22.41 (17.11)
Practice nurses	2.88 (4.64)	4.51 (6.73)	6.02 (9.24)	7.25 (11.02)
No. of hospital admissions per person, mean (SD)				
Emergency	0.11 (0.44)	0.23 (0.67)	0.44 (0.95)	0.74 (1.25)
Elective	0.26 (1.87)	0.41 (2.91)	0.59 (4.94)	0.69 (6.08)
No. of inpatient days per person, mean (SD)				
Emergency	1.01 (6.42)	2.13 (9.39)	4.34 (13.55)	7.81 (18.52)
Elective	0.32 (3.03)	0.52 (4.04)	0.68 (4.60)	0.87 (6.02)

Repeated measures per person: mean (SD) = 5.91 (3.59); median (range) = 5 (1-11); 25% percentile = 3; 75% percentile = 9.

Adjusted impact of frailty on general practice use

Higher adjusted GP consultation rates were significantly associated with increasing age, female gender and black ethnicity, but not with deprivation (**table 2**). Consultations with practice nurses followed a similar pattern, but men and white patients tended to have higher consultation rates. After adjusting for patient-level confounders, general practice consultations increased with frailty (**table 2**). Compared with non-frail status, IRR for GP consultations were 1.24 (95% CI: 1.21-1.27) for mild frailty, 1.41 (95% CI: 1.35-1.47) for moderate frailty and 1.52 (95% CI: 1.42-1.62) for severe frailty. Practice nurses visits had similar associations with frailty, with the greatest increase over baseline for severely frail patients.

The absolute differences in consultation levels were predicted using these regressions (**table 3**). Compared with the non-frail group, there were on average 2.5 more GP consultations and 0.9 more nurses visits annually for the group with mild frailty. The increases were 4.1 with GPs and 1.5 with nurses for moderate frailty, and 5.2 with GPs and 2.0 with nurses for severe frailty.

Our analyses indicate that a non-frail patient would cost £1021.55 per year for consultations with GPs and practice nurses (£990.93 and £30.62, respectively) (**table 3**). Using this as a baseline, a patient with mild frailty would cost an additional £249.32 annually (£241.57 with GPs and £7.75 with nurses). A patient with moderate frailty would cost an additional £417.82 per year (£404.26 with GPs and £13.56 with nurses). For severe frailty, we estimated an annual cost of £532.29 for extra consultations (£514.69 with GPs and £17.60 with nurses).

Adjusted impact of frailty on hospital care usage

Higher adjusted emergency hospital admission rates were significantly associated with male gender, increasing age and levels of deprivation (**table 2**). Elective admission rates decreased in older age groups and there was no social gradient, with similar patterns for length of stay.

After adjustment, increasing frailty was associated with increased hospital admission rates (**table 2**). Compared with the non-frail group, the adjusted IRRs for annual emergency admissions were 1.64 (95% CI: 1.60-1.68) for mild frailty, 2.45 (95% CI: 2.37-2.53) for moderate frailty and 3.16 (95% CI: 3.00-3.33) for severe frailty. Following emergency admission, patients stayed in hospital for more than four times longer than the non-frail population if they were moderately frail (IRR: 4.45; 95% CI: 4.19-4.73), and more than seven times longer if they were severely frail (IRR: 7.26; 95% CI: 6.61-7.97).

Elective admissions also increased with frailty. Compared with the non-frail group, the adjusted IRRs for annual elective admissions were 1.50 (95% CI: 1.46-1.54) for mild frailty, 1.85 (95% CI: 1.79-1.92) for moderate frailty and 1.93 (95% CI: 1.82-2.05) for severe frailty. There was a threefold increase in combined inpatient days per year following elective admission for moderate and severe frailty (IRRs of 3.07 (95% CI: 2.81-3.35) and 3.64 (95% CI: 3.14-4.22) respectively).

The absolute adjusted differences in annual hospital admissions between frailty categories were relatively small (**table 3**). On average patients with severe frailty had 0.3 additional emergency admissions per year compared with non-frail patients. However, the differences were more substantial for days of inpatient care. Patients would, on average, stay in hospital for another 25.8 days per year following emergency admission if they were severely frail (29.9 for severe frailty and 4.1 for non-frail). Moderate frailty was associated with 14.2 additional days in hospital (18.3 for moderate frailty).

We estimated the economic impact of frailty on hospital care in 2013/14. There were 57,974 patients eligible for analyses with 42,281 hospital admissions in this year. After adjustment, the average annual cost of hospital admission (emergency and elective) increased from £606.80 for non-frail patients to £918.53 for mild frailty; £1397.58 for moderate frailty; and £2182.71 for severe frailty (**table 3**). More severe frailty status had greater impact on the costs of emergency admissions than elective admissions.

Table 2 Adjusted impact of frailty on healthcare use, 2003/04 - 2013/14.

	General practice consultations				Hospital admissions				Hospital inpatient days			
	GPs		Practice nurses		Emergency		Elective		Emergency		Elective	
	IRR[a]	95% CI[b]	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI	IRR	95% CI
Baseline eFI category[c] (reference = non-frail)												
Mild frailty	1.24***	[1.21 - 1.27]	1.25***	[1.23 - 1.28]	1.64***	[1.60 - 1.68]	1.50***	[1.46 - 1.54]	2.19***	[2.09 - 2.30]	2.04***	[1.92 - 2.17]
Moderate frailty	1.41***	[1.35 - 1.47]	1.44***	[1.38 - 1.51]	2.45***	[2.37 - 2.53]	1.85***	[1.79 - 1.92]	4.45***	[4.19 - 4.73]	3.07***	[2.81 - 3.35]
Severe frailty	1.52***	[1.42 - 1.62]	1.58***	[1.45 - 1.71]	3.16***	[3.00 - 3.33]	1.93***	[1.82 - 2.05]	7.26***	[6.61 - 7.97]	3.64***	[3.14 - 4.22]
Baseline age group (reference = 65 - 70)												
70 - 75	1.10***	[1.09 - 1.12]	1.11***	[1.09 - 1.12]	1.21***	[1.16 - 1.25]	1.14***	[1.11 - 1.18]	1.60***	[1.49 - 1.72]	1.25***	[1.15 - 1.36]
75 - 80	1.21***	[1.19 - 1.23]	1.19***	[1.16 - 1.23]	1.51***	[1.45 - 1.57]	1.27***	[1.22 - 1.33]	2.66***	[2.47 - 2.87]	1.50***	[1.36 - 1.65]
80 - 85	1.32***	[1.29 - 1.35]	1.26***	[1.21 - 1.31]	1.93***	[1.84 - 2.02]	1.15***	[1.09 - 1.20]	4.91***	[4.50 - 5.36]	1.25***	[1.13 - 1.38]
85 - 90	1.44***	[1.39 - 1.49]	1.26***	[1.19 - 1.34]	2.27***	[2.16 - 2.40]	0.95	[0.90 - 1.01]	7.69***	[7.01 - 8.43]	0.90	[0.75 - 1.07]
90 +	1.57***	[1.49 - 1.66]	1.19***	[1.08 - 1.31]	2.68***	[2.51 - 2.87]	0.62***	[0.56 - 0.68]	11.96***	[10.55-13.56]	0.58***	[0.44 - 0.75]
Gender (reference = Male)												
Female	1.05***	[1.03 - 1.07]	0.98	[0.96 - 1.00]	0.74***	[0.71 - 0.77]	0.85***	[0.82 - 0.89]	0.63***	[0.58 - 0.69]	0.84***	[0.78 - 0.91]
Ethnic group (reference = White)												
Asian	1.16	[0.97 - 1.38]	0.79	[0.61 - 1.03]	1.00	[0.92 - 1.09]	1.11	[0.96 - 1.28]	0.97	[0.80 - 1.17]	0.87	[0.72 - 1.04]
Black	1.14*	[1.02 - 1.27]	0.76**	[0.63 - 0.92]	0.88*	[0.78 - 0.99]	0.99	[0.87 - 1.13]	0.88	[0.73 - 1.06]	0.77**	[0.63 - 0.93]
Mixed	1.09	[0.99 - 1.21]	0.83*	[0.70 - 0.98]	0.86	[0.66 - 1.13]	0.88	[0.71 - 1.08]	0.68	[0.41 - 1.12]	0.55**	[0.38 - 0.80]
Other or Not stated	1.02	[0.96 - 1.09]	0.72***	[0.61 - 0.86]	0.94	[0.87 - 1.02]	0.93	[0.84 - 1.02]	0.77**	[0.65 - 0.92]	0.77**	[0.65 - 0.90]
Missing	0.98	[0.93 - 1.03]	0.91*	[0.85 - 0.98]	0.90***	[0.85 - 0.96]	0.83***	[0.79 - 0.88]	0.85**	[0.77 - 0.95]	0.89**	[0.81 - 0.97]
IMD categories (reference = 1st category)												
2nd category	0.99	[0.93 - 1.06]	0.98	[0.86 - 1.11]	1.08***	[1.04 - 1.13]	0.99	[0.94 - 1.04]	1.16***	[1.08 - 1.24]	1.04	[0.97 - 1.12]
3rd category	1.00	[0.94 - 1.07]	1.03	[0.92 - 1.16]	1.16***	[1.11 - 1.21]	1.00	[0.94 - 1.06]	1.38***	[1.28 - 1.49]	1.06	[0.97 - 1.17]
4th category	0.96	[0.88 - 1.04]	0.96	[0.84 - 1.11]	1.19***	[1.13 - 1.27]	0.94	[0.86 - 1.02]	1.48***	[1.35 - 1.63]	0.97	[0.86 - 1.09]
5th category - most deprived	1.02	[0.91 - 1.15]	0.98	[0.77 - 1.24]	1.47***	[1.36 - 1.60]	0.96	[0.89 - 1.04]	2.09***	[1.86 - 2.34]	0.88*	[0.77 - 1.00]

Missing	1.07	[0.93 - 1.23]	0.85	[0.68 - 1.07]	0.51*	[0.28 - 0.90]	0.14***	[0.07 - 0.30]	0.20**	[0.07 - 0.55]	0.12***	[0.04 - 0.33]
Drop out	0.72***	[0.69 - 0.76]	0.49***	[0.46 - 0.53]	3.40***	[3.24 - 3.56]	1.06**	[1.02 - 1.10]	15.49***	[13.93-17.22]	2.90***	[2.58 - 3.27]

Each outcome variable was estimated using two-level negative binomial regression with random intercept at patient-level, adjusted for baseline age, gender, an interaction between age and gender, ethnic group, deprivation, non-frailty long-term conditions (cancer, depression, epilepsy, SMI and learning disability), registration drop-out and year dummies.
a. Incident rate ratio. b. 95% confidence interval. c. electronic Frailty Index (eFI) category: 0-0.12 non-frail; 0.12-0.24 mild frailty; 0.24-0.36 moderate frailty; >0.36 severe frailty.
*** p<0.001, ** p<0.01, * p<0.05.

Table 3 Adjusted healthcare use and costs by frailty categories.

	Non-frail	Mild frailty	Moderate frailty	Severe frailty
General practice consultations[a]				
GPs	10.05*** (0.35)	12.50*** (0.36)	14.15*** (0.38)	15.27*** (0.48)
Practice nurses	3.48*** (0.21)	4.36*** (0.25)	5.02*** (0.27)	5.48*** (0.32)
Hospital admissions[a]				
Emergency	0.15*** (0.003)	0.24*** (0.005)	0.36*** (0.01)	0.46*** (0.01)
Elective	0.24*** (0.01)	0.37*** (0.01)	0.45*** (0.01)	0.47*** (0.02)
Inpatient days[a]				
Emergency	4.12*** (0.24)	9.03*** (0.51)	18.34*** (1.02)	29.91*** (1.81)
Elective	0.34*** (0.01)	0.69*** (0.04)	1.04*** (0.06)	1.24*** (0.10)
Costs - general practice consultations[b]				
GPs	990.93	1232.50	1395.19	1505.62
Practice nurses	30.62	38.37	44.18	48.22
Total	1021.55	1270.87	1439.37	1553.84
Costs - hospital admissions[c]				
Emergency	369.22*** (58.29)	509.23*** (56.24)	857.73*** (59.23)	1579.96*** (74.40)
Elective	241.67*** (11.94)	412.41*** (12.19)	539.83*** (22.14)	598.57*** (22.14)
Total	606.80*** (60.50)	918.53*** (58.64)	1397.58*** (65.91)	2182.71*** (79.98)
Costs - total	1628.35	2189.40	2836.95	3736.55

a. Predicted healthcare use per person per year using negative binomial regressions in table 2.
b. Costs were calculated using predicted healthcare use multiplied by the average cost per consultation.
c. Predicted costs using two-level linear regressions with random intercept at practice-level, adjusted for baseline age, gender, ethnic group, deprivation, non-frailty long-term conditions and registration drop-out.
Standard errors in parentheses are robust to unspecified correlations. *** p<0.001, ** p<0.01, * p<0.05.

Discussion

We found that frailty was associated with large increases in general practice consultations, hospital admissions and length of hospital stay, consistent with international studies [17-20]. The greatest impact of frailty was on length of inpatient stay following emergency hospital admission, with severely frail patients staying in hospital over seven times longer than non-frail patients. This finding is likely to reflect not only greater medical need, but also lack of resources to support these patients in the community following discharge [21]. Extended stays for frail patients are compounded by social deprivation; people living in more deprived areas are more likely to experience emergency hospitalisation, and to have an extended hospital stay following admission.

Our estimated costs of hospital admissions are generally comparable to findings in other European countries [4, 22]. We estimate that annual costs for general practice consultations and hospital admissions increase from £1628.35 for non-frail older people to £2189.40 for people with mild frailty, £2836.95 for moderate frailty and £3736.55 for severe frailty. Based on estimates of national frailty prevalence [14] and 2017 population estimates [23], this equates to a national cost of frailty to the UK NHS of £5.8 billion per year. In terms of NHS workload, an additional 29.1 million general practice consultations, 1.0 million emergency admissions and 1.1 million elective admissions are associated with frailty each year. Frailty is also associated with an additional 61.5 million patient days in hospital per year following emergency admission, and 3.3 million patient days following elective admission.

We focused on patients with existing chronic disease, which, combined with the use of average costs for consultations and hospital admissions, is likely to underestimate the true costs of caring for patients with increasing frailty. We calculated the average costs of general practice consultations using published information because of missing consultation length data, which is likely to further underestimate the economic impact of frailty, as consultation length and prescription costs are likely to increase with deteriorating health. Furthermore, we were unable to examine the impact of frailty on the use of community services such as rehabilitation and care homes, as the necessary linkages are not available in the CPRD database. Our findings are therefore an underestimate of the total cost for treating and looking after the frail population, considering inputs from both health and social care sectors. More comprehensive estimates would be needed from future research for the planning and organisation of integrated care pathways.

Conclusion

Our findings confirm that older people with frailty are high intensity users of healthcare resources, and resource use increases with frailty severity. A particularly notable finding is a seven-fold increase in length of hospital stay for people with severe frailty, compared to non-frail older people. These findings should help direct appropriate allocation of national healthcare resources towards older people living with different degrees of frailty, and provide commissioners with the necessary evidence on which to commission and evaluate suitably costed services which consider impact on healthcare resource use. Findings could also be used by commissioners and providers of health and social care services to resource and implement evidence-based frailty services as part of a population health management strategy [24], including measures targeting reduced length of hospital stay, as described in the 2019 NHS Long Term Plan [25].

Key points

We estimate an annual additional 29.1 million NHS general practice consultations, 1.0 million emergency admissions and 1.1 million elective admissions are associated with frailty.

Following emergency hospitalisation, older people with severe frailty have a seven-fold increased length of stay, compared with non-frail older people.

People with frailty account for an estimated annual additional 61.5 million patient days in hospital per year following emergency admission.

The estimated extra annual NHS cost of managing frailty is £561.05 for each patient with mild frailty, £1208.60 for moderate frailty and £2108.20 for severe frailty.

The total additional UK NHS primary and secondary care costs for older people with frailty is an estimated £6 billion per year.

References

1. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. Lancet. 2013;381(9868):752-62.

2. Reeves D, Pye S, Ashcroft DM, Clegg A, Kontopantelis E, Blakeman T, et al. The challenge of ageing populations and patient frailty: can primary care adapt? BMJ. 2018;362:k3349.

3. NHS Employers. General Medical Services (GMS) contract: Guidance for GMS contract 2017/18. 2017 [updated 30 October 2017.] Available from: http://www.nhsemployers.org/gms201718.

4. Garcia-Nogueras I, Aranda-Reneo I, Pena-Longobardo LM, Oliva-Moreno J, Abizanda P. Use of Health Resources and Healthcare Costs associated with Frailty: The FRADEA Study. J Nutr Health Aging. 2017;21(2):207-14.

5. Comans TA, Peel NM, Hubbard RE, Mulligan AD, Gray LC, Scuffham PA. The increase in healthcare costs associated with frailty in older people discharged to a post-acute transition care program. Age and ageing. 2016;45(2):317-20.

6. Herrett E, Gallagher AM, Bhaskaran K, Forbes H, Mathur R, van Staa T, et al. Data Resource Profile: Clinical Practice Research Datalink (CPRD). Int J Epidemiol. 2015;44(3):827-36.

7. NHS Digital. Hospital Episode Statistics. https://digital.nhs.uk/data-services/hospital-episode-statistics

8. Ministry of Housing, Communities & Local Government. English indices of deprivation 2015. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

9. Office for National Statistics. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths

10. NHS Employers. General Medical Services (GMS) contract Quality and Outcomes Framework (QOF): Guidance for GMS contract 2015/16. 2015.

11. Personal Social Service Research Unit (PSSRU). Unit Costs of Health & Social Care 2014. 2014.

12. Department of Health. Payment by Results: Guidance for 2013 - 14. 2013.

13. Department of Health. Reference costs 2013 - 14. 2014.

14. Clegg A, Bates C, Young J, Ryan R, Nichols L, Ann Teale E, et al. Development and validation of an electronic frailty index using routine primary care electronic health record data. Age Ageing. 2016;45(3):353-60.

15. Department for Communities and Local Government. The English Indices of Deprivation 2015. 2015.

16. NHS Digital. Introduction to Healthcare Resource Groups. http://content.digital.nhs.uk/hrg. Last access on 3 November 2017

17. Simpson KN, Seamon BA, Hand BN, Roldan CO, Taber DJ, Moran WP, et al. Effect of frailty on resource use and cost for Medicare patients. J Comp Eff Res. 2018.

18. Dent E, Dal Grande E, Price K, Taylor AW. Frailty and usage of health care systems: Results from the South Australian Monitoring and Surveillance System (SAMSS). Maturitas. 2017;104:36-43.

19. Roe L, Normand C, Wren M-A, Browne J, O'Halloran AM. The impact of frailty on healthcare utilisation in Ireland: evidence from the Irish longitudinal study on ageing. BMC Geriatr. 2017;17(1):203.

20. Ilinca S and Calciolari s. The patterns of health care utilization by elderly Europeans: Frailty and its implications for health systems. Health Services Research. 2015;50:1.

21. National Audit Office. Discharging older patients from hospital. 2016.

22. Bock J-O, Konig H-H, Brenner H, Haefeli WE, Quinzler R, Matschinger H, et al. Associations of frailty with health care costs--results of the ESTHER cohort study. BMC Health Serv Res. 2016;16:128.

23. Office for National Statistics. Population estimates for the UK, England, Wales, Scotland and Northern Ireland: mid-2017. 2018. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2017.

24. Harrison JK, Clegg A, Conroy SP, Young J. Managing frailty as a long-term condition. Age Ageing. 2015;44(5):732-5.

25. NHS. The NHS long term plan. 2019.