The electronic frailty index as an indicator of community healthcare service utilisation in the older population.

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Abstract

Background: Older people with frailty are particularly high users of healthcare services, however a lack of standardised recording of frailty in different healthcare electronic datasets has limited investigations into healthcare service usage and demand of the older frail population.
Objectives: To investigate the community service demand of frail patients using the electronic frailty index (eFI) as a measure of frailty.
Study design and setting: A retrospective cohort study using anonymised linked healthcare patient data from primary care, community services and acute hospitals in Norfolk.
Participants: Patients aged 65 and over who had an eFI assessment score established in their primary care electronic patient record in Norwich based General Practices.
Results: We include data from 22,859 patients with an eFI score. Frailty severity increased with age and was associated with increased acute hospital admission within a 6 month window. Patients with a frail eFI score were also more likely to have a community service referral within a 6 month window of frailty assessment, with a RR of 1.84 (1.76 to 1.93) for mild frailty, 1.96 (1.83 to 2.09) for moderate frailty and 2.95 (2.76 to 3.14) for severe frailty scores. We also found that frail patients had more community referrals per patient then those classified as fit and required more care plans per community referral.
Conclusions: eFI score was an indicator of community service use, with increasing severity of frailty being associated with higher community healthcare requirements. The eFI may help planning of community services for the frail population.

Keywords: frailty, electronic frailty index, service use, electronic health record, community care

Word Count: 2,426

Introduction

Approximately 14% of community dwelling people over 65 years old experience frailty, increasing to 50% in those over 85 years [1]. These individuals experience physical weakness, falls, high rates of infection, cognitive impairment, disability and impaired recovery after minor stress events [2]. Inevitably, there is a high social care burden, increased hospital admissions and mortality [3-5]. With more information on how frail people use services, care planning could be improved to enhance quality of life and reduce unnecessary health and social care use. However, a lack of clinical consensus and a gold standard assessment tool for frailty in healthcare settings has led to reduced visibility of the condition, particularly in recorded electronic patient data [6], leading to several recommendations in the UK to increase the identification of frailty in routine clinical care [7].

Recently an electronic frailty index (eFI) was developed using routine primary care Electronic Health Record (EHR) data, incorporating 36 deficits to generate an eFI score categorising patients as fit (0-0.12), mild (0.12-0.24), moderate (0.24-0,36) or severely frail (>0.36) [8]. The eFI tool was shown to be a robust predictor of mortality, hospitalisation and nursing home admission [8]. Since it only requires routinely collected data, patients with frailty can be identified easily in primary care for targeting health interventions, fall risk and medical assessments to avoid unplanned admissions [9]. Whilst the tool has been found to be a predictor of hospitalisations and nursing home admission, it is unclear if it is associated with high community care use. Therefore, the aim of this study was to determine whether frail patients, as measured by the eFI, were also high users of community and acute services by linking primary, secondary and community care data.

Methods

Study design

We conducted a retrospective cohort study using linked General Practice (GP) primary care, community and acute hospital patient data in Norfolk to determine community service use of patients with a primary care eFI score of mild, moderate and severe compared to fit patients. After frailty assessment, which was determined as the index date, patient service use was followed up for 6 months in both community healthcare and acute hospital databases.

Data extraction and linkage

Health services provided by the NHS are delivered through four main providers. First, primary care services are delivered through individual general practices. Second, acute services, such as hospital admissions and emergency attendances, are delivered by acute hospitals (in Norfolk there are three acute hospitals). Third, community health services providing a wide range of intermediate care in the community, such as community hospitals, district nursing and rehabilitation (in Norfolk there is one provider of community services). Fourth, mental health services are delivered by a separate organisation (in Norfolk there is one provider of mental health services). In addition, to these providers there are a number of other organisations that provide ancillary services, such as ambulance services and sexual health.

Primary care data was extracted from Norwich CCG primary care SystmOne databases to obtain a cohort of patients over 65 that had undergone an eFI assessment from 1 January 2014. Only primary care data from the Norwich CCG was available for extraction (one out of five Clinical Commissioning Groups (CCGs) in Norfolk). Primary care patient eFI scores were then linked using pseudonymised

patient identifiers to community services data from the Norfolk Community Health and Care (NCH&C) NHS trust to determine community service utilisation. The NCH&C trust is the 5th largest in the country and provides over 70 community healthcare services across Norfolk serving a population of nearly 900,000 people. During a community referral, care plans are implemented to manage the reason for referral.

Acute hospital data was added from Secondary Users Service (SUS) data from two of three acute Norfolk hospitals, the Norfolk and Norwich University Hospital NHS foundation trust (NNUH) and the Queen Elizabeth Hospital (QEH). Admissions, referrals, care plans, age and gender data were extracted. Data was extracted, linked and analysed by the North East London Commissioning Support Unit (NEL CSU) business analytics team, as part of their service evaluation.

Participants

Patients registered to Norwich general practices were included in the analysis if they were over 65, had undergone an eFI assessment and had a score documented in their electronic general practice SystmOne patient record.

Analysis

We used descriptive statistics as well as formal statistical modelling for the analysis of data. Distribution of patients by severity (or level) of frailty score and age category was looked at by using frequencies and percentages. Use of community services and secondary health care use of patients with different levels of frailty (eFI score of mild, moderate and severe) were compared to that of patients without frailty (eFI fit) using descriptive statistics (frequencies and percentages) as well as formal statistical modelling. Generalised linear models (GLM) for binary (yes/no) outcomes with binomial family and log link were used to compare the risk of acute admission and community referral in patients with mild, moderate and severe frailty eFI scores with that of fit patients. Frequencies and percentages were calculated to look at the distribution of patients and GLM for binary outcomes to estimate and compare the percentages of patients via relative risk (RR).

Results

A total of 22,859 patients over 65 years old registered to a Norwich General Practice underwent an eFI assessment and were included for analysis. From the entire patient cohort, 65.2% had an eFI score of fit, 22.6% were mild, 8.2% were moderate and 4% had an eFI score as severe, comparable with previous reports [8]. Frailty eFI scores increased with age, about 50% of patients in all five-year age bands above 85 years old had a frail eFI score (Table 1).

Table 1: Frailty incidence and severity increases with age (age bands in years).

Age band	65-69 Count (%)	70-74	75-79	80-84	85-89	90-94	95-99	100-104	Total
eFI Fit	4135 (73.98)	3654 (71.21)	2840 (65.57)	2205 (60.23)	1358 (52.88)	547 (45.51)	151 (44.41)	18 (48.65)	14908 (65.22)
eFI Mild	1060 (18.97)	1033 (20.13)	993 (22.93)	874 (23.87)	715 (27.84)	379 (31.53)	103 (30.29)	10 (27.03)	5167 (22.60)
eFI Moderate	305 (5.46)	344 (6.70)	359 (8.29)	379 (10.35)	287 (11.18)	152 (12.65)	44 (12.94)	3 (8.11)	1873 (8.19)
eFI Severe	89 (1.59)	100 (1.95)	139 (3.21)	203 (5.54)	208 (8.10)	124 (10.32)	42 (12.35)	6 (16.22)	911 (3.99)

The eFI cohort was linked to SUS data from two acute Norfolk hospitals to validate the relationship between frailty eFI score and greater risk of acute hospital admission in this regional population compared to previous reports [8]. Indeed, we found that those with a frail eFI score were more likely to have a non-elective acute hospital admission within 6 months of their frailty assessment compared to fit patients, 38.09% of patients with a severe eFI score had an acute admission compared to 16.22% of fit patients (Table 2). Estimated relative risks (RR) of an acute hospital admission within 6 months for patients with mild, moderate and severe frailty eFI scores were 1.55, 1.80 and 2.35 respectively compared to patients classified as fit (Table 2). The respective confidence intervals and p-values suggest that the associations between frailty and acute hospital admission are highly statistically significant.

Table 2: Frail patients were more likely to have non-elective acute admission within 6 months of frailty assessment.

eFI score	Patients with GP eFI score	Number of patients with non-elective acute admission within 6 months	% of patients with non-elective acute admission within 6 months	Relative Risk (RR) of acute admission within 6 months for each category	
				RR (95% CI)	p-value
eFI Fit	14908	2418	16.22%	--	--
eFI Mild	5167	1299	25.14%	1.55 (1.46 to 1.64)	<0.001
eFI Moderate	1873	547	29.20%	1.80 (1.66 to 1.95)	<0.001
eFI Severe	911	347	38.09%	2.35 (2.14 to 2.57)	<0.001

Reference group is fit

To investigate community needs of patients with different frailty scores, we investigated NCH&C trust community service use within a 6-month window of frailty assessment. A frailty eFI score of mild, moderate or severe was associated with higher rates of community referrals compared with those classified as fit, with 19.92% of fit patients with a community referral in a 6 month window after assessment compared to 39.78% of eFI patients scored as frail (Table 3). Severity of eFI score was a strong indicator of community referrals with 58.78% of severe eFI patients requiring a community referral compared with 36.71% and 39.03% of mild and moderate eFI patients respectively (Table 3). Estimated relative risks (RR) of a community referral within 6 months for patients with an eFI assessment score of mild, moderate and severe frailty were 1.84, 1.96 and 2.95 respectively compared to patients with a fit eFI assessment score (Table 3). Similar to acute admission, the respective confidence intervals and p-values suggest that the associations between frailty and acute hospital admission are highly statistically significant.

Table 3: Community service use of patients with a frailty assessment within a 6 month window after frailty assessment score.

Outcome	eFI Fit	eFI Mild	eFI Moderate	eFI Severe
Number of patients in each category	14908	5167	1873	911
Patients with community referral in 6 months (Count (%))	2970 (19.92%)	1897 (36.71%)	731 (39.03%)	535 (58.73%)
Relative Risk (RR) of community referral for each category				
RR (95% CI)	--	1.84 (1.76 to 1.93)	1.96 (1.83 to 2.09)	2.95 (2.76 to 3.14)
P- value	--	<0.001	<0.001	<0.001
Patients with community referral in 6 months	2970	1897	731	535

Total number of community referrals	7389	8565	4119	3435
Average number of community referrals per patient	2.49	4.52	5.63	6.42
Number of care plans	16370	23614	11529	10216
Average number of care plans per community referral/spell	2.22	2.76	2.80	2.97

Reference group is 'fit'

The number of community referrals per patient in each eFI category also increased with severity. The average number of community referrals per fit patient was 2.49 compared to 6.42 community referrals per patient with a severe eFI score (Table 3). This suggests that patients with frail eFI scores are high users of community services, with severe eFI patients having more than twice the amount of referrals within a 6 month window compared to fit patients. The community services used by patients who had an eFI score can be found in Supplementary table 1. Patients over 65 from all eFI bands had the most referrals to the community nursing and therapy service category, with 74.34% of all community referrals falling under community nursing and therapy. Within frailty bands, 59.8% of fit patient referrals and 84% of severe frailty referrals were for this service, suggesting nursing services are an important part of their community support.

We also found that the average number of care plans required per referral for fit patients was 2.22 compared to 2.97 for severe eFI patients indicative of more complex care needs in the community (Table 3).

Discussion

In this study, we show for the first time that eFI score is correlated with community service use, further validating its use as a frailty assessment tool in UK health settings. We validate that eFI score and severity increases with age band, and is associated with increased acute non-elective admissions within a 6-month window after frailty assessment. We have also shown that eFI frailty status is significantly associated with increased community service use. This suggests that community services are an important aspect of frailty healthcare and are essential in the planning of future provision for this population. Ensuring there is enough community service capacity is particularly pertinent with the current ambition to keep frail patients away from acute hospitals and will be a critical for the longer term. Furthermore, the service with the highest number of referrals for patients with any eFI score was the community nurse and therapy service, given the increasing shortfall of district health nurses on the NHS this could be particularly problematic in the future [10]. Without nurses based in community, older patients may not have the support to maintain their independence by having their care closer to home, potentially leading to quicker decline and acute hospital admissions.

Additionally we see a correlation between the severity of frailty score and community health service use, therefore early detection of those at risk of frailty within primary care, could allow intervention strategies to not only reduce unplanned hospital admission but also reduce the burden on community services. Timely detection may also provide community services to produce tailored frailty care plans based on the whole individual rather than a single condition. Furthermore this earlier identification and intervention may decrease future healthcare costs [11].

Although we have used the eFI in this study, there are several tools currently available to assess frailty including Fried's Cardiovascular Health Study (CHS) frailty index, the Frailty Index (FI) of accumulative deficits, Clinical Frailty Scale (CFS) and the comprehensive geriatric assessment amongst others with marked heterogeneity regarding validity, predictive ability and feasibility [3, 12-

15]. Many of the tools require additional clinical resources and data collection, whereas the eFI relies only on what is routinely recorded encompassing a range of physical, disease and neurological conditions, furthermore it is has been shown to be feasible and acceptable for use in UK general practices [9]. Outside of general practices, the electronic system based scoring tool could be used with relative ease by community staff to highlight any presence of frailty during routine consultations, which could positively influence care plan decisions appropriate for frail patients with more complex care requirements.

Limitations of the study

There are some key limitations to this study, firstly we were only able to obtain eFI scores from general practice data in the Norwich area of Norfolk, and therefore can only provide a partial picture of the population. Those living in more coastal or rural areas of the UK may have different severity bandings, acute hospital and community service use. We also could only analyse data from two out of three of the acute Norfolk hospitals and did not have data from mental health services. However, we did include the main acute trust, which is based in Norwich where our eFI data was obtained, therefore it can be speculated that the majority of the population registered with a Norwich based general practice will also be likely to receive at their treatment at that acute hospital.

Another important consideration is that we have used the eFI as an indicator of frailty status but we cannot confirm whether additional clinical judgement was employed to verify these eFI scores. We were also unable to include any patient over 65 that did not have a frailty assessment eFI score limiting the population sample. The eFI assessment relies on routinely recorded electronic data, which can often be missing, thus another key limitation. Additionally studies with the Clinical Practice Research Datalink has shown a strong association with length of registration and eFI score, which could affect the validity of the screening [16] . We have also only assessed frailty using eFI at one time point, a longitudinal setting to look at how these scores and service demands change overtime in individuals would be beneficial. Finally, given that the eFI assessment tool has only been implemented in a primary care setting, we were unable to provide secondary validation of frailty score in acute hospital or community datasets as they did not contain any frailty assessment score in their electronic datasets.

Implications

From July 2017 it is a contractual obligation for GPs to routinely perform frailty assessment in patients over 65 using an appropriate tool such as the eFI [17, 18]. Through linkage of anonymised primary care data to hospital and community service data we have shown that eFI score is correlated with community care use. Those patients with a frail eFI score are higher users of community services compared to those patients with a fit score in their eFI, suggesting that eFI frailty is an indicator of community service use. Severe eFI patients have more than twice the amount of community referrals to fit patients, and require more care plans per community referral, suggesting more complex care needs. Frailty assessment of the older population is important to understand their relationships with healthcare, thus enable better evidence based healthcare service planning and opportunities for specialised frailty community care plans. It would be interesting to determine whether factors such as geographical remoteness affects the use of community services by frail patients when compared to those in more urban areas. This could facilitate service planning to ensure frail patients can access sufficient community care, regardless of location. Future research to include mental health services would provide a more complete picture of service requirements of frail population. This could improve our understanding of how mental health affects the development and severity of frailty [19].

Conflicts of Interest

The authors do not declare any conflicts of interest.

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Supplementary figures

Supplementary figure 1

Service category	Service name
Adult Speech and Language Therapy	Adult Speech and Language Therapy Community Central and west
Cardiac Rehabilitation	Cardiac Rehabilitation
Community Nursing and Therapy (CN&t)	CN&T Admission Avoidance
	CN&T Awaiting Determination
	CN&T Care at Home
	CN&T Case Management
	CN&T Community Matron
	CN&T Community Phlebotomy
	CN&T No Appropriate Service
	CN&T Nursing
	CN&T Occupational Therapy
	CN&T Out of Hours Unplanned Care
	CN&T Physiotherapy
	CN&T Therapy
	CN&T Wound Care
Continence	Continence

	Continence Awaiting Determination
	Continence Nursing Home Audit
Early Intervention Team	Early Intervention Team
Early Supported Discharge Norfolk	ESD Norfolk Psychology
	ESD Norfolk Stroke
	ESD Norfolk Stroke 6 month Follow Up
	ESD Norfolk Stroke Community Follow up
	ESD Norfolk Stroke Follow Up Service
	ESD Norfolk Stroke InReach
	ESD Norfolk Stroke Psychology
	ESD Norfolk Stroke Rehabilitation
	Inpatient Specialist Stroke Rehab
Foot Health	Biomechanics
	Community Podiatry
Heart Failure Norwich	Heart Failure Norwich
Homeward	Homeward Awaiting Determination
	HomeWard IV Therapy
	HomeWard Procured Beds
	HomeWard Virtual Ward
ICES Review and Recall	ICES Review and Recall
Integrated Therapy Partnership	ITP MSK Occupational Therapy
	ITP MSK Physiotherapy
	ITP Orthopaedic Triage
Lymphoedema	Lymphoedema
MSK Occupational Therapy North and West	MSK Occupational Therapy North and West
MSK Physiotherapy West	MSK Physiotherapy West
Phlebotomy Clinic	Phlebotomy Clinic
PILOT Services	Occupational Therapy and Ambulance Service
Podiatric Surgery	Podiatric Surgery
Prosthetics	Prosthetics
Pulmonary Rehabilitation	Pulmonary Rehabilitation
Specialist and Enhanced Palliative Care Central	SEPC Awaiting In-patient bed
	SEPC Breathlessness
	SEPC Community Nurse
	SEPC Complimentary Therapies
	SEPC Day Therapy
	SEPC Out-Patient
	SEPC Psychological Services
	SEPC Triage
Specialist Nursing Epilepsy	Specialist Nursing Epilepsy
Wheelchairs	Wheelchairs