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Economic Evaluation

System-Wide Patterns of Costs and Service Use Among Frequent Emergency Department Users in the United Kingdom

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ABSTRACT

Objectives: We estimate healthcare costs and service utilization for frequent users (FUs) of emergency departments (EDs) compared with non-FUs across the urgent care pathway, using regional UK data. Recognizing FU heterogeneity and differences in service models, we examine cost variation by patient characteristics and across healthcare providers.

Methods: Data were obtained from the Centre for Urgent and Emergency Care Research database, linking ED, emergency inpatient, ambulance, and National Health Service 111 data in Yorkshire and the Humber. FUs were defined as patients with 85 ED attendances over the 12-month period from April 2016 to March 2017. Multilevel generalized linear regression, adjusting for demographics, deprivation, psychosocial problems, multimorbidity, and acuity, estimated annual costs and utilization, with random effects by hospital trust. Earlier years (2014/2015-2015/2016) were examined in sensitivity analyses.

Results: FUs accounted for 2.8% of patients but 14.8% of total costs. Model-adjusted annual ED attendances were 9.1 for FUs versus 2.2 for non-FUs. Adjusted annual per-patient costs (3 154 764 FUs; 32 772 non-FUs) were driven largely by inpatient admissions. FUs also had higher ambulance and National Health Service 111 use. Among FUs, psychosocial issues were associated with more ED and pre-hospital use, whilst older patients with multi-morbidity were more likely to require admission. FU costs varied across providers, with lower-than-average costs in one trust operating a community-based FU service.

Conclusion: FUs generate disproportionately high costs across the urgent and emergency care network. Tailored interventions and coordinated emergency, primary, and community care may help address complex needs, reduce avoidable ED admissions, and improve patient outcomes.

Keywords: ambulance, emergency department, frequent users, healthcare costs, healthcare utilization, hospital admissions, NHS trusts, high user.

VALUE HEALTH REG ISSUES. 2026; ■:101636

Introduction

Frequent users (FUs) of emergency departments (EDs), typically defined as patients with 3 to 5 or more visits per year,[1] represent a small proportion of the population but account for a disproportionately large number of attendances.[2] FUs contribute to overcrowding,[3] which can lead to system inefficiencies, including extended waiting times, increased staff workload, and compromises in care quality.[4] In the United Kingdom, quantifying the impact of FUs is particularly important amid rising demand for emergency services.[5]

FUs are a heterogeneous population with varied needs, including mental health problems, substance misuse, social challenges, frailty, and multimorbidity.[6] These diverse characteristics likely underpin different reasons for frequent ED use, with some patients using EDs as substitutes for inaccessible nonhospital care, whereas others use them as complements to broader care because of complex or severe health needs.[7]

Attendance patterns also vary, including transient bursts, persistent usage across multiple years,[8-11] and multisite attendance.[12-14] Heterogeneity also extends to FU services: UK healthcare providers implement diverse interventions, including hospital-based mental health support through liaison psychiatry, care coordination for multimorbid patients, and community-based initiatives.[15]

Given the variety of interventions targeting FUs' heterogeneous needs, characterizing their emergency care use and associated costs is essential for informing cost-effectiveness assessments. Beyond repeated ED attendances, FUs also place higher demands on the wider emergency care network, with increased use of inpatient,[16] outpatient,[17] ambulance,[18] and primary care services.[19] However, few large-scale studies globally have analyzed FU healthcare costs in large populations,[7,12,20-22] and none in the United Kingdom have examined costs across the broader emergency care network.

Examining variation across providers can show how different service models affect emergency care costs and the potential budget impact for local commissioners. It is also important to consider not just annual care costs but total emergency care costs per ED attendance, including linked ambulance and inpatient use. This provides insight into patient needs, distinguishing repeated lower-cost, potentially avoidable visits from higher-cost attendances reflecting greater complexity.

This study uses the Centre for Urgent and Emergency Care database (CUREd), providing a unique opportunity to examine FUs across linked emergency care data in a large UK region.[23] Our research questions were to quantify the annual healthcare costs and service utilization of FUs (RQ1); explore variation by patient characteristics, including age, sex, multimorbidity, psychosocial problems, and deprivation, both between FUs and non-FUs and within FUs (RQ2); examine variation across healthcare providers delivering different local FU services (RQ3); and analyze total emergency care costs per ED attendance, assessing differences between FUs and non-FUs and within FUs by attendance volume and patient characteristics (RQ4).

In the absence of robust randomized evidence, real-world observational analyses increasingly inform policy.[24] Our findings can inform local commissioning decisions, for example, on the scaling or discontinuation of regional FU services.

Methods

Data Sources and Sample Selection

CUREd integrates routine data from 19 EDs in Yorkshire and the Humber, a large and ethnically diverse region in northern England with over 5 million residents (approximately 9% of the UK population).[25] CUREd links multiple data to trace urgent and emergency care from patient calls through to discharge or death. Data span 2011 to 2017, including over 9 million ED attendances and 10 million inpatient admissions, in a format comparable to England's Hospital Episode Statistics (HES). Additionally, it links over 4 million ambulance records from Yorkshire Ambulance Service and 4.5 million National Health Service (NHS) 111 calls.[23] Because ambulance and NHS 111 data are not available in HES, CUREd offers a more complete view of emergency care use within the region.

In CUREd, each ED admission is linked to an acute NHS Trust, a publicly funded provider responsible for delivering hospital and specialist care within a defined geographic area. There are 14 acute NHS Trusts in Yorkshire and the Humber. We excluded patients from a children's Trust and one other Trust with very high levels of missing patient age data. No exclusions were applied for patient characteristics.

Our primary analysis covered the 2016/17 financial year (April 2016-March 2017) and included all patients with at least 1 ED attendance during that period. Sensitivity analyses were conducted for the preceding financial years (April 2014-March 2015 and April 2015-March 2016) to assess robustness over time. Financial years were used to align with NHS budgeting and reporting cycles, consistent with the study's objective to inform local commissioners. Final sample sizes are reported in Appendix 1.

Explanatory Variables

FU status

We defined FUs as patients with 5 or more ED attendances in the 12-month 2016/2017 financial year, based on recommendations from a systematic review.[1] For the sensitivity analyses, FU status was defined separately within each financial year, meaning that an individual's classification could differ across years. In some analyses, we included a "high-volume" FU variable, defined as 10 or more ED attendances per year.

Psychosocial problems

We categorized patients as having psychosocial problems if any of their ED attendances included a mental health or social diagnosis. CUREd includes ED diagnoses in 2 formats: HES Accident and Emergency and ICD-10 codes. Psychosocial issues were identified by HES codes "35" (psychiatric conditions) and "37" (social problems), or by all diagnoses under ICD-10 chapters "F" (mental, behavioral, and neurodevelopmental conditions) and "R45" (symptoms and signs related to emotional state) (Appendix 2). Each ED attendance in CUREd could contain up to 12 diagnoses, and the psychosocial variable was coded "yes" if any matched these codes.

Physical health morbidities

We identified physical health morbidities by mapping HES and ICD-coded ED diagnoses to a broader "attendance reasons" variable (Appendix 2). Diagnoses related to cardiac, central nervous system, endocrine, gastrointestinal, genitourinary, respiratory, or vascular/hematological conditions were classified as physical health morbidities. Repeated diagnoses were deduplicated across, but not within, individual ED attendances. For instance, multiple cardiac diagnoses during a single attendance were counted separately, whereas repeated cardiac diagnoses across multiple attendances were treated as a single morbidity. After deduplication, morbidities were summed, and patients were categorized as having none, 1, or multiple morbidities. This approach aligns with the Elixhauser and Charlson indices, which consider similar comorbidities over a 12-month period.[26]

Recent low-acuity attendance

CUREd includes a variable indicating whether ED attendances were low acuity (yes/no), derived using a validated method based on processes of care. Low acuity refers to attendances where patients did not receive investigations, treatments, or referrals requiring the facilities of a type 1 ED.[27] We categorized patients annually as having a recent low-acuity attendance if they had any such attendances within the year. This approach was chosen to provide a sensitive indicator of exposure because low-acuity attendances were infrequently recorded in the dataset.

Demographic variables

We included demographic variables from patients' first ED attendance or next nonmissing attendance. Age was grouped into bands: 0-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80+ years. Biological sex was recorded as male or female. To avoid small category sizes and improve regression stability, ethnicity was condensed from 19 categories into 6 (Asian, Black, Mixed, Other, White, and Unknown), following a commonly used UK health research approach.[28] For the same reason, the Index of Multiple Deprivation (IMD) decile was collapsed into quintiles. The IMD is a UK composite, area-level measure of relative deprivation based on income, employment, education, health, crime, housing, and environment. It is commonly reported in quintiles, ranking households from most-deprived (=1) to least-deprived (=5) areas.[29]

Healthcare provider and FU services

The healthcare provider was the NHS Trust assigned to patients' ED record. Because patients could attend multiple providers, we assigned each to a "main" provider, based on the highest number of ED attendances or, in the case of a tie, the longest duration of care. We identified FU services at each provider through surveys of healthcare professionals and Freedom of Information requests. We describe services as "none" if no designated staff time was allocated (including case management only), "hospital-based liaison" if services were provided with designated staff time within liaison psychiatry, "hospital-based non-liaison" if hospital-based but staffed by other healthcare professionals (eg, nurses), and "community" if delivered by multidisciplinary teams in community settings, outside hospital.

Outcome Variables

ED attendances

Patients' ED utilization was measured as total attendances per year. Costs were calculated by assigning each attendance to a healthcare resource group (HRG) using NHS 2021/22 Grouper software.[30] HRGs were matched to unit costs from the 2021/22 National Schedule of NHS Costs.[31] Annual ED costs were summed across all attendances.

Inpatient admissions

Inpatient admissions in CUREd are limited to records in which the admission method was via the emergency department.[23] National data indicate that approximately 75% of emergency hospital admissions in England occur through ED pathways[32] and that emergency admissions account for around one-third of all inpatient hospital episodes.[33] Therefore, our data capture the dominant route of emergency hospitalization, although they do not include elective admissions or emergency admissions via non-ED routes.

We converted the Finished Consultant Episode (FCE) level data to continuous inpatient periods (CIPs). CIPs were constructed by first creating spell-level data sequencing patients' FCEs within a single provider, then consolidating spells to account for transfers between hospitals. Mapping the full patient pathway from admission to discharge enables more accurate costing.[34,35] Each CIP was assigned an HRG using the National Health Service Grouper software (inputting spell data as FCEs, and CIPs as spells). Outdated codes (eg, atrial fibrillation diagnoses) were manually recoded to correct common grouping errors.

CIP costs were calculated by assigning nonelective units costs from the 2021/2022 National Schedule of NHS Costs to "core" and "unbundled" HRGs.[30] For extended stays, additional costs were applied to bed days beyond the HRG average trim point. Because excess bed day costs are no longer reported, these were sourced from the 2017/2018 NHS Reference Costs[36] and adjusted to 2021/2022 prices using the NHS Cost Inflation Index.[37] Inpatient resource utilization was measured as total CIPs per patient per year.

Ambulance call outs

Ambulance utilization was measured as total annual callouts per patient in the Yorkshire Ambulance Service data set. Callouts were categorized as "see and treat," (on-site treatment without hospital transfer), or "see and convey" (treatment plus transport to a healthcare facility). Unit costs for both categories were taken from the 2021/2022 National Schedule of NHS Costs.[30]

NHS 111 calls

NHS 111 utilization was measured as total annual calls per patient. Because of no standardized unit costs, costs were estimated by multiplying total call duration by the hourly rate for AfC Band 5 healthcare professionals.[37] Qualification costs were excluded, assuming that call handlers do not require training equivalent to that of other healthcare professionals, such as nurses.

Total costs

The primary outcome was total annual costs, summed across ED, inpatient, ambulance, and NHS 111 services.

Missing Data

CUREd is a routinely collected administrative data set that undergoes preprocessing and quality assurance before release, resulting in low levels of missingness. Missing data were handled according to variable type. For demographic variables, completeness was maximized using all available entries within the year and across linked data sets (ED, inpatient, NHS 111, and ambulance). Variables derived from ED diagnostic coding, which have lower completeness in routine data, were coded such that missing entries were treated as absence of the condition. Outcome data with missing information required for costing (eg, HRG codes) were retained and assigned the overall mean unit cost for the relevant attendance type. The final analytic sample included 816 426 complete cases from 822 882 original records (0.78% missing).

Data Analysis

We used multilevel regression models to account for patients nested within providers. Sequential likelihood ratio tests comparing nested models (no random effects, random intercepts, and random slopes) indicated the best fit included random intercepts and random slopes for FU status. This structure captured variation in the relationship between FU status and outcomes at both patient and provider levels. Patients were assumed to belong to a single main provider because a multiple membership model failed to converge with over 95% attending only 1 provider.

The primary regression outcome for RQ1-RQ3 was annual total costs, which were log-transformed to address skewness and improve model fit; gamma models were tested but failed to converge with the specified random-effects structure. Secondary outcomes were individual service utilization/costs, which exhibited different distributional characteristics. ED outcomes comprised exclusively non-zero values, whereas inpatient, ambulance, and NHS 111 outcomes included excess zeros. For these distributions, Poisson, negative binomial, and 2-part models (and their zero-inflated variants) were considered but did not converge within the multilevel framework. Although ED outcomes could have been log-transformed, they were analyzed on the raw scale to maintain consistency in modeling and interpretation across secondary outcomes. For RQ4, the outcome was mean cost per ED attendance, calculated by dividing annual total costs by annual ED utilization.

To address RQ1, RQ2, and RQ4, we estimated patient-level fixed effects, testing interactions between FU status and patient characteristics (demographic variables, psychosocial problems, multimorbidity, and low acuity). All interaction terms were statistically significant, improved model fit, and were retained in the final model. Results are reported as predicted marginal costs for FUs and non-FUs across levels of each explanatory variable. Because total costs were log-transformed, the model was multiplicative rather than additive. Predictions on the original scale were obtained using a smearing estimator,[38] which exponentiates model outputs and multiplies them by a smearing factor.

To address RQ3, we assessed provider-level variation using the intraclass correlation coefficient (ICC), which quantifies the proportion of total variance in outcomes attributable to differences between healthcare providers. The ICC was calculated by dividing provider-level variance (random intercept variance + random slope variance + 2 × covariance) by the total variance (provider-level variance + residual patient-level variance).[39] Correlations between provider-level intercepts and slopes were examined to assess whether providers differed in costs by FU status. Provider random effects are reported alongside FU service type; however, service type was not included as an explanatory variable because of the small number of providers and heterogeneity in service models.

All analyses were conducted in R version 4.2.0, using the "lme4" package. Model selection was informed by likelihood ratio tests (for nested models) and by comparison of Akaike/Bayesian Information Criteria.

Results

Descriptive Summary

In the primary study year (2016/2017), FUs represented a small proportion of ED patients (2.82%, n = 22 418) but accounted for a disproportionately large share of costs, contributing 13.7% of total ED costs and 14.8% of total emergency care costs. The proportion of FUs had increased from 2.75% (n = 21 645) in 2015/2016 and 2.65% (n = 20 556) in 2014/15; both increases were statistically significant (chi-squared tests, $P < .01$). Between 2014 and 2017, total emergency care expenditure rose by 341 million (from 31.62 billion to 31.66 billion), of which 24 million (59%) was attributable to FUs (increasing from 222 million to 246 million).

Table 1 (and Appendix 3) summarizes patient characteristics by FU status. Age profiles were broadly similar, although patients aged 70+ represented 31.2% of FUs versus 20.6% of non-FUs. FUs were more likely to be female, of White ethnicity, and from the most-deprived IMD quintile. They also had a substantially higher prevalence of psychosocial problems and low-acuity attendances.

Comparing attendance reasons, non-FUs were more likely to present with injuries (21.9% vs 7.5%) or infections (5.8% vs 4.2%), whereas FUs more often had physical morbidities, particularly respiratory (2.7% vs 3.1%) and genitourinary (4.8% vs 5.6%) disorders. FUs also had higher rates of "no classification" (32.9% vs 44.0%). In terms of treatments, FUs were less likely to receive wound or fracture care (3.6% vs 0.9%) or minor surgeries (0.6% vs 0.2%) but were more likely to receive airway and respiratory treatments (4.4% vs 7.5%), and observation, monitoring, or diagnostic review (17.5% vs 25.6%). Full attendance details are presented in Appendix 3.

The sample comprised 12 providers (Table 1), each showing considerable variation in patient characteristics (Appendix 4). One provider had over 60% of patients from the most-deprived IMD quintile, whereas another had fewer than 4%. Differences were also observed in mean age and ethnic composition. Data quality varied: only 4 providers consistently reported ED diagnoses, and there was substantial variation in recorded low-acuity admissions, likely reflecting inconsistencies in data recording practices.

The proportion of FUs across providers ranged from 1.9% to 3.3%, with the share of total costs attributable to FUs varying from 10.3% to 17.1% (Appendix 4). Most (81.8%) attended a single provider for all their visits, compared with 97.5% of non-FUs. Multiprovider attendance was more common among White FUs,

Table 1. Summary of patient characteristic by FU Status 2016/17, N (%).

	Total (N = 816 426)	Non-FUs (N = 794 008)	FUs (N = 22 418)	Stat sig
Patient Characteristics				
Age ≥ 70 years	170 147 (20.8)	163 148 (20.6)	6999 (31.2)	***
Sex = Female	416 230 (51.0)	404 587 (51.0)	11 643 (51.9)	**
Ethnicity = White	663 707 (81.3)	644 348 (81.2)	19 359 (86.3)	***
IMD Quintile = 1	312 360 (38.3)	300 985 (37.9)	11 375 (50.7)	***
≥1 Psychosocial Adm	8322 (1.0)	6458 (0.8)	1864 (8.3)	***
Physical Morbidities = Yes[†]	80 176 (9.8)	73 873 (9.3)	6303 (28.1)	***
≥1 Low Acuity Adm[†]	120 609 (14.8)	112 126 (14.1)	8483 (37.8)	***
Main Provider				***
#1	61 995 (7.6)	60 092 (7.6)	1903 (8.5)	
#2	26 248 (3.2)	25 658 (3.2)	590 (2.6)	
#3	30 361 (3.7)	29 788 (3.8)	573 (2.6)	
#4	41 273 (5.1)	40 134 (5.1)	1139 (5.1)	
#5	38 369 (4.7)	37 422 (4.7)	947 (4.2)	
#6	94 758 (11.6)	92 626 (11.7)	2132 (9.5)	
#7	75 634 (9.3)	73 441 (9.3)	2193 (9.8)	
#8	78 661 (9.6)	76 719 (9.7)	1942 (8.7)	
#9	108 555 (13.3)	105 103 (13.2)	3452 (15.4)	
#10	73 842 (9.0)	71 908 (9.1)	1934 (8.6)	
#11	75 783 (9.3)	73 798 (9.3)	1985 (8.9)	
#12	110 947 (13.6)	107 319 (13.5)	3628 (16.2)	

FU indicates frequent users; IMD, Index of Multiple Deprivation in which 1 = most deprived; Adm. = admission; Physical Morbidities = 1 or more physical morbidities recorded; Main provider[1-12] are the anonymized Acute NHS Trust where patients recorded their largest number ED admissions per year.
[†]Missing information was coded as absence of condition/s. Differences between non-FUs and FUs assessed using chi-square test, *** = $P < .001$; ** = $P < .01$.

those from less-deprived areas, and individuals with low-acuity or psychosocial problems (Appendix 4).

Multilevel Regression

Annual costs per patient for FUs versus non-FUs (RQ1)

Per-patient total costs from the multilevel regression model were significantly higher for FUs than non-FUs in 2016/17: £15 764 (SE = £584) versus £2772 (SE = £64). Consistent results were observed in both sensitivity analyses for 2014/2015 and 2015/2016. Full regression results, including coefficients and significance levels, are reported in Appendix 5.

Costs and utilization patterns are summarized in Table 2 and reported in full in Appendix 6. FUs had significantly higher ED utilization, with average annual ED costs of £2468 versus £584 for non-FUs. However, ED attendances accounted for only 23% of the total cost difference, with admitted patient care being the primary cost driver: non-FUs averaged 0.84 admissions per year costing £2415, whereas FUs averaged 2.96 admissions costing £7362. Ambulance use was also higher, contributing 15% to the cost difference, alongside increased NHS 111 utilization.

Annual costs per patient by FU characteristics (RQ2)

There were substantial differences by patient characteristics that were generally larger among FUs (Table 3). Age was a key predictor of higher costs for non-FUs, but the increase with age was more pronounced for FUs. Costs were also higher among White patients, and for those with physical morbidities or psychosocial problems.

Service utilization across the emergency care network generally rose with ED attendances, though patterns varied by patient characteristics (Appendix 6). White, male, low-IMD, or multimorbid patients consistently showed high utilization across all services. Older FUs had fewer ED visits but markedly higher inpatient admissions and ambulance callouts. In contrast, low-acuity FUs and FUs with psychosocial problems had very high ED, ambulance, and NHS 111 usage relative to inpatient admissions. Despite these lower inpatient rates, they remained substantially higher than those of non-FUs (Appendix 6).

Table 2. Adjusted 2016/2017 costs by service type and FU Status, AME (SE).

	Predicted outcomes, Non-FUs	Predicted outcomes, FUs	Stat sig
Costs, £			
ED	583.51 (10.96)	2468.45 (92.63)	***
Inpatient	2414.93 (61.77)	7361.94 (376.56)	***
Ambulance	311.93 (15.34)	1488.71 (157.29)	***
NHS 111	17.97 (0.53)	89.47 (5.88)	***
Utilization, N			
ED admissions	2.15 (0.02)	9.08 (0.22)	***
Inpatient admissions	0.84 (0.15)	2.96 (0.15)	***
Ambulance	0.85 (0.04)	4.09 (0.43)	***
NHS 111	1.18 (0.04)	5.31 (0.334)	***

AME indicates average marginal effect; ED, emergency department; FU, frequent user; SE, standard error.
***$P < .001$. Results are derived from multilevel regression models adjusted for age, sex, ethnicity, index of multiple deprivation, psychosocial problems, comorbidities, and low-acuity attendance, with random slopes for FU status. Values represent adjusted mean predicted annual costs/utilization averaged across observed covariates (ie, the overall mean for non-FUs and FUs).

Table 3. Adjusted 2016/2017 Total Costs by patient characteristics, AME.

	Predicted costs (£), non-FUs	Predicted costs (£), FUs
Overall mean	15 764	2772
Age		
0 to 19	8492	1766
20 to 29	9245	1746
30 to 39	11 143	1829
40 to 49	13 905	1993
50 to 59	16 559	2298
60 to 69	22 582	3165
70 to 79	27 180	4916
80+	30 840	8678
Sex		
Male	2808	15 982
Female	2737	15 548
Ethnicity		
Asian	2689	15 224
Black	2816	14 259
Mixed	2908	14 966
Other	2636	14 431
Unknown	2547	16 760
White	3071	19 529
IMD		
1 (most deprived)	3186	16 464
2	2899	16 641
3	2758	16 044
4	2654	15 388
5 (least deprived)	2423	14 390
≥1 Psychosocial Admission[†]		
No	2095	13 741
Yes	3669	18 084
Physical Morbidities[†]		
None	1373	11 549
One	2801	15 866
Multiple (>1)	5542	21 377
≥1 Low-Acuity Admission[†]		
No	3481	17 534
Yes	2208	14 172

FU indicates frequent users; IMD, Index of Multiple Deprivation.
[†]Missing diagnostic information was coded as absence of condition(s). Predicted annual total costs (£) are derived from the multilevel log-linear model and presented as average marginal effects (AMEs) on the natural cost scale following back-transformation using a smearing estimator. All covariates were interacted with FU status; results are shown separately for FUs and non-FUs. The "Overall mean" row represents the adjusted mean predicted annual cost averaged across observed covariates. Full regression coefficients are reported in Appendix 5.

Annual provider costs (RQ3)

Although provider-level random effects improved model fit, between-provider variation in total costs in 2016/2017 was small. Overall, less than 3.5% of cost variation was attributable to differences between providers, with the majority occurring within providers (ie, due to individual-level factors or residual variance). The ICCs were 1.67% for non-FUs and 3.41% for FUs. Positive correlations (0.30) between random intercepts and random slopes indicate that providers with higher baseline costs also tended to have higher FU-related costs.

Figure 1 and Appendix 7 report provider-level random effects. After adjusting for patient characteristics, the provider with a community-based FU service had the highest positive intercept but a negative slope, indicating higher-than-average baseline costs (24.7% above the mean) but lower-than-average FU costs (7.4% below the mean).

Patient costs per ED attendance (RQ4)

Total costs (ED, inpatient, ambulance, and NHS 111) per ED attendance were marginally lower for FUs than non-FUs, (both averaging approximately £1400). Reductions in per-attendance costs were more pronounced among high-volume FUs (£1295) compared with non-FUs (£1427) (Appendix 8). Costs also varied by patient characteristics: those aged 70+ incurred the highest costs (>£2250), and multimorbid patients had elevated costs (>£2000 for non-FUs; >£1700 for FUs). Among non-FUs, patients with psychosocial problems had slightly higher per-attendance costs (+£200) than those without; this pattern was reversed among FUs. Per-attendance costs decreased across decreasing deprivation quintiles among non-FUs, whereas no clear gradient was observed among FUs.

Discussion

Key Policy Implications

This study provides the first comprehensive cost analysis of FUs of EDs in a large UK population and the first globally to compare FU-related costs across multiple healthcare providers. In the CUREd data, total emergency care utilization and associated costs increased between 2014 and 2017, with more than half of the observed increase attributable to FUs. In the primary analysis year (2016/2017), annual FU costs exceeded £220 million across the 12 NHS Trusts. These findings demonstrate a substantial system-wide burden across ED, inpatient, NHS 111, and ambulance care, reinforcing the need for coordinated strategies across the interconnected urgent and emergency care network.

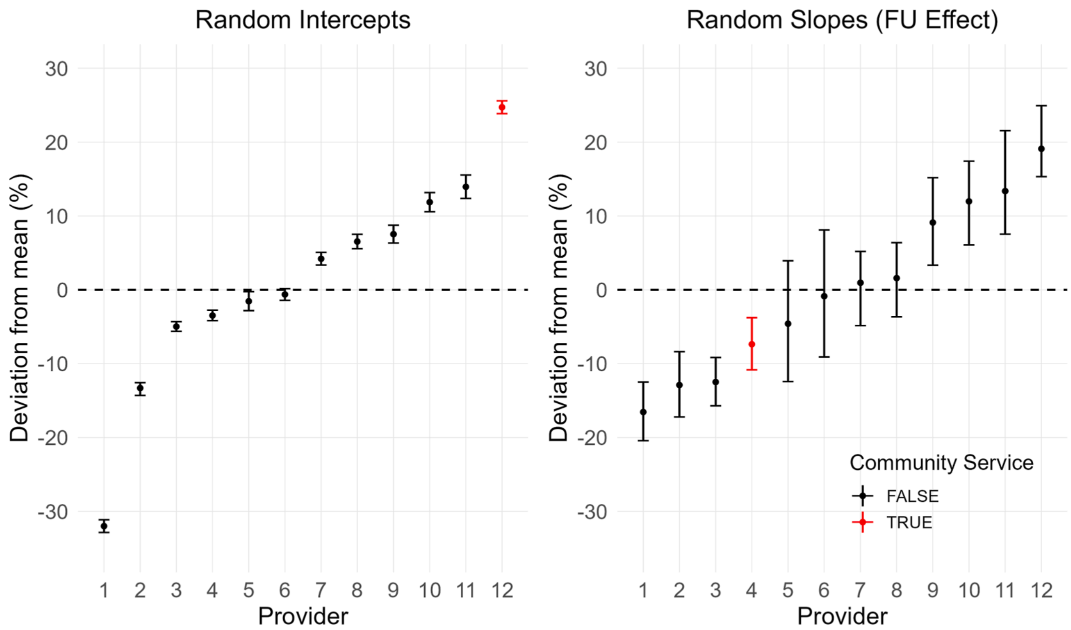
Although defined by repeated ED use, the major cost driver for FUs was inpatient admissions, due to their intensity, longer stays, greater bed occupancy, and higher resource use. We also found substantially higher inpatient costs for FUs with low-acuity ED attendances compared with non-FUs, suggesting that some admissions may be unnecessary, possibly to relieve ED pressures. High patient volumes and increased staff workload have been linked to greater likelihood of hospital admission.[40] Moreover, EDs may not be well suited to address the complex clinical and social needs of FUs. Both scenarios highlight the potential value of earlier, targeted support in primary or community care to better meet these needs and reduce pressure on hospital services.

Generalizability

Although our analysis is based on data from a single UK region, Yorkshire and the Humber is large and demographically diverse, encompassing multiple ethnic groups and a wide range of socioeconomic contexts. This makes our findings likely generalizable to other UK regions with similar or less diverse populations and healthcare access. For example, a national study of FUs in England similarly found higher inpatient admission rates among FUs compared with non-FUs.[16] We plan to extend this work using national HES data to validate our findings more broadly.

Our results also align with international evidence. Among over 200 000 ED users in New York City, inpatient admissions accounted for the largest share of Medicaid costs, which were more than 3 times higher for FUs than non-FUs.[20] Similarly, among rural US FUs, inpatient care costs were approximately 5 times higher than ED costs.[22]

Figure 1. Provider-level random effects from the 2016/2017 Multilevel Total Costs Model. Displays caterpillar plots for the estimated provider random intercepts and random slopes for frequent user (FU) status. Values are expressed as percentage deviation from the overall mean predicted cost. Error bars represent 95% confidence intervals. Providers delivering community-based FU services are highlighted in red.



Heterogeneity and Targeted Policy Responses

FUs are a highly heterogeneous population with diverse health and social needs.[41] Much literature focuses on those facing psychosocial challenges, including homelessness, substance use, and mental illness.[6] In our study, these individuals had high NHS 111 and ambulance use but relatively low inpatient costs, suggesting complex needs that hospital-based care may poorly address and that could be better managed through primary or community services.

Some NHS providers have developed targeted interventions for FUs with psychosocial problems, varying widely in eligibility, resources, and design.[15] One provider in our sample ran a community-led FU service with a multidisciplinary team, dedicated staff time, and interventions tailored to individual needs.[15] This provider had lower-than-average FU costs despite the highest average costs for general ED users. Wider adoption of community-based FU services could similarly reduce FU-related costs in other settings, but further research using national data and longitudinal methods is required. More broadly, limited variation in FU costs across providers after adjusting for patient differences may reflect the modest reach or impact of current services or their focus on small subgroups within the wider FU population.

The highest-costing FUs were elderly patients, particularly those with multiple morbidities and from socially deprived areas. Repeated ED visits and long waits can be especially distressing for this group, who often experience frailty and complex care needs.[42] Contributing factors may include barriers to accessing community healthcare, a preference for hospital-based care, unresolved issues from prior admissions, and poor coordination between care settings.[42] In some cases, emergency admission may be a less effective route than proactive support in primary or community services. Rising demand from such admissions increases costs, waiting times, and overcrowding, particularly due to extended hospital stays.[43]

Despite their high needs, elderly FUs remain under-researched,[44] and few interventions have specifically targeted them. One randomized controlled trial found that a community-based health coaching service improved mortality in men aged 75 and over at high risk of hospitalization.[45] Frequent ED use at the end of life is associated with inadequate community support, poor coordination, and delayed discharge.[42] Although proactive multidisciplinary care has shown promise for frail older adults,[46] these models have yet to be tailored for elderly FUs. Further research is needed to determine whether such targeted approaches could improve outcomes and reduce demand on emergency care.

Limitations

Our primary analysis used data from a single 12-month financial year (April 2016-March 2017). This approach may have introduced some misclassification because individuals identified as non-FUs within this fixed period could meet frequent user criteria within alternative 12-month windows (eg, January-December). We considered alternative approaches using rolling 12-month definitions,[7,21] which may more precisely identify individuals over time. However, such approaches are less suited to reporting costs within fixed commissioning periods because individuals may contribute only partially across overlapping windows. A key objective of the study was to inform local commissioners about the scale and distribution of costs across providers. Feedback from dissemination events with NHS commissioners, clinicians, and professionals delivering FU services indicated that financial-year analyses were more interpretable and directly relevant to budgeting and service planning than rolling or index-based longitudinal approaches.

Missing diagnoses in around half of ED records may have biased group definitions for the psychosocial and physical morbidity variables. Because these groups had generally higher ED attendance, their elevated prevalence among FUs might partly reflect fewer missing entries. To address this, we tested an alternative definition using patients' main diagnosis across attendances and found consistent patterns in resource use.

The lack of mortality data may have led to underestimation of annual costs, given high mortality among FUs. Excluding primary care, outpatient, and medication costs—also known to be elevated among FUs[17]—similarly limited our scope and prevented us analyzing relationships between demand across these settings.

Finally, it remains unclear what proportion of FU costs reflect increased needs versus avoidable use. Our low-acuity measure identified potentially avoidable ED visits, in which patients had relatively higher ED use but fewer inpatient admissions. Future research could further classify inpatient episodes as avoidable or unavoidable.

Conclusions

Although a small proportion of patients, FUs generate disproportionately high emergency care costs, largely driven by inpatient admissions. Costs and utilization vary by patient characteristics, reflecting complex and overlapping medical and social needs. Tailored interventions and coordinated community care could help address these needs, reduce avoidable hospital use, and ease pressure on EDs.

Author Disclosures

Author disclosure forms can be accessed below in the Supplemental Material section.

Supplemental Material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.vhri.2026.101636.

Article and Author Information

Accepted for Publication: March 13, 2026

Published Online: xxxx

doi: https://doi.org/10.1016/j.vhri.2026.101636

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Authorship Confirmation: All authors certify that they meet the ICMJE criteria for authorship.

Funding/Support: This research was funded by the National Institute for Health and Care Research (NIHR) Health Services and Delivery Research Programme [project reference 132852]. The development of the CUREd database was funded by the National Institute for Health and Care Research, Yorkshire and Humber Applied Research Collaborations NIHR200166. The authors gratefully acknowledge the contribution of the NHS Trusts in the Yorkshire and the Humber region, which provided the original data to the CUREd Research Database, a Connected Health Cities study now continued through the NIHR Applied Research Collaboration in Yorkshire and Humber. The views expressed in this article are those of the author(s) and do not represent those of The University of Sheffield, NHSA, NHS, NIHR, or the Department of Health and Social Care.

Role of the Funder/Sponsors: The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Acknowledgment: The authors thank Jin Huajie, a member of the project steering committee, for discussing an early draft of this paper at the Health Economists' Society Group (HESG) Winter Meeting in Bristol 2025. The authors also extend their gratitude to other members of the steering committee—Jonathan Bisson, Jonathan Benger, Geoffrey Wong, and Jennifer Bostock—for their valuable contributions. Additionally, we appreciate the feedback provided by audience members at the HESG Winter Meeting in Bristol 2025 on the original draft. Finally, we thank the members of the Patient and Public Involvement and Engagement group—Saffron Baldoza, Sarah Markham, Hannah Din, and Louise Todd—for their insightful comments on the preliminary results.

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