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Use of hospital services by age and comorbidity after an index heart failure admission in England: observational study

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Abstract

Objectives: To describe hospital inpatient, emergency department (ED) and outpatient department (OPD) activity for patients in the year following their first emergency admission for heart failure (HF). To assess compliance with current guidelines that recommend specialist assessment within two weeks of hospital discharge.

Design: Observational study of national administrative data.

Setting: all acute NHS hospitals in England.

Participants: 82,241 patients with an index emergency admission between April 2009 and March 2011 with a primary diagnosis of HF.

Main outcome measures: cardiology OPD appointment within two weeks and within a year of discharge from the index admission; emergency department (ED) and inpatient use within a year

Results: 15.1% died during the admission. Of the 69,848 survivors, 19.7% were readmitted within 30 days and half within a year, the majority for non-HF diagnoses. 6.7% returned to the ED within a week of discharge, of whom the majority (77.6%) were admitted. The two most common OPD specialties during the year were cardiology (24.7% of the total appointments) and anticoagulant services (12.5%). Although half of all patients had a cardiology appointment within a year, the proportion within the recommended two weeks of discharge was just 6.8% overall and varied by age, from 2.4% in those aged 90+ to 19.6% in those aged 18-45 ($p<0.0001$); appointments in other specialties made up only some of the

shortfall. More comorbidity at any age was associated with higher rates of cardiology OPD follow-up.

Conclusion: patients with HF are high users of hospital services. Post-discharge cardiology OPD follow-up rates fell well below current NICE guidelines, particularly for the elderly and those with less comorbidity.

Key words: heart failure; hospital utilisation; administrative data

Strengths and limitations of this study

- Patients with heart failure (HF) frequently have high unplanned admission and readmission rates, but much less is known about their use of emergency and outpatient departments and the role of non-cardiology specialties. We made use of national administrative data for England that capture this activity
- Linkage to death registrations and the use of cumulative incidence rates allowed outpatient department utilisation for cardiology and other specialties to be correctly calculated
- We did not have data on subsequent follow-up in the community

Introduction

Heart failure (HF) is a serious chronic disease that is common in most countries. In the UK it affects around 900,000 people with an estimated cost to the NHS of 1-2% of the annual budget [1]. Responding to the limited knowledge on the epidemiology, clinical characteristics and outcomes of real-world patients with HF, the European Society of Cardiology (ESC) Heart Failure Registry was established, covering over 100 centres in 12 European countries other than the UK. Its pilot study reported wide differences in patient characteristics, treatment and outcomes for both inpatients and outpatients [2]. The annual national HF audits for England and Wales [3] have also documented variations in care processes and outcomes. The sixth and most recent published national audit (2012/13) shows for the first time a fall in mortality among contributing hospitals, consistent with international trends [4]. Following hospitalisation, the challenge is to ensure a seamless transition from inpatient to outpatient care and integration with chronic HF management. The ESC guidelines recommend multidisciplinary management programmes with structured follow-up that includes patient education, optimization of medical treatment, psychosocial support, and improved access to care [5]. Accordingly, there is a growing global focus on the timing of specialist follow-up as part of this transition. A Medicare and Get With The Guidelines study in the US found that hospitals with the lowest rates of follow-up within 7 days of discharge had the highest 30-day readmission rates [6]. The AHA guidelines describe a post-discharge follow-up visit within 7 to 14 days and/or a telephone follow-up within 3 days of hospital discharge as “reasonable” [7]. The National Institute for Health and Care Excellence (NICE) guideline on diagnosing and managing acute heart failure in adults [8]

states that "a follow-up clinical assessment should be undertaken by a member of the specialist heart failure team within two weeks of the person being discharged from hospital." We determined the proportion of patients offered a cardiology outpatient department (OPD) appointment within two weeks of discharge as a proxy for this and investigated how it varied by age and comorbidity.

Previous work has focused on aggregate emergency admission rates or on patient and hospital factors that predict readmission and mortality. These outcomes are important, but to better understand true demand a broader understanding of the use of other hospital services by HF patients is required. The NHS in England benefits from national linked data that encompass inpatient, day case, OPD and emergency department (ED) activity. To date there has been little published on data by HF patients in England or elsewhere. We describe this use in the year after an index HF admission, both overall and related to age and comorbidity.

Methods

Data source

Hospital Episodes Statistics (HES) is the national administrative database for England and covers all NHS hospitals and Independent Sector Treatment Centres, totalling around 15 million records each year; similar systems exist for the other UK countries. Since 2003/4 it has included OPD records (60 million records each year), and since 2007/8 it has included ED records (now around 19 million each year). Records can be matched for the same patient

using an identifier that uses a combination of unique NHS number, date of birth, sex, postcode and hospital number. Inpatient diagnosis fields use ICD10. Procedures are coded using the UK's own OPCS system [9]. As the ED and OPD diagnosis fields are too still infrequently populated to be useful, we restricted analyses of the ED portion of HES to the fact, date and outcome of the attendance, and the OPD portion to the fact, date and specialty of the appointment.

Patient cohort and subgroups

We derived a cohort of HF patients admitted as an emergency (ICD10 I50 as the primary diagnosis) discharged between April 2009 and March 2011: these admissions are defined as index admissions. Patients were excluded if they had had an emergency admission with a primary diagnosis of HF in the previous three years [10].

Comorbidities and procedures were taken from the index and from any admissions in the year before the index, as described in our previous studies on readmissions in HF patients [10, 11]: see supplementary Table A1. To investigate differences by patient characteristics, we defined two 'extreme' subgroups: a young group, aged <65, and an elderly multimorbid group, aged 80+ with at least three comorbidities from our list.

Measures of hospital use

We linked the index admissions to ED attendances and OPD appointments for up to 365 days after the discharge date of the index admission. Duplicate OPD appointments and those cancelled by the hospital were removed; for some analyses we also dropped OPD

appointments cancelled by the patient. The specialty was noted. Several mental health specialties were combined, and diabetic medicine was combined with endocrinology.

Subsequent admissions were divided into elective and emergency based on the "method of admission" field and counted. It was noted via the "disposal" field whether the ED attendances ended in admission. OPD non-attendance was flagged using the "attended" field. For the time from discharge to first ED attendance and first OPD appointment, we ignored any intervening admission. In contrast, for readmission, we tracked forward in time to find the next admission for each patient. If that next admission was an emergency, it was counted as a readmission. If, however, the next one was an elective, then it was not counted as a readmission, which is the usual (strict) definition of a readmission.

Analysis

Patient characteristics and hospital use were summarised for all patients who survived the index admission. For the tables, we simply present rates or other summaries. For the plots of activity over time within the first year after discharge, we accounted for the competing risk of death using cumulative incidence rates [12]. Kaplan-Meier curves treat deaths as censored, giving invalid risk estimates for non-death outcomes. As we had out-of-hospital deaths linked to the admissions database only for deaths up to August 2011, for these plots we used index admissions between April 2009 and August 2010, to allow a full year's follow-up. For OPD appointments within two weeks of discharge, we assumed that the proportion of patients discharged alive but who died within two weeks was negligible and so used the full set of patients.

Patient involvement

Given our specific aims, no patients were involved in setting the research question or the outcome measures, and nor were they involved in the design and implementation of the study. We will work with colleagues at the NIHR Imperial College Patient Safety Translational Research Centre to advise on plans for dissemination of these findings.

Results

All patients combined

There were 82,241 index admissions between April 2009 and March 2011, with 12,393 (15.1%) ending in death: 10.7% were aged under 65, of whom 6.2% died during the index HF admission, and 36.0% were aged 80+ with three or more comorbidities, of whom 21.5% died during the index HF admission. Patients were mostly elderly and multimorbid (Table 1). All results below refer to the 69,848 survivors of the index admission.

ED attendances were common after the index admission. 6.7% of patients attended the ED within a week of index discharge, of which 77.6% resulted in readmission. 70.5% of ED attendances within the year resulted in admission. The 30-day all-cause readmission rate was 19.7%, whereas the 30-day rate for readmissions with HF as the primary diagnosis was only 5.6%. Just over half of all index survivors were readmitted as an emergency within a year: around a quarter of these had HF as the primary diagnosis. During the same period, about one in four patients had one or more elective admissions, totalling 36,481 elective

admissions. Other than for cataracts, these were often diagnostic procedures or for cardiac pacing. 74% were same-day discharges.

Over 85% of patients were offered at least one OPD appointment in the year after the index discharge: by "offered" we included all appointments not cancelled by the hospital, i.e., including those not attended or cancelled by the patient. Cardiology was the most commonly used OPD specialty, with the anticoagulant service second most common (Table 2). Overall, patients who were offered at least one appointment during the year were offered a median of six (Table 3). One in ten patients saw three or more different specialties.

For all patients there was a median of 27 days between discharge and the first appointment. Of these, 9.7% were cancelled by the patient, 12.9% were missed by the patient on the day and 1.9% resulted in admission on the same day. 30.1% were at cardiology clinics, with ophthalmology and Medicine for the Elderly (geriatric medicine) being the two next commonest. Only 6.8% of patients were offered a cardiology appointment within two weeks; for all specialties combined, the proportion reviewed within two weeks was 28.2%.

Results by patient subgroup

In the young subgroup, 6.2% had an ED attendance within a week of discharge, of whom 69.6% were admitted. For the elderly multimorbid subgroup, these figures were both significantly higher at 7.3% and 80.1% ($p<0.001$). Within a year of discharge, 52.3% in the young subgroup had an ED attendance, of whom only 64.7% were admitted. For the elderly

multimorbid subgroup, these figures were again both significantly higher at 61.9% and 75.7% ($p<0.001$). The time to first attendance was similar for both groups.

Readmission rates were consistently higher in the elderly multimorbid than in young patients, and the primary diagnosis differed a little by age. Of the 30-day readmissions, 29.9% in the young and 28.1% in the elderly multimorbid were for HF; of the 365-day readmissions, 28.1% in the young and just 22.3% in the elderly multimorbid were for HF. Elective admission rates were twice as common for the young than for the elderly multimorbid.

For both subgroups, outpatient appointments were common in the year after the index HF admission. Using cumulative incidences, only about 5% of patients in the young subgroup had no outpatient appointments, compared with about 20% of patients in the elderly multimorbid subgroup (Figure 1). Young patients with at least one outpatient appointment had on average more than double the number of appointments compared with the equivalent elderly group. Young patients were seen ten days earlier on average (median 20 days since index discharge compared with 30 days, Table 3).

Regarding the NICE guideline, 12.1% of the young and 4.3% of the elderly multimorbid group were offered a cardiology outpatient appointment within two weeks of discharge; OPD follow-up rates for all specialties combined at two weeks were 38.9% for the young and 23.8% for the elderly multimorbid. After cardiology, the next most common specialty for both subgroups was the anticoagulant service, followed by clinical haematology and general

medicine in the young and ophthalmology and Medicine for the Elderly (1.7% of patients) in the elderly multimorbid.

As the cardiology OPD follow-up rates differed greatly between our young and elderly multimorbid subgroups, we stratified by age and number of comorbidities. After stratifying just by age, the cardiology follow-up rates ranged from 2.4% in those aged 90+ to 19.6% in those aged under 45, an eight-fold difference (Figure 2). These age differences were statistically significant ($p<0.0001$, Gray's test for separation between the curves [13]).

Within each age group, the *more* comorbidities a patient had, the *higher* their cardiology follow-up rate. Figure 3 shows this for the commonest age group, 80-84, though it was true for all age bands. At the two-week point and also throughout the year, the variation by age was greater than the variation by comorbidity.

Discussion

Summary of findings

In this national study of adult patients with an index admission for HF in England, the patients commonly had subsequent planned and unplanned hospital contact including inpatient, ED and OPD activity. ED reattendance was common: 6.7% within a week and 57.4% in a year: only 1 in 4 who attended in the year after discharge were not readmitted. Over half of all patients had at least one unplanned admission within a year, most being for non-HF diagnoses. OPD attendance was high and covered a broad range of specialties.

Cardiology and anticoagulation services were the two most common, with low use by Medicine for the Elderly – surprising, given the age of population.

The proportion reviewed by a cardiologist in the OPD within two weeks of inpatient discharge as now recommended by NICE and American Heart Association guidelines was only 6.8%, with large differences by patient subgroup. The proportion reviewed was highest for the youngest patients, an advantage maintained throughout the subsequent year. Patients with more comorbidities had a higher chance of cardiology follow-up, suggesting that the specialists take on more of the more complex cases. However, the effect of age appeared greater than that of comorbidity and operated in the opposite direction. Elderly patients did not seem to be seen more by other specialties instead including care of the elderly services – Figure 1 shows that their follow-up rate in OPD for all specialties combined was still lower than that for patients under 65. The proportion of elderly multimorbid patients attending a general medicine clinic within two weeks of discharge was 1.5% (compared with 2.6% in the young subgroup) and the proportion for Medicine for the Elderly only 1.7%.

Results in relation to other studies

There are few national studies of hospital utilisation by patients with HF beyond those of readmissions. A study of geographical variation in hospital use in the health care system of the Department of Veterans Affairs for various chronic diseases including HF found large variations in inpatient but not OPD use across the USA [14], though a Medicare-GWTG study of 225 participating hospitals found that the early follow-up rate for HF ranged from under 10% to 64% by hospital [6]. The ESC HF pilot registry covering participating centres in 12

European countries only reported mortality and readmission as outcomes [2]. Ours is the first UK study to describe ED and OPD activity. As expected, use of cardiology and the anticoagulant service were common, but we were a little surprised by the large number of appointments for ophthalmology, which varied by age. An increasing amount of eye treatments such as laser photocoagulation now take place in the OPD. The large numbers of older people attending ophthalmology OPDs are added to by large numbers of diabetic individuals with or at risk of eye disease [15], and nearly 1 in 3 of our cohort had diabetes recorded.

Strengths and weakness of this study

England and the other UK countries benefit from national hospital databases like HES, enabling transfers and readmissions to any other NHS hospital to be tracked. With a time lag, records are also linked to death registrations, which we used to account for the competing risk of death in the cumulative incidence plots. As well as the large sample size, using national administrative data avoids the selection bias of clinical trials.

Administrative data also have limitations. A systematic review of studies of the data quality of HES found that for inpatient records the primary diagnosis was correct 96% of the time for studies since 2005 [16]. The accuracy of recording of secondary diagnoses varies by hospital, and the comorbidity frequencies that we calculated are likely to be underestimates despite tracking back to obtain information from previous admissions. Much less is known about ED and OPD records. HES ED counts have until recently regularly been compared against the number of recorded ED attendances in quarterly monitoring (QMAE) returns. In 2010/11, there were 15.8 million attendances reported in ED HES (excluding planned follow-

up appointments) compared with 21.4 million reported in QMAE [17]. However, non-submitting walk-in centres and minor injury units account for the vast majority of the shortfall. The paucity of diagnosis information in both ED and OPD records meant that we were unable to estimate reliably which attendances or appointments are primarily for the HF and which are for other problems.

As HES is a hospital database, it lacks information on activity in primary care, the sector in which much management and monitoring of patients takes place. Patients with HF have on average 11 to 13 contacts per year with their GP or other members of the primary care team [1]. Work from Spain suggests that there is also considerable variability in the use of those services and in the management of HF patients by GPs [18]. HF is considered an ambulatory or primary care sensitive condition, one for which hospital admission could be prevented by interventions in primary care. However, practice-level quality of care scores did not correlate with the fall in admission rates in England [19]. As HES would not capture primary care activity, any NICE-recommended *initial* post-inpatient discharge follow-up by the specialist heart failure team that does occur in primary care would be missed. However, in the UK this is uncommon and should not invalidate our use of OPD records.

Our use of an index HF admission simplifies what we intended as a simply descriptive analysis and represents a convenient reference point in time to examine service use [20-22]. As this was their first emergency HF admission for at least three years, we assumed that either they had been stable during that time or they were new HF patients. A more sophisticated approach using multistate models, for example, could investigate the interrelations between the different NHS contacts.

HES data do not include diagnosis dates or information on where the diagnosis was made. A Canadian study found that half of HF patients have it diagnosed in the ED (14%) or as an inpatient (37%), with the other half mostly in general rather than specialist outpatient clinics [23]; outcomes differed markedly depending on the place of diagnosis.

Lastly, we were restricted to 2009/10 and 2010/11 data because of the unavailability of linked mortality files for more recent years. It will be interesting to repeat this analysis once sufficient data have accrued after the October 2014 NICE guidelines that recommend two-week post-discharge cardiology follow-up.

Implications for clinical practice

Our findings reaffirm both the high mortality and high hospital service utilisation for ED, inpatient and outpatient sectors in patients with heart failure. The England and Wales national audit report, our recent study that combined the audit results with HES [7] and work from outside the UK [6, 24] showed the benefit of cardiologist input and follow-up, now recommended by NICE and the ESC [8, 25]. However, for this study period only 6.7% of index survivors had a cardiology OPD appointment within two weeks of their index HF admission and only half had one within a year, suggesting that further progress is needed. The proportion reviewed by a cardiologist within two weeks varied eight-fold across age groups, with older people being disadvantaged. Although one in five patients had appointments in other clinics in the same period, including various medical specialties, around three-quarters did not. It will be important to monitor progress against this measure in the future.

Conclusions

Our results confirm that patients with HF often have multiple comorbidities and hence complex medical needs, with a high use of hospital services beyond the index acute admission. Our subgroup analyses by age and comorbidity show notable differences which need to be addressed to meet best practice and the recent NICE and European guidance for specialist outpatient follow-up.

Competing interest statement

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) AB and PA have support from Dr Foster Intelligence for the submitted work; (2) No author has any relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) No authors has any non-financial interests that may be relevant to the submitted work. We have read and understood BMJ policy on declaration of interests and declare the following interests as above.

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Contributor statement

AB and MRC conceived the study. AB and RG prepared and analysed the data. AB wrote the first draft of the manuscript; all authors critically appraised and revised it. AB is the guarantor for the study. All authors had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Patient consent form

There are no identifiable patients in this study.

Ethics approval

We have permission from the Confidentiality Advisory Group under Section 251 of the NHS Act 2006 (formerly Section 60 approval from the Patient Information Advisory Group) to hold confidential data and analyse them for research purposes (PIAG 2-05(d)/2007). We

have approval to use them for research and measuring quality of delivery of healthcare, from the South East Ethics Research Committee (10/H1102/25).

Role of the study sponsors/funders

The sponsors/funders had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript. We have not been paid to write this article. The authors have independence of research from the funders.

Transparency declaration

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Copyright statement

Data sharing

No additional data available

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Figure legends

Figure 1. Cumulative proportion of patients with at least one OPD appointment (any specialty) by number of days since index discharge

Figure 2. Cumulative proportion of patients offered at least one cardiology OPD appointment in the year following the index HF admission by age group

Figure 3. Cumulative proportion of patients aged 80-84 offered at least one cardiology OPD appointment in the year following the index HF admission by number of comorbidities

Tables

Table 1. Characteristics of patients discharged alive from their index HF admission

		Number	%
Age group	18-44	812	1.2
	45-64	7462	10.7
	65-79	24759	35.4
	80+	36815	52.7
Sex	Male	34988	50.1
	Female	34860	49.9
Age group: males	Male 18-44	519	1.5
	Male 45-64	5011	14.3
	Male 65-79	14158	40.5
	Male 80+	15300	43.7
Age group: females	Female 18-44	293	0.8
	Female 45-64	2451	7.0
	Female 65-79	10601	30.4
	Female 80+	21515	61.7
IMD quintile	1 (least deprived)	10260	14.7
	2	13668	19.6
	3	14933	21.4
	4	15638	22.4

	5 (most deprived)	15349	22.0
Living alone		6523	9.3
CABG*		1008	1.4
PTCA*		1913	2.7
CRT*		287	0.4
Other pacing		2491	3.6
Stroke		1550	2.2
Pneumonia		8906	12.8
Ischaemic heart disease		33966	48.6
Dementia		3387	4.8
Arrhythmias		39902	57.1
Valvular disease		18847	27.0
Peripheral vascular disease		6580	9.4
Hypertension		44858	64.2
Chronic pulmonary disease		18184	26.0
Diabetes Mellitus		21480	30.8
Renal disease		16289	23.3
Obesity		3733	5.3
Mental health		6400	9.2

3+ comorbidities		45164	64.7
3+ comorbidities other than hypertension		33562	48.1
Arrhythmias and hypertension		26032	37.3
IHD and hypertension		23830	34.1
IHD and arrhythmias		19741	28.3
Subgroup	0 (neither of the below)	38340	54.9
	1 = Young (<65 years old)	8274	11.8
	2 = Elderly comorbid (aged 80+ with 3+ comorbidities)	23234	33.3
Index LOS (nights)	0-2	14991	21.5
	3-6	17367	24.9
	7-20	28047	40.2
	21+	9443	13.5

Key: * CABG = coronary artery bypass graft; PTCA = percutaneous transluminal coronary angioplasty; CRT = cardiac resynchronisation therapy

Table 2. Top 15 specialties for OPD appointments in year after index HF admission, ranked by total number of appointments

Specialty	Total number of appointments (% of total)	Number (%) patients with appointment	Ranking of specialties based on number of patients attending	% appointments not attended
Cardiology	113398 (24.7)	34702 (49.7)	1	11.9
Anticoagulant services	57090 (12.5)	5489 (7.9)	8	8.2
Ophthalmology	32657 (7.1)	13618 (19.5)	2	13.4
General Medicine	23674 (5.2)	9647 (13.8)	3	10.4
Nephrology	23182 (5.1)	5796 (8.3)	6	10.6
Clinical Haematology	20720 (4.5)	4905 (7.0)	12	8.7
Geriatric Medicine	19230 (4.2)	8393 (12.0)	4	14.0
Respiratory Medicine	17130 (3.7)	7985 (11.4)	5	14.0
Endocrinology	16244 (3.5)	5216 (7.5)	9	12.7
Trauma & Orthopaedics	12538 (2.7)	5750 (8.2)	7	10.9
Urology	9921 (2.2)	4981 (7.1)	11	14.0
General Surgery	9228 (2.0)	5163 (7.4)	10	11.4
Dermatology	8735 (1.9)	3544 (5.1)	14	9.9
Ear, Nose & Throat (ENT)	6507 (1.4)	3670 (5.3)	13	11.7

Gastroenterology	5353 (1.2)	3323 (4.8)	15	14.8

Table 3. Hospital contacts in year after index admission overall and by patient subgroup

	Patients aged <65	Elderly multimorbid group	All patients
Emergency adms: % with none	48.2	34.5	40.3
Emergency adms: % with 1-2	36.6	48.3	44.1
Emergency adms: % with 3+	15.1	17.2	15.6
Elective adms: % with 1+	43.7	20.1	28.1
Total inpatient bed-days	91,254	357,554	943,745
OPD appts: % with none*	4.9	19.4	14.5
OPD appts: median number of appts (IQR) in those with 1+*	9 (4 - 15)	4 (2 - 8)	6 (3 - 11)
Time to first offered OPD appt post-discharge: median days (IQR) in those with 1+ post-discharge OPD*	20 (8 - 44)	30 (12 - 64)	27 (10 - 56)
% with OPD appt within a week of discharge*	20.3	11.6	14.2
% admitted on same day as attended OPD appt	1.0	0.6	0.7

ED attendances not ending in admission: % with 1+	27.3	23.6	23.9
% who die within a year of index discharge	12.6	36.6	27.3
7-day emergency readmission rate	5.8	7.5	6.8
30-day emergency readmission rate	17.4	22.0	19.7
365-day emergency readmission rate	42.0	59.5	52.2

* Includes all OPD appointments irrespective of whether attended or not and includes those cancelled by the patient

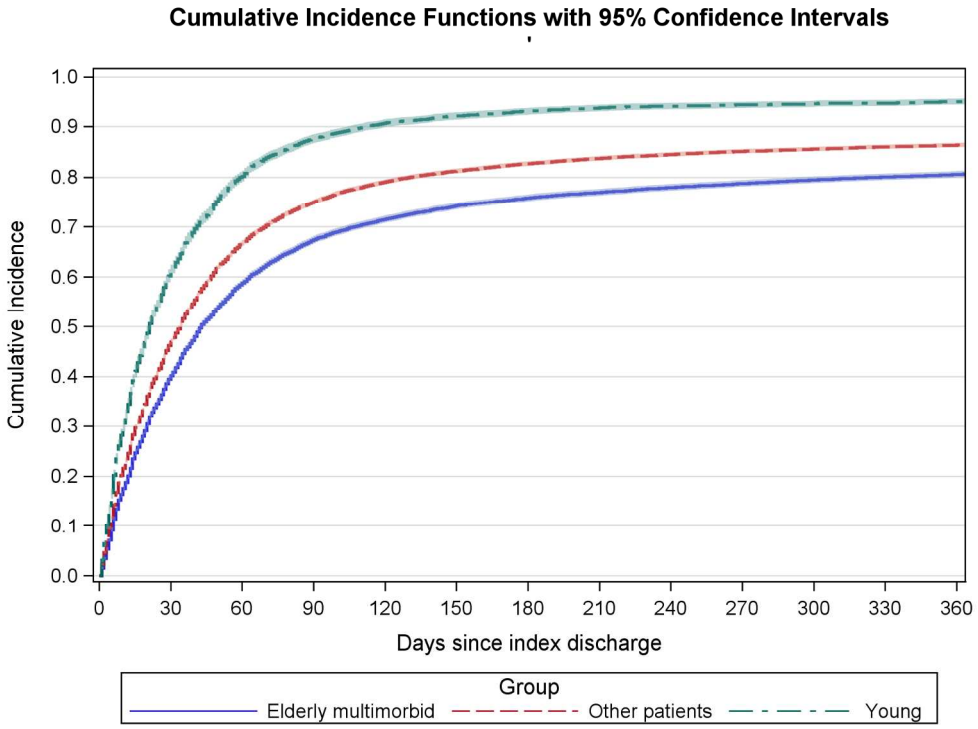

Figure 1

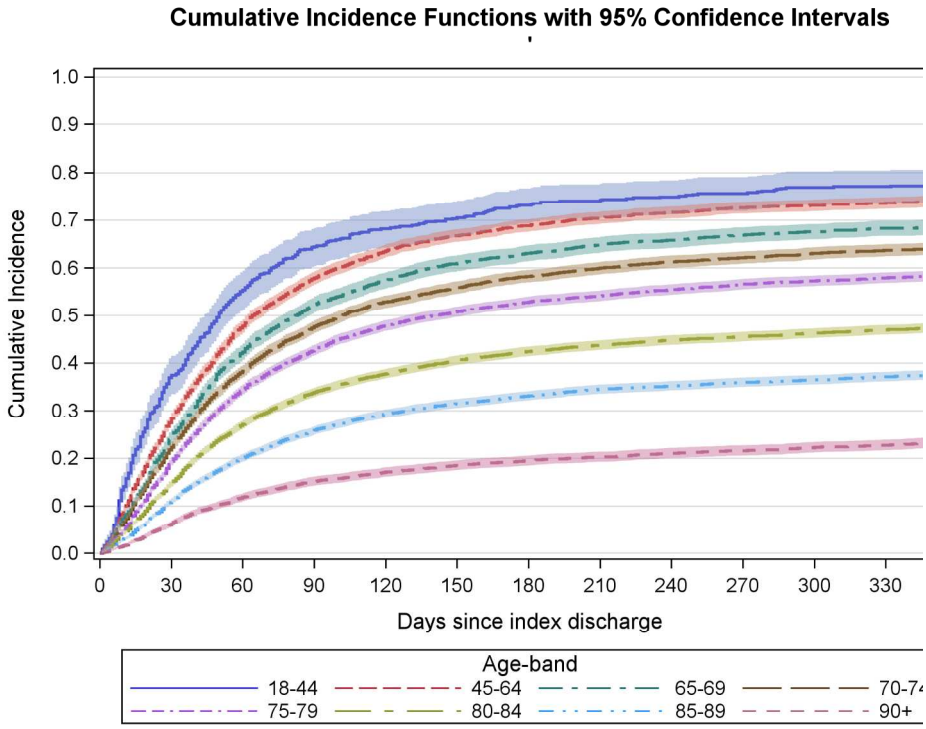

Figure 2

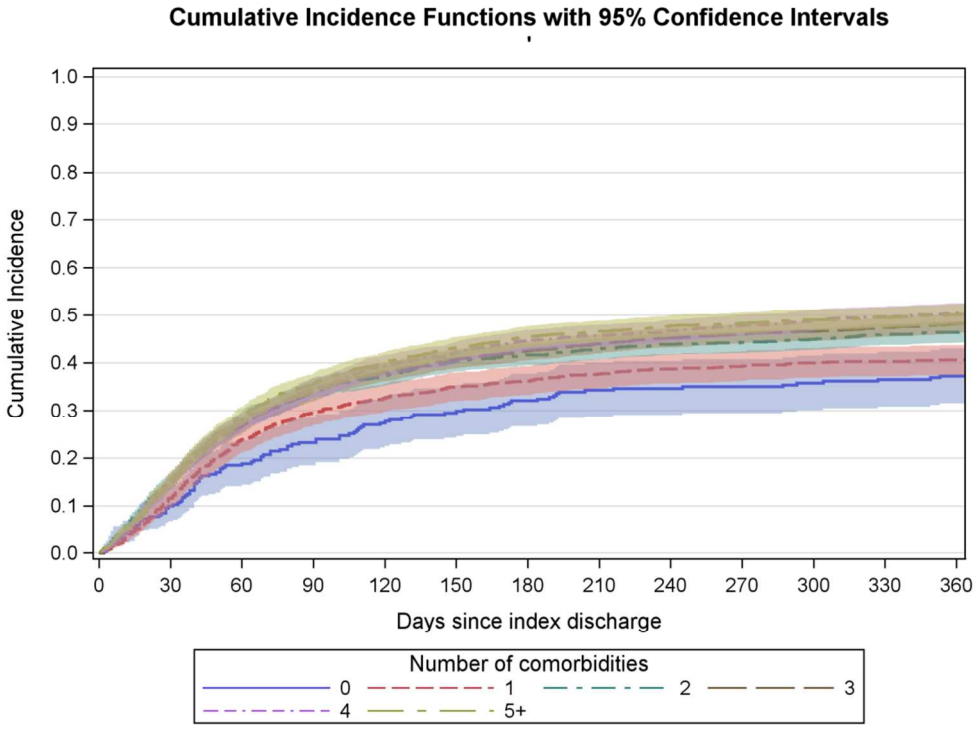

Figure 3

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Use of hospital services by age and comorbidity after an index heart failure admission in England: observational study

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Use of hospital services by age and comorbidity after an index heart failure admission in England: observational study

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Abstract

Objectives: To describe hospital inpatient, emergency department (ED) and outpatient department (OPD) activity for patients in the year following their first emergency admission for heart failure (HF). To assess the proportion receiving specialist assessment within two weeks of hospital discharge, as now recommended by guidelines.

Design: Observational study of national administrative data.

Setting: all acute NHS hospitals in England.

Participants: 82,241 patients with an index emergency admission between April 2009 and March 2011 with a primary diagnosis of HF.

Main outcome measures: cardiology OPD appointment within two weeks and within a year of discharge from the index admission; emergency department (ED) and inpatient use within a year

Results: 15.1% died during the admission. Of the 69,848 survivors, 19.7% were readmitted within 30 days and half within a year, the majority for non-HF diagnoses. 6.7% returned to the ED within a week of discharge, of whom the majority (77.6%) were admitted. The two most common OPD specialties during the year were cardiology (24.7% of the total appointments) and anticoagulant services (12.5%). Although half of all patients had a cardiology appointment within a year, the proportion within the recommended two weeks of discharge was just 6.8% overall and varied by age, from 2.4% in those aged 90+ to 19.6% in those aged 18-45 ($p<0.0001$); appointments in other specialties made up only some of the

shortfall. More comorbidity at any age was associated with higher rates of cardiology OPD follow-up.

Conclusion: patients with HF are high users of hospital services. Post-discharge cardiology OPD follow-up rates fell well below current NICE guidelines, particularly for the elderly and those with less comorbidity.

Key words: heart failure; hospital utilisation; administrative data

Strengths and limitations of this study

- Patients with heart failure (HF) frequently have high unplanned admission and readmission rates, but much less is known about their use of emergency and outpatient departments and the role of non-cardiology specialties. We made use of national administrative data for England that capture this activity
- Linkage to death registrations and the use of cumulative incidence rates allowed outpatient department utilisation for cardiology and other specialties to be correctly calculated
- We did not have data on subsequent follow-up in the community

Introduction

Heart failure (HF) is a serious chronic disease that is common in most countries. In the UK it affects around 900,000 people with an estimated cost to the NHS of 1-2% of the annual budget [1]. Responding to the limited knowledge on the epidemiology, clinical characteristics and outcomes of real-world patients with HF, the European Society of Cardiology (ESC) Heart Failure Registry was established, covering over 100 centres in 12 European countries other than the UK. Its pilot study reported wide differences in patient characteristics, treatment and outcomes for both inpatients and outpatients [2]. The annual national HF audits for England and Wales [3] have also documented variations in care processes and outcomes. The sixth and most recent published national audit (2012/13) shows for the first time a fall in mortality among contributing hospitals, consistent with international trends [4]. Following hospitalisation, the challenge is to ensure a seamless transition from inpatient to outpatient care and integration with chronic HF management. The ESC guidelines recommend multidisciplinary management programmes with structured follow-up that includes patient education, optimization of medical treatment, psychosocial support, and improved access to care [5]. Accordingly, there is a growing global focus on the timing of specialist follow-up as part of this transition. A Medicare and Get With The Guidelines study in the US found that hospitals with the lowest rates of follow-up within 7 days of discharge had the highest 30-day readmission rates [6]. The AHA guidelines describe a post-discharge follow-up visit within 7 to 14 days and/or a telephone follow-up within 3 days of hospital discharge as “reasonable” [7]. The National Institute for Health and Care Excellence (NICE) guideline on diagnosing and managing acute heart failure in adults [8]

states that "a follow-up clinical assessment should be undertaken by a member of the specialist heart failure team within two weeks of the person being discharged from hospital." We determined the proportion of patients offered a cardiology outpatient department (OPD) appointment within two weeks of discharge as a proxy for this and investigated how it varied by age and comorbidity.

Previous work has focused on aggregate emergency admission rates or on patient and hospital factors that predict readmission and mortality. These outcomes are important, but to better understand true demand a broader understanding of the use of other hospital services by HF patients is required. The NHS in England benefits from national linked data that encompass inpatient, day case, OPD and emergency department (ED) activity. To date there has been little published on data by HF patients in England or elsewhere. We describe this use in the year after an index HF admission, both overall and related to age and comorbidity.

Methods

Data source

Hospital Episodes Statistics (HES) is the national administrative database for England and covers all NHS hospitals and Independent Sector Treatment Centres, totalling around 15 million records each year; similar systems exist for the other UK countries. Since 2003/4 it has included OPD records (60 million records each year), and since 2007/8 it has included ED records (now around 19 million each year). Records can be matched for the same patient

using an identifier that uses a combination of unique NHS number, date of birth, sex, postcode and hospital number. Inpatient diagnosis fields use ICD10. Procedures are coded using the UK's own OPCS system [9]. As the ED and OPD diagnosis fields are too still infrequently populated to be useful, we restricted analyses of the ED portion of HES to the fact, date and outcome of the attendance, and the OPD portion to the fact, date and specialty of the appointment.

Patient cohort and subgroups

We derived a cohort of HF patients admitted as an emergency (ICD10 I50 as the primary diagnosis) discharged between April 2009 and March 2011: these admissions are defined as index admissions. Patients were excluded if they had had an emergency admission with a primary diagnosis of HF in the previous three years [10].

Comorbidities and procedures were taken from the index and from any admissions in the year before the index, as described in our previous studies on readmissions in HF patients [10, 11]: see supplementary Table A1. To investigate differences by patient characteristics, we defined two 'extreme' subgroups: a young group, aged <65, who had with fewer than three comorbidities from our list and an elderly multimorbid group, aged 80+ with at least three comorbidities from our list.

Measures of hospital use

We linked the index admissions to ED attendances and OPD appointments for up to 365 days after the discharge date of the index admission. Duplicate OPD appointments and those cancelled by the hospital were removed; for some analyses we also dropped OPD

appointments cancelled by the patient. The specialty was noted. Several mental health specialties were combined, and diabetic medicine was combined with endocrinology.

Subsequent admissions were divided into elective and emergency based on the "method of admission" field and counted. It was noted via the "disposal" field whether the ED attendances ended in admission. OPD non-attendance was flagged using the "attended" field. For the time from discharge to first ED attendance and first OPD appointment, we ignored any intervening admission. In contrast, for readmission, we tracked forward in time to find the next admission for each patient. If that next admission was an emergency, it was counted as a readmission. If, however, the next one was an elective, then it was not counted as a readmission, which is the usual (strict) definition of a readmission.

Analysis

Patient characteristics and hospital use were summarised for all patients who survived the index admission. For the tables, we simply present rates or other summaries. For the plots of activity over time within the first year after discharge, we accounted for the competing risk of death using cumulative incidence rates [12]. Kaplan-Meier curves treat deaths as censored, giving invalid risk estimates for non-death outcomes. As we had out-of-hospital deaths linked to the admissions database only for deaths up to August 2011, for these plots we used index admissions between April 2009 and August 2010, to allow a full year's follow-up. For OPD appointments within two weeks of discharge, we assumed that the proportion of patients discharged alive but who died within two weeks was negligible and so used the full set of patients.

Patient involvement

Given our specific aims, no patients were involved in setting the research question or the outcome measures, and nor were they involved in the design and implementation of the study. We will work with colleagues at the NIHR Imperial College Patient Safety Translational Research Centre to advise on plans for dissemination of these findings.

Results

All patients combined

There were 82,241 index admissions between April 2009 and March 2011, with 12,393 (15.1%) ending in death: 4.5% were aged under 65 with fewer than three comorbidities, of whom 5.4% died during the index HF admission, and 36.0% were aged 80+ with three or more comorbidities, of whom 21.5% died during the index HF admission. Patients were mostly elderly and multimorbid (Table 1). All results below refer to the 69,848 survivors of the index admission.

ED attendances were common after the index admission. 6.7% of patients attended the ED within a week of index discharge, of which 77.6% resulted in readmission. 70.5% of ED attendances within the year resulted in admission. The 30-day all-cause readmission rate was 19.7%, whereas the 30-day rate for readmissions with HF as the primary diagnosis was only 5.6%. Just over half of all index survivors were readmitted as an emergency within a year: around a quarter of these had HF as the primary diagnosis. During the same period, about one in four patients had one or more elective admissions, totalling 36,481 elective

admissions. Other than for cataracts, these were often diagnostic procedures or for cardiac pacing. 74% were same-day discharges.

Over 85% of patients were offered at least one OPD appointment in the year after the index discharge: by "offered" we included all appointments not cancelled by the hospital, i.e., including those not attended or cancelled by the patient. Cardiology was the most commonly used OPD specialty, with the anticoagulant service second most common (Table 2). Overall, patients who were offered at least one appointment during the year were offered a median of six (Table 3). One in ten patients saw three or more different specialties.

For all patients there was a median of 27 days between discharge and the first appointment. Of these, 9.7% were cancelled by the patient, 12.9% were missed by the patient on the day and 1.9% resulted in admission on the same day. 30.1% were at cardiology clinics, with ophthalmology and Medicine for the Elderly (geriatric medicine) being the two next commonest. Only 6.8% of patients were offered a cardiology appointment within two weeks; for all specialties combined, the proportion reviewed within two weeks was 28.2%.

Results by patient subgroup

In the young subgroup, 5.1% had an ED attendance within a week of discharge, of whom 64.9% were admitted. For the elderly multimorbid subgroup, these figures were both significantly higher at 7.3% and 80.0% (both $p<0.001$). Within a year of discharge, 43.2% in the young subgroup had an ED attendance, of whom only 58.5% were admitted. For the

elderly multimorbid subgroup, these figures were again both significantly higher at 61.9% and 73.7% (both p<0.001). The time to first attendance was similar for both groups.

Readmission rates were consistently higher in the elderly multimorbid than in young patients, and the primary diagnosis differed little by age. Of the 30-day readmissions, 30.4% in the young and 28.1% in the elderly multimorbid were for HF (p=0.268); of the 365-day readmissions, 24.5% in the young and just 22.3% in the elderly multimorbid were for HF (p=0.079). Elective admission rates were twice as common for the young than for the elderly multimorbid. The total number of inpatient bed days in the year after index discharge was 91,254 in the young group and 357,554 in the elderly group, with 943,745 bed days for all patients combined.

For both subgroups, outpatient appointments were common in the year after the index HF admission. Using cumulative incidences, only about 5% of patients in the young subgroup had no outpatient appointments, compared with about 20% of patients in the elderly multimorbid subgroup (Figure 1, Table 3). Young patients with at least one outpatient appointment had on average more than double the number of appointments compared with the equivalent elderly group. Young patients were seen ten days earlier on average (median 20 days since index discharge compared with 30 days).

Regarding the NICE guideline, 12.6% of the young and 4.3% of the elderly multimorbid group were offered a cardiology outpatient appointment within two weeks of discharge; OPD follow-up rates for all specialties combined at two weeks were 35.5% for the young and 23.8% for the elderly multimorbid. After cardiology, the next most common specialty for

both subgroups was the anticoagulant service, followed by clinical haematology and general medicine in the young and ophthalmology and Medicine for the Elderly (1.7% of patients) in the elderly multimorbid.

As the cardiology OPD follow-up rates differed greatly between our young and elderly multimorbid subgroups, we stratified by age and number of comorbidities. After stratifying just by age, the cardiology follow-up rates ranged from 2.4% in those aged 90+ to 19.6% in those aged under 45, an eight-fold difference (Figure 2). These age differences were statistically significant ($p<0.0001$, Gray's test for separation between the curves [13]).

Within each age group, the *more* comorbidities a patient had, the *higher* their cardiology follow-up rate. Figure 3 shows this for the commonest age group, 80-84, though it was true for all age bands. At the two-week point and also throughout the year, the variation by age was greater than the variation by comorbidity.

Discussion

Summary of findings

In this national study of adult patients with an index admission for HF in England, the patients commonly had subsequent planned and unplanned hospital contact including inpatient, ED and OPD activity. ED reattendance was common: 6.7% within a week and 57.4% in a year: only 1 in 4 who attended in the year after discharge were not readmitted. Over half of all patients had at least one unplanned admission within a year, most being for

non-HF diagnoses. OPD attendance was high and covered a broad range of specialties. Cardiology and anticoagulation services were the two most common, with low use by Medicine for the Elderly – surprising, given the age of population.

The proportion reviewed by a cardiologist in the OPD within two weeks of inpatient discharge as now recommended by NICE and American Heart Association guidelines was only 6.8%, with large differences by patient subgroup. The proportion reviewed was highest for the youngest patients, an advantage maintained throughout the subsequent year. Patients with more comorbidities had a higher chance of cardiology follow-up, suggesting that the specialists take on more of the more complex cases. However, the effect of age appeared greater than that of comorbidity and operated in the opposite direction. Elderly patients did not seem to be seen more by other specialties instead including care of the elderly services – Figure 1 shows that their follow-up rate in OPD for all specialties combined was still lower than that for patients under 65. The proportion of elderly multimorbid patients attending a general medicine clinic within two weeks of discharge was 1.5% (compared with 2.6% in the young subgroup) and the proportion for Medicine for the Elderly only 1.7%.

Results in relation to other studies

There are few national studies of hospital utilisation by patients with HF beyond those of readmissions. A study of geographical variation in hospital use in the health care system of the Department of Veterans Affairs for various chronic diseases including HF found large variations in inpatient but not OPD use across the USA [14], though a Medicare-GWTG study of 225 participating hospitals found that the early follow-up rate for HF ranged from under

10% to 64% by hospital [6]. The ESC HF pilot registry covering participating centres in 12 European countries only reported mortality and readmission as outcomes [2]. Ours is the first UK study to describe ED and OPD activity. As expected, use of cardiology and the anticoagulant service were common, but we were a little surprised by the large number of appointments for ophthalmology, which varied by age. An increasing amount of eye treatments such as laser photocoagulation now take place in the OPD. The large numbers of older people attending ophthalmology OPDs are added to by large numbers of diabetic individuals with or at risk of eye disease [15], and nearly 1 in 3 of our cohort had diabetes recorded.

Strengths and weakness of this study

England and the other UK countries benefit from national hospital databases like HES, enabling transfers and readmissions to any other NHS hospital to be tracked. With a time lag, records are also linked to death registrations, which we used to account for the competing risk of death in the cumulative incidence plots. As well as the large sample size, using national administrative data avoids the selection bias of clinical trials.

Administrative data also have limitations. A systematic review of studies of the data quality of HES found that for inpatient records the primary diagnosis was correct 96% of the time for studies since 2005 [16]. The accuracy of recording of secondary diagnoses varies by hospital, and the comorbidity frequencies that we calculated are likely to be underestimates despite tracking back to obtain information from previous admissions. Much less is known about ED and OPD records. HES ED counts have until recently regularly been compared against the number of recorded ED attendances in quarterly monitoring (QMAE) returns. In

2010/11, there were 15.8 million attendances reported in ED HES (excluding planned follow-up appointments) compared with 21.4 million reported in QMAE [17]. However, non-submitting walk-in centres and minor injury units account for the vast majority of the shortfall. The paucity of diagnosis information in both ED and OPD records meant that we were unable to estimate reliably which attendances or appointments are primarily for the HF and which are for other problems.

As HES is a hospital database, it lacks information on activity in primary care, the sector in which much management and monitoring of patients takes place. Patients with HF have on average 11 to 13 contacts per year with their GP or other members of the primary care team [1]. Work from Spain suggests that there is also considerable variability in the use of those services and in the management of HF patients by GPs [18]. HF is considered an ambulatory or primary care sensitive condition, one for which hospital admission could be prevented by interventions in primary care. However, practice-level quality of care scores did not correlate with the fall in admission rates in England [19]. As HES would not capture primary care activity, any NICE-recommended *initial* post-inpatient discharge follow-up by the specialist heart failure team that does occur in primary care would be missed. However, in the UK this is uncommon and should not invalidate our use of OPD records.

Our use of an index HF admission simplifies what we intended as a simply descriptive analysis and represents a convenient reference point in time to examine service use [20-22]. As this was their first emergency HF admission for at least three years, we assumed that either they had been stable during that time or they were new HF patients. A more

sophisticated approach using multistate models, for example, could investigate the interrelations between the different NHS contacts.

HES data do not include diagnosis dates or information on where the diagnosis was made. A Canadian study found that half of HF patients have it diagnosed in the ED (14%) or as an inpatient (37%), with the other half mostly in general rather than specialist outpatient clinics [23]; outcomes differed markedly depending on the place of diagnosis.

Lastly, we were restricted to 2009/10 and 2010/11 data because of the unavailability of linked mortality files for more recent years. It will be interesting to repeat this analysis once sufficient data have accrued after the October 2014 NICE guidelines that recommend two-week post-discharge cardiology follow-up.

Implications for clinical practice

Our findings reaffirm both the high mortality and high hospital service utilisation for ED, inpatient and outpatient sectors in patients with heart failure. The England and Wales national audit report, our recent study that combined the audit results with HES [7] and work from outside the UK [6, 24] all showed the benefit of cardiologist input and follow-up. This is now recommended by NICE and the ESC [8, 25] but UK guidelines have changed over time. We studied index admissions from April 2009 to March 2011. At the start of the study period, the guidance to the NHS in England from NICE (issued in July 2003) [26] stated that "patients with heart failure should generally be discharged from hospital only when their clinical condition is stable and the management plan is optimised. Timing of discharge should take into account patient and carer wishes and the level of care and support that can

be provided in the community". There was no mention of care after discharge other than to state that all patients "require monitoring… to include clinical assessment, a review of medication, and serum urea, electrolytes, creatinine and eGFR", with a recommendation that this should take place at least every six months. An update to this guidance was issued during our study period (on 25 August 2010) [27], which reiterated the same advice but added a recommendation that during hospital admission the medical team should seek advice from a specialist in heart failure. Quality Standards related to this guidance were not issued until after our study period (June 2011) [28].

The lack of detailed advice on hospital and transitional care was recognised, and NICE issued new guidelines on the diagnosis and treatment of acute (i.e. hospitalised) heart failure in 2014 [8] and related Quality Standards in 2015 [29] after the period of our study. Four recommendations related to the organisation of hospital and transitional care [8]. All hospitals were to provide a specialist heart failure team based on a cardiology ward and providing outreach services; everyone admitted with suspected heart failure was to have early and continuing input from the specialist team; discharge from hospital and subsequent management in primary care (including ongoing monitoring and care by a multidisciplinary team) should be planned; and a follow-up clinical assessment should be undertaken by a member of the specialist heart failure team within two weeks of the person being discharged from hospital. These recommendations were then endorsed in the new NHS Quality Standards for Acute Heart Failure, issued on 3 December 2015 [29]. It remains to be seen how quickly and consistently these standards will be implemented across the NHS in England. For our study period only 6.7% of index survivors had a cardiology OPD appointment within two weeks of their index HF admission, and only half had one within a

year. Our work suggests that there will need to be considerable organisational change to reach the two-week follow-up target. It will be important to monitor progress against this measure in the future.

Conclusions

Our results confirm that patients with HF often have multiple comorbidities and hence complex medical needs, with a high use of hospital services beyond the index acute admission. Our subgroup analyses by age and comorbidity show notable differences which need to be addressed to meet best practice and the recent NICE and European guidance for specialist outpatient follow-up.

Competing interest statement

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) AB and PA have support from Dr Foster Intelligence for the submitted work; (2) No author has any relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) No authors has any non-financial interests that may be relevant to the submitted work. We have read and understood BMJ policy on declaration of interests and declare the following interests as above.

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Contributor statement

AB and MRC conceived the study. AB and RG prepared and analysed the data. AB wrote the first draft of the manuscript; all authors critically appraised and revised it. AB is the guarantor for the study. All authors had full access to all of the data (including statistical

reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Patient consent form

There are no identifiable patients in this study.

Ethics approval

We have permission from the Confidentiality Advisory Group under Section 251 of the NHS Act 2006 (formerly Section 60 approval from the Patient Information Advisory Group) to hold confidential data and analyse them for research purposes (PIAG 2-05(d)/2007). We have approval to use them for research and measuring quality of delivery of healthcare, from the South East Ethics Research Committee (10/H1102/25).

Role of the study sponsors/funders

The sponsors/funders had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript. We have not been paid to write this article. The authors have independence of research from the funders.

Transparency declaration

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Copyright statement

Data sharing

No additional data available

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Figure legends

Figure 1. Cumulative proportion of patients with at least one OPD appointment (any specialty) by number of days since index discharge

Figure 2. Cumulative proportion of patients offered at least one cardiology OPD appointment in the year following the index HF admission by age group

Figure 3. Cumulative proportion of patients aged 80-84 offered at least one cardiology OPD appointment in the year following the index HF admission by number of comorbidities

Tables

Table 1. Characteristics of patients discharged alive from their index HF admission

		Number	%
Age group	18-44	812	1.2
	45-64	7462	10.7
	65-79	24759	35.4
	80+	36815	52.7
Sex	Male	34988	50.1
	Female	34860	49.9
Age group: males	Male 18-44	519	1.5
	Male 45-64	5011	14.3
	Male 65-79	14158	40.5
	Male 80+	15300	43.7
Age group: females	Female 18-44	293	0.8
	Female 45-64	2451	7.0
	Female 65-79	10601	30.4
	Female 80+	21515	61.7
IMD quintile	1 (least deprived)	10260	14.7
	2	13668	19.6
	3	14933	21.4
	4	15638	22.4

	5 (most deprived)	15349	22.0
Living alone		6523	9.3
CABG*		1008	1.4
PTCA*		1913	2.7
CRT*		287	0.4
Other pacing		2491	3.6
Stroke		1550	2.2
Pneumonia		8906	12.8
Ischaemic heart disease		33966	48.6
Dementia		3387	4.8
Arrhythmias		39902	57.1
Valvular disease		18847	27.0
Peripheral vascular disease		6580	9.4
Hypertension		44858	64.2
Chronic pulmonary disease		18184	26.0
Diabetes Mellitus		21480	30.8
Renal disease		16289	23.3
Obesity		3733	5.3
Mental health		6400	9.2

3+ comorbidities		45164	64.7
3+ comorbidities other than hypertension		33562	48.1
Arrhythmias and hypertension		26032	37.3
IHD and hypertension		23830	34.1
IHD and arrhythmias		19741	28.3
Subgroup	0 (neither of the below)	38340	54.9
	1 = Young (<65 years old with <3 comorbidities)	3515	5.0
	2 = Elderly comorbid (aged 80+ with 3+ comorbidities)	23234	33.3
Index LOS (nights)	0-2	14991	21.5
	3-6	17367	24.9
	7-20	28047	40.2
	21+	9443	13.5

Key: * CABG = coronary artery bypass graft; PTCA = percutaneous transluminal coronary angioplasty; CRT = cardiac resynchronisation therapy

Table 2. Top 15 specialties for OPD appointments in year after index HF admission, ranked by total number of appointments

Specialty	Total number of appointments (% of total)	Number (%) patients with appointment	Ranking of specialties based on number of patients attending	% appointments not attended
Cardiology	113398 (24.7)	34702 (49.7)	1	11.9
Anticoagulant services	57090 (12.5)	5489 (7.9)	8	8.2
Ophthalmology	32657 (7.1)	13618 (19.5)	2	13.4
General Medicine	23674 (5.2)	9647 (13.8)	3	10.4
Nephrology	23182 (5.1)	5796 (8.3)	6	10.6
Clinical Haematology	20720 (4.5)	4905 (7.0)	12	8.7
Geriatric Medicine	19230 (4.2)	8393 (12.0)	4	14.0
Respiratory Medicine	17130 (3.7)	7985 (11.4)	5	14.0
Endocrinology	16244 (3.5)	5216 (7.5)	9	12.7
Trauma & Orthopaedics	12538 (2.7)	5750 (8.2)	7	10.9
Urology	9921 (2.2)	4981 (7.1)	11	14.0
General Surgery	9228 (2.0)	5163 (7.4)	10	11.4
Dermatology	8735 (1.9)	3544 (5.1)	14	9.9
Ear, Nose & Throat (ENT)	6507 (1.4)	3670 (5.3)	13	11.7

Gastroenterology	5353 (1.2)	3323 (4.8)	15	14.8

Table 3. Hospital contacts in year after index admission overall and by patient subgroup

	Patients aged <65 and not multimorbid	Patients aged 80+ and multimorbid	All patients
Emergency adms: % with none	58.6	34.5	40.3
Emergency adms: % with 1-2	33.0	48.3	44.1
Emergency adms: % with 3+	8.4	17.2	15.6
7-day emergency readmission rate	4.8	7.5	6.8
30-day emergency readmission rate	14.0	22.0	19.7
365-day emergency readmission rate	33.2	59.5	52.2
Elective adms: % with none	56.1	79.7	71.7
Elective adms: % with 1+	43.9	20.3	28.3
Median and interquartile range (IQR) for inpatient bed days	1 (0 to 6)	4 (1 to 12)	3 (0 to 10)
OPD appts: % with none*	5.9	19.4	14.5
OPD appts: % with 1+*	94.1	80.6	85.5
% with any OPD appt within two weeks of discharge*	35.5	23.8	28.2
% with cardiology OPD appt within two weeks of discharge*	12.6	4.3	6.3

% admitted on same day as attended OPD appt	1.0	0.6	0.7
ED attendances not ending in admission: % with none	76.4	76.4	76.1
ED attendances not ending in admission: % with 1+	23.6	23.6	23.9
% who die within a year of index discharge	9.8	36.6	27.3

* Includes all OPD appointments irrespective of whether attended or not and includes those cancelled by the patient

All comparisons between young and elderly groups have p<0.0001 except for ED attendances not ending in admission (p=0.99)

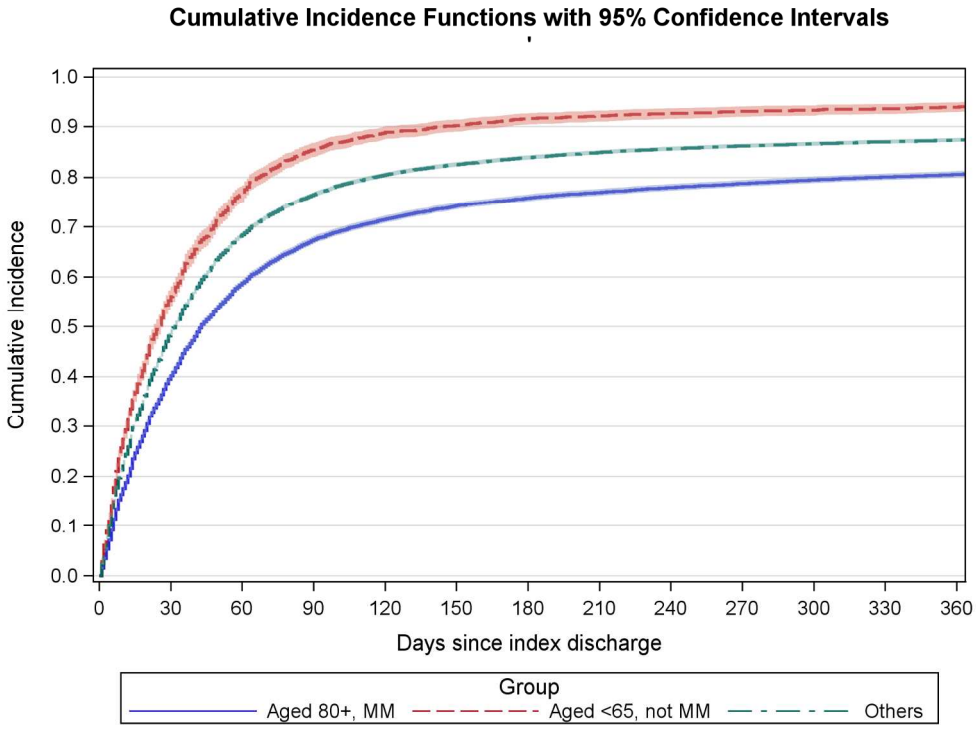

Figure 1

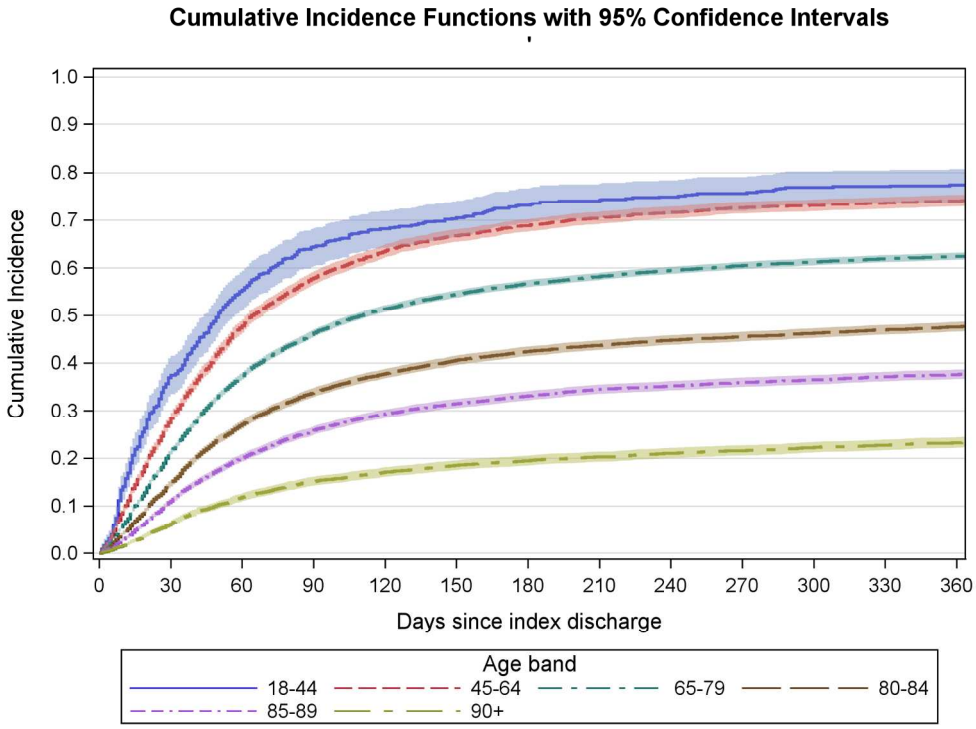

Figure 2

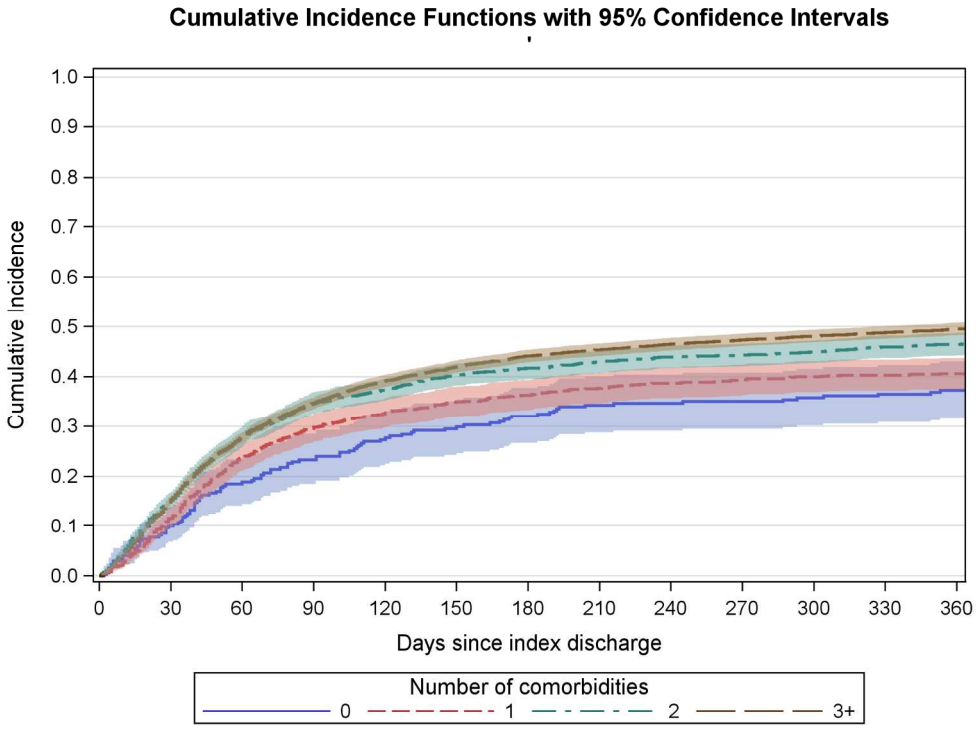

Figure 3

Supplementary Table A1. List and descriptions of patient factors used in risk-adjustment regression models

Factor	Codes and/or description (ICD10 unless specified)
Age	Categorised at 18-44 then five-year bands from 45-49 to 85-89, then 90+
Sex	
Carstairs deprivation fifth	Measure of socio-economic status of small geographical area of residence
CABG in year before or during index HF admission	OPCS codes K40, K41, K42, K43, K44, K45, K46
PTCA in year before or during index HF admission	OPCS codes K49, K50, K75
Implantable cardioverter defibrillator implanted in year before or during index HF admission	OPCS codes K590, K591, K592, K593, K594, K596, K598, K599
Pacemaker (not CRT) inserted in year before or during index HF admission	OPCS codes K600, K601, K602, K603, K605, K606, K607, K608, K609, K610, K611,K612, K613, K615, K616, K617, K618, K619
CRT inserted in year before or during index HF admission	OPCS codes K607, K617
OPD appointments missed in year before index HF admission	

OPD appointments attended in year before index HF admission	
Comorbidity flags, all defined using ICD10 codes:	All comorbidity flags were based on information during the index admission or in any admission in previous year
Stroke	I60, I61, I62, I63, I64
Pneumonia	J12, J13, J14, J15, J16, J17, J18
Ischaemic heart disease	I20, I21, I22, I23, I25
Dementia	F00, F01, F02, F051
Arrhythmias	I441, I442, I443, I456, I459, I47, I48, I49, R000, R001, R008, T821, Z450, Z950
Heart valve disorders	A520, I05, I06, I07, I08, I091, I098, I34, I35, I36, I37, I38, I39, Q230, Q231, Q232, Q233, Z952, Z953, Z954
Peripheral vascular disease	I70, I71, I731, I738, I739, I771, I790, I792, K551, K558, K559, Z958, Z959
Hypertension	I10, I11, I12, I13, I15
Chronic lung diseases	I278, I279, J40, J41, J42, J43, J44, J45, J46, J47, J60, J61, J62, J63, J64, J65, J66, J67, J684, J701, J703
Diabetes	E10, E11, E12, E13, E14
Renal disease	I120, I131, N18, N19, N250, Z490, Z491, Z492, Z940, Z992

Obesity	E66
Any mental health condition (except dementia)	F06, F07, F09, then rest of F chapter from F20 onwards
Living alone	Z602

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Use of hospital services by age and comorbidity after an index heart failure admission in England: observational study

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Use of hospital services by age and comorbidity after an index heart failure admission in England: observational study

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Abstract

Objectives: To describe hospital inpatient, emergency department (ED) and outpatient department (OPD) activity for patients in the year following their first emergency admission for heart failure (HF). To assess the proportion receiving specialist assessment within two weeks of hospital discharge, as now recommended by guidelines.

Design: Observational study of national administrative data.

Setting: all acute NHS hospitals in England.

Participants: 82,241 patients with an index emergency admission between April 2009 and March 2011 with a primary diagnosis of HF.

Main outcome measures: cardiology OPD appointment within two weeks and within a year of discharge from the index admission; emergency department (ED) and inpatient use within a year

Results: 15.1% died during the admission. Of the 69,848 survivors, 19.7% were readmitted within 30 days and half within a year, the majority for non-HF diagnoses. 6.7% returned to the ED within a week of discharge, of whom the majority (77.6%) were admitted. The two most common OPD specialties during the year were cardiology (24.7% of the total appointments) and anticoagulant services (12.5%). Although half of all patients had a cardiology appointment within a year, the proportion within the recommended two weeks of discharge was just 6.8% overall and varied by age, from 2.4% in those aged 90+ to 19.6% in those aged 18-45 ($p<0.0001$); appointments in other specialties made up only some of the

shortfall. More comorbidity at any age was associated with higher rates of cardiology OPD follow-up.

Conclusion: patients with HF are high users of hospital services. Post-discharge cardiology OPD follow-up rates fell well below current NICE guidelines, particularly for the elderly and those with less comorbidity.

Key words: heart failure; hospital utilisation; administrative data

Strengths and limitations of this study

- Patients with heart failure (HF) frequently have high unplanned admission and readmission rates, but much less is known about their use of emergency and outpatient departments and the role of non-cardiology specialties. We made use of national administrative data for England that capture this activity
- Linkage to death registrations and the use of cumulative incidence rates allowed outpatient department utilisation for cardiology and other specialties to be correctly calculated
- We did not have data on subsequent follow-up in the community

Introduction

Heart failure (HF) is a serious chronic disease that is common in most countries. In the UK it affects around 900,000 people with an estimated cost to the NHS of 1-2% of the annual budget [1]. Responding to the limited knowledge on the epidemiology, clinical characteristics and outcomes of real-world patients with HF, the European Society of Cardiology (ESC) Heart Failure Registry was established, covering over 100 centres in 12 European countries other than the UK. Its pilot study reported wide differences in patient characteristics, treatment and outcomes for both inpatients and outpatients [2]. The annual national HF audits for England and Wales [3] have also documented variations in care processes and outcomes. The sixth and most recent published national audit (2012/13) shows for the first time a fall in mortality among contributing hospitals, consistent with international trends [4]. Following hospitalisation, the challenge is to ensure a seamless transition from inpatient to outpatient care and integration with chronic HF management. The ESC guidelines recommend multidisciplinary management programmes with structured follow-up that includes patient education, optimization of medical treatment, psychosocial support, and improved access to care [5]. Accordingly, there is a growing global focus on the timing of specialist follow-up as part of this transition. A Medicare and Get With The Guidelines study in the US found that hospitals with the lowest rates of follow-up within 7 days of discharge had the highest 30-day readmission rates [6]. The AHA guidelines describe a post-discharge follow-up visit within 7 to 14 days and/or a telephone follow-up within 3 days of hospital discharge as “reasonable” [7]. The National Institute for Health and Care Excellence (NICE) guideline on diagnosing and managing acute heart failure in adults [8]

states that "a follow-up clinical assessment should be undertaken by a member of the specialist heart failure team within two weeks of the person being discharged from hospital." We determined the proportion of patients offered a cardiology outpatient department (OPD) appointment within two weeks of discharge as a proxy for this and investigated how it varied by age and comorbidity.

Previous work has focused on aggregate emergency admission rates or on patient and hospital factors that predict readmission and mortality. These outcomes are important, but to better understand true demand a broader understanding of the use of other hospital services by HF patients is required. The NHS in England benefits from national linked data that encompass inpatient, day case, OPD and emergency department (ED) activity. To date there has been little published on data by HF patients in England or elsewhere. We describe this use in the year after an index HF admission, both overall and related to age and comorbidity.

Methods

Data source

Hospital Episodes Statistics (HES) is the national administrative database for England and covers all NHS hospitals and Independent Sector Treatment Centres, totalling around 15 million records each year; similar systems exist for the other UK countries. Since 2003/4 it has included OPD records (60 million records each year), and since 2007/8 it has included ED records (now around 19 million each year). Records can be matched for the same patient

using an identifier that uses a combination of unique NHS number, date of birth, sex, postcode and hospital number. Inpatient diagnosis fields use ICD10. Procedures are coded using the UK's own OPCS system [9]. As the ED and OPD diagnosis fields are too still infrequently populated to be useful, we restricted analyses of the ED portion of HES to the fact, date and outcome of the attendance, and the OPD portion to the fact, date and specialty of the appointment.

Patient cohort and subgroups

We extracted emergency admissions for HF (ICD10 I50 as the primary diagnosis) with discharge dates between April 2009 and March 2011: for each patient, the first of these admissions was defined as their index admission. Patients were excluded if they had had an emergency admission with a primary diagnosis of HF in the previous three years [10].

Comorbidities and procedures were taken from the index and from any admissions in the year before the index, as described in our previous studies on readmissions in HF patients [10, 11]: see supplementary Table A1. To investigate differences by patient characteristics, we defined two 'extreme' subgroups: a young group, aged <65, who had with fewer than three comorbidities from our list and an elderly multimorbid group, aged 80+ with at least three comorbidities from our list.

Measures of hospital use

We linked the index admissions to ED attendances and OPD appointments for up to 365 days after the discharge date of the index admission. Duplicate OPD appointments and those cancelled by the hospital were removed; for some analyses we also dropped OPD

appointments cancelled by the patient. The specialty was noted. Several mental health specialties were combined, and diabetic medicine was combined with endocrinology.

Subsequent admissions were divided into elective and emergency based on the "method of admission" field and counted. It was noted via the "disposal" field whether the ED attendances ended in admission. OPD non-attendance was flagged using the "attended" field. For the time from discharge to first ED attendance and first OPD appointment, we ignored any intervening admission. In contrast, for readmission, we tracked forward in time to find the next admission for each patient. If that next admission was an emergency, it was counted as a readmission. If, however, the next one was an elective, then it was not counted as a readmission, which is the usual (strict) definition of a readmission.

Analysis

Patient characteristics and hospital use were summarised for all patients who survived the index admission. For the tables, we simply present rates or other summaries; chi-squared tests were used to compare proportions. For the plots of activity over time within the first year after discharge, we accounted for the competing risk of death using cumulative incidence rates [12]. Kaplan-Meier curves treat deaths as censored, giving invalid risk estimates for non-death outcomes. As we had out-of-hospital deaths linked to the admissions database only for deaths up to August 2011, for these plots we used index admissions between April 2009 and August 2010, to allow a full year's follow-up. For OPD appointments within two weeks of discharge, we assumed that the proportion of patients discharged alive but who died within two weeks was negligible and so used the full set of patients.

Patient involvement

Given our specific aims, no patients were involved in setting the research question or the outcome measures, and nor were they involved in the design and implementation of the study. We will work with colleagues at the NIHR Imperial College Patient Safety Translational Research Centre to advise on plans for dissemination of these findings.

Results

All patients combined

There were 82,241 index admissions between April 2009 and March 2011, with 12,393 (15.1%) ending in death: 4.5% were aged under 65 with fewer than three comorbidities, of whom 5.4% died during the index HF admission, and 36.0% were aged 80+ with three or more comorbidities, of whom 21.5% died during the index HF admission. Patients were mostly elderly and multimorbid (Table 1). All results below refer to the 69,848 survivors of the index admission.

ED attendances were common after the index admission. 6.7% of patients attended the ED within a week of index discharge, of which 77.6% resulted in readmission. 70.5% of ED attendances within the year resulted in admission. The 30-day all-cause readmission rate was 19.7%, whereas the 30-day rate for readmissions with HF as the primary diagnosis was only 5.6%. Just over half of all index survivors were readmitted as an emergency within a year: around a quarter of these had HF as the primary diagnosis. During the same period,

about one in four patients had one or more elective admissions, totalling 36,481 elective admissions. Other than for cataracts, these were often diagnostic procedures or for cardiac pacing. 74% were same-day discharges.

Over 85% of patients were offered at least one OPD appointment in the year after the index discharge: by "offered" we included all appointments not cancelled by the hospital, i.e., including those not attended or cancelled by the patient. Cardiology was the most commonly used OPD specialty, with the anticoagulant service second most common (Table 2). Overall, patients who were offered at least one appointment during the year were offered a median of six (Table 3). One in ten patients saw three or more different specialties.

For all patients there was a median of 27 days between discharge and the first appointment. Of these, 9.7% were cancelled by the patient, 12.9% were missed by the patient on the day and 1.9% resulted in admission on the same day. 30.1% were at cardiology clinics, with ophthalmology and Medicine for the Elderly (geriatric medicine) being the two next commonest. Only 6.8% of patients were offered a cardiology appointment within two weeks; for all specialties combined, the proportion reviewed within two weeks was 28.2%.

Results by patient subgroup

In the young subgroup, 5.1% had an ED attendance within a week of discharge, of whom 64.9% were admitted. For the elderly multimorbid subgroup, these figures were both significantly higher at 7.3% and 80.0% (both $p<0.001$). Within a year of discharge, 43.2% in the young subgroup had an ED attendance, of whom only 58.5% were admitted. For the

elderly multimorbid subgroup, these figures were again both significantly higher at 61.9% and 73.7% (both p<0.001). The time to first attendance was similar for both groups.

Readmission rates were consistently higher in the elderly multimorbid than in young patients, and the primary diagnosis differed little by age. Of the 30-day readmissions, 30.4% in the young and 28.1% in the elderly multimorbid were for HF (p=0.268); of the 365-day readmissions, 24.5% in the young and just 22.3% in the elderly multimorbid were for HF (p=0.079). Elective admission rates were twice as common for the young than for the elderly multimorbid. The total number of inpatient bed days in the year after index discharge was 91,254 in the young group and 357,554 in the elderly group, with 943,745 bed days for all patients combined.

For both subgroups, outpatient appointments were common in the year after the index HF admission. Using cumulative incidences, only about 5% of patients in the young subgroup had no outpatient appointments, compared with about 20% of patients in the elderly multimorbid subgroup (Figure 1, Table 3). Young patients with at least one outpatient appointment had on average more than double the number of appointments compared with the equivalent elderly group. Young patients were seen ten days earlier on average (median 20 days since index discharge compared with 30 days).

Regarding the NICE guideline, 12.6% of the young and 4.3% of the elderly multimorbid group were offered a cardiology outpatient appointment within two weeks of discharge; OPD follow-up rates for all specialties combined at two weeks were 35.5% for the young and 23.8% for the elderly multimorbid. After cardiology, the next most common specialty for

both subgroups was the anticoagulant service, followed by clinical haematology and general medicine in the young and ophthalmology and Medicine for the Elderly (1.7% of patients) in the elderly multimorbid.

As the cardiology OPD follow-up rates differed greatly between our young and elderly multimorbid subgroups, we stratified by age and number of comorbidities. After stratifying just by age, the cardiology follow-up rates ranged from 2.4% in those aged 90+ to 19.6% in those aged under 45, an eight-fold difference (Figure 2). These age differences were statistically significant ($p<0.0001$, Gray's test for separation between the curves [13]).

Within each age group, the *more* comorbidities a patient had, the *higher* their cardiology follow-up rate. Figure 3 shows this for the commonest age group, 80-84, though it was true for all age bands. At the two-week point and also throughout the year, the variation by age was greater than the variation by comorbidity.

Discussion

Summary of findings

In this national study of adult patients with an index admission for HF in England, the patients commonly had subsequent planned and unplanned hospital contact including inpatient, ED and OPD activity. ED reattendance was common: 6.7% within a week and 57.4% in a year: only 1 in 4 who attended in the year after discharge were not readmitted. Over half of all patients had at least one unplanned admission within a year, most being for

non-HF diagnoses. OPD attendance was high and covered a broad range of specialties. Cardiology and anticoagulation services were the two most common, with low use by Medicine for the Elderly – surprising, given the age of population.

The proportion reviewed by a cardiologist in the OPD within two weeks of inpatient discharge as now recommended by NICE and American Heart Association guidelines was only 6.8%, with large differences by patient subgroup. The proportion reviewed was highest for the youngest patients, an advantage maintained throughout the subsequent year. Patients with more comorbidities had a higher chance of cardiology follow-up, suggesting that the specialists take on more of the more complex cases. However, the effect of age appeared greater than that of comorbidity and operated in the opposite direction. Elderly patients did not seem to be seen more by other specialties instead including care of the elderly services – Figure 1 shows that their follow-up rate in OPD for all specialties combined was still lower than that for patients under 65. The proportion of elderly multimorbid patients attending a general medicine clinic within two weeks of discharge was 1.5% (compared with 2.6% in the young subgroup) and the proportion for Medicine for the Elderly only 1.7%.

Results in relation to other studies

There are few national studies of hospital utilisation by patients with HF beyond those of readmissions. A study of geographical variation in hospital use in the health care system of the Department of Veterans Affairs for various chronic diseases including HF found large variations in inpatient but not OPD use across the USA [14], though a Medicare-GWTG study of 225 participating hospitals found that the early follow-up rate for HF ranged from under

10% to 64% by hospital [6]. The ESC HF pilot registry covering participating centres in 12 European countries only reported mortality and readmission as outcomes [2]. Ours is the first UK study to describe ED and OPD activity. As expected, use of cardiology and the anticoagulant service were common, but we were a little surprised by the large number of appointments for ophthalmology, which varied by age. An increasing amount of eye treatments such as laser photocoagulation now take place in the OPD. The large numbers of older people attending ophthalmology OPDs are added to by large numbers of diabetic individuals with or at risk of eye disease [15], and nearly 1 in 3 of our cohort had diabetes recorded.

Strengths and weakness of this study

England and the other UK countries benefit from national hospital databases like HES, enabling transfers and readmissions to any other NHS hospital to be tracked. With a time lag, records are also linked to death registrations, which we used to account for the competing risk of death in the cumulative incidence plots. As well as the large sample size, using national administrative data avoids the selection bias of clinical trials.

Administrative data also have limitations. A systematic review of studies of the data quality of HES found that for inpatient records the primary diagnosis was correct 96% of the time for studies since 2005 [16]. The accuracy of recording of secondary diagnoses varies by hospital, and the comorbidity frequencies that we calculated are likely to be underestimates despite tracking back to obtain information from previous admissions. Much less is known about ED and OPD records. HES ED counts have until recently regularly been compared against the number of recorded ED attendances in quarterly monitoring (QMAE) returns. In

2010/11, there were 15.8 million attendances reported in ED HES (excluding planned follow-up appointments) compared with 21.4 million reported in QMAE [17]. However, non-submitting walk-in centres and minor injury units account for the vast majority of the shortfall. The paucity of diagnosis information in both ED and OPD records meant that we were unable to estimate reliably which attendances or appointments are primarily for the HF and which are for other problems.

As HES is a hospital database, it lacks information on activity in primary care, the sector in which much management and monitoring of patients takes place. Patients with HF have on average 11 to 13 contacts per year with their GP or other members of the primary care team [1]. Work from Spain suggests that there is also considerable variability in the use of those services and in the management of HF patients by GPs [18]. HF is considered an ambulatory or primary care sensitive condition, one for which hospital admission could be prevented by interventions in primary care. However, practice-level quality of care scores did not correlate with the fall in admission rates in England [19]. As HES would not capture primary care activity, any NICE-recommended *initial* post-inpatient discharge follow-up by the specialist heart failure team that does occur in primary care would be missed. However, in the UK this is uncommon and should not invalidate our use of OPD records.

Our use of an index HF admission simplifies what we intended as a simply descriptive analysis and represents a convenient reference point in time to examine service use [20-22]. As this was their first emergency HF admission for at least three years, we assumed that either they had been stable during that time or they were new HF patients. A more

sophisticated approach using multistate models, for example, could investigate the interrelations between the different NHS contacts.

HES data do not include diagnosis dates or information on where the diagnosis was made. A Canadian study found that half of HF patients have it diagnosed in the ED (14%) or as an inpatient (37%), with the other half mostly in general rather than specialist outpatient clinics [23]; outcomes differed markedly depending on the place of diagnosis.

Lastly, we were restricted to 2009/10 and 2010/11 data because of the unavailability of linked mortality files for more recent years. It will be interesting to repeat this analysis once sufficient data have accrued after the October 2014 NICE guidelines that recommend two-week post-discharge cardiology follow-up.

Implications for clinical practice

Our findings reaffirm both the high mortality and high hospital service utilisation for ED, inpatient and outpatient sectors in patients with heart failure. The England and Wales national audit report, our recent study that combined the audit results with HES [7] and work from outside the UK [6, 24] all showed the benefit of cardiologist input and follow-up. This is now recommended by NICE and the ESC [8, 25] but UK guidelines have changed over time. We studied index admissions from April 2009 to March 2011. At the start of the study period, the guidance to the NHS in England from NICE (issued in July 2003) [26] stated that "patients with heart failure should generally be discharged from hospital only when their clinical condition is stable and the management plan is optimised. Timing of discharge should take into account patient and carer wishes and the level of care and support that can

be provided in the community". There was no mention of care after discharge other than to state that all patients "require monitoring… to include clinical assessment, a review of medication, and serum urea, electrolytes, creatinine and eGFR", with a recommendation that this should take place at least every six months. An update to this guidance was issued during our study period (on 25 August 2010) [27], which reiterated the same advice but added a recommendation that during hospital admission the medical team should seek advice from a specialist in heart failure. Quality Standards related to this guidance were not issued until after our study period (June 2011) [28].

The lack of detailed advice on hospital and transitional care was recognised, and NICE issued new guidelines on the diagnosis and treatment of acute (i.e. hospitalised) heart failure in 2014 [8] and related Quality Standards in 2015 [29] after the period of our study. Four recommendations related to the organisation of hospital and transitional care [8]. All hospitals were to provide a specialist heart failure team based on a cardiology ward and providing outreach services; everyone admitted with suspected heart failure was to have early and continuing input from the specialist team; discharge from hospital and subsequent management in primary care (including ongoing monitoring and care by a multidisciplinary team) should be planned; and a follow-up clinical assessment should be undertaken by a member of the specialist heart failure team within two weeks of the person being discharged from hospital. These recommendations were then endorsed in the new NHS Quality Standards for Acute Heart Failure, issued on 3 December 2015 [29]. It remains to be seen how quickly and consistently these standards will be implemented across the NHS in England. For our study period only 6.7% of index survivors had a cardiology OPD appointment within two weeks of their index HF admission, and only half had one within a

year. Our work suggests that there will need to be considerable organisational change to reach the two-week follow-up target. It will be important to monitor progress against this measure in the future.

Conclusions

Our results confirm that patients with HF often have multiple comorbidities and hence complex medical needs, with a high use of hospital services beyond the index acute admission. Our subgroup analyses by age and comorbidity show notable differences which need to be addressed to meet best practice and the recent NICE and European guidance for specialist outpatient follow-up.

Competing interest statement

All authors have completed the Unified Competing Interest form at www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare that (1) AB and PA have support from Dr Foster Intelligence for the submitted work; (2) No author has any relationships with companies that might have an interest in the submitted work in the previous 3 years; (3) their spouses, partners, or children have no financial relationships that may be relevant to the submitted work; and (4) No authors has any non-financial interests that may be relevant to the submitted work. We have read and understood BMJ policy on declaration of interests and declare the following interests as above.

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Contributor statement

AB and MRC conceived the study. AB and RG prepared and analysed the data. AB wrote the first draft of the manuscript; all authors critically appraised and revised it. AB is the guarantor for the study. All authors had full access to all of the data (including statistical

reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis.

Patient consent form

There are no identifiable patients in this study.

Ethics approval

We have permission from the Confidentiality Advisory Group under Section 251 of the NHS Act 2006 (formerly Section 60 approval from the Patient Information Advisory Group) to hold confidential data and analyse them for research purposes (PIAG 2-05(d)/2007). We have approval to use them for research and measuring quality of delivery of healthcare, from the South East Ethics Research Committee (10/H1102/25).

Role of the study sponsors/funders

The sponsors/funders had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript. We have not been paid to write this article. The authors have independence of research from the funders.

Transparency declaration

The lead author (the manuscript's guarantor) affirms that the manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

Copyright statement

Data sharing

No additional data available

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Figure legends

Figure 1. Cumulative proportion of patients with at least one OPD appointment (any specialty) by number of days since index discharge

Figure 2. Cumulative proportion of patients offered at least one cardiology OPD appointment in the year following the index HF admission by age group

Figure 3. Cumulative proportion of patients aged 80-84 offered at least one cardiology OPD appointment in the year following the index HF admission by number of comorbidities

Tables

Table 1. Characteristics of patients discharged alive from their index HF admission

		Number	%
Age group	18-44	812	1.2
	45-64	7462	10.7
	65-79	24759	35.4
	80+	36815	52.7
Sex	Male	34988	50.1
	Female	34860	49.9
Age group: males	Male 18-44	519	1.5
	Male 45-64	5011	14.3
	Male 65-79	14158	40.5
	Male 80+	15300	43.7
Age group: females	Female 18-44	293	0.8
	Female 45-64	2451	7.0
	Female 65-79	10601	30.4
	Female 80+	21515	61.7
IMD quintile	1 (least deprived)	10260	14.7
	2	13668	19.6
	3	14933	21.4
	4	15638	22.4

	5 (most deprived)	15349	22.0
Living alone		6523	9.3
CABG*		1008	1.4
PTCA*		1913	2.7
CRT*		287	0.4
Other pacing		2491	3.6
Stroke		1550	2.2
Pneumonia		8906	12.8
Ischaemic heart disease		33966	48.6
Dementia		3387	4.8
Arrhythmias		39902	57.1
Valvular disease		18847	27.0
Peripheral vascular disease		6580	9.4
Hypertension		44858	64.2
Chronic pulmonary disease		18184	26.0
Diabetes Mellitus		21480	30.8
Renal disease		16289	23.3
Obesity		3733	5.3
Mental health		6400	9.2

3+ comorbidities		45164	64.7
3+ comorbidities other than hypertension		33562	48.1
Arrhythmias and hypertension		26032	37.3
IHD and hypertension		23830	34.1
IHD and arrhythmias		19741	28.3
Subgroup	0 (neither of the below)	38340	54.9
	1 = Young (<65 years old with <3 comorbidities)	3515	5.0
	2 = Elderly comorbid (aged 80+ with 3+ comorbidities)	23234	33.3
Index LOS (nights)	0-2	14991	21.5
	3-6	17367	24.9
	7-20	28047	40.2
	21+	9443	13.5

Key: * CABG = coronary artery bypass graft; PTCA = percutaneous transluminal coronary angioplasty; CRT = cardiac resynchronisation therapy

Table 2. Top 15 specialties for OPD appointments in year after index HF admission, ranked by total number of appointments

Specialty	Total number of appointments (% of total)	Number (%) patients with appointment	Ranking of specialties based on number of patients attending	% appointments not attended
Cardiology	113398 (24.7)	34702 (49.7)	1	11.9
Anticoagulant services	57090 (12.5)	5489 (7.9)	8	8.2
Ophthalmology	32657 (7.1)	13618 (19.5)	2	13.4
General Medicine	23674 (5.2)	9647 (13.8)	3	10.4
Nephrology	23182 (5.1)	5796 (8.3)	6	10.6
Clinical Haematology	20720 (4.5)	4905 (7.0)	12	8.7
Geriatric Medicine	19230 (4.2)	8393 (12.0)	4	14.0
Respiratory Medicine	17130 (3.7)	7985 (11.4)	5	14.0
Endocrinology	16244 (3.5)	5216 (7.5)	9	12.7
Trauma & Orthopaedics	12538 (2.7)	5750 (8.2)	7	10.9
Urology	9921 (2.2)	4981 (7.1)	11	14.0
General Surgery	9228 (2.0)	5163 (7.4)	10	11.4
Dermatology	8735 (1.9)	3544 (5.1)	14	9.9
Ear, Nose & Throat (ENT)	6507 (1.4)	3670 (5.3)	13	11.7

Gastroenterology	5353 (1.2)	3323 (4.8)	15	14.8

Table 3. Hospital contacts in year after index admission overall and by patient subgroup

	Patients aged <65 and not multimorbid	Patients aged 80+ and multimorbid	All patients
Emergency adms: % with none	58.6	34.5	40.3
Emergency adms: % with 1-2	33.0	48.3	44.1
Emergency adms: % with 3+	8.4	17.2	15.6
7-day emergency readmission rate	4.8	7.5	6.8
30-day emergency readmission rate	14.0	22.0	19.7
365-day emergency readmission rate	33.2	59.5	52.2
Elective adms: % with none	56.1	79.7	71.7
Elective adms: % with 1+	43.9	20.3	28.3
Median and interquartile range (IQR) for inpatient bed days	1 (0 to 6)	4 (1 to 12)	3 (0 to 10)
OPD appts: % with none*	5.9	19.4	14.5
OPD appts: % with 1+*	94.1	80.6	85.5
% with any OPD appt within two weeks of discharge*	35.5	23.8	28.2
% with cardiology OPD appt within two weeks of discharge*	12.6	4.3	6.3

% admitted on same day as attended OPD appt	1.0	0.6	0.7
ED attendances not ending in admission: % with none	76.4	76.4	76.1
ED attendances not ending in admission: % with 1+	23.6	23.6	23.9
% who die within a year of index discharge	9.8	36.6	27.3

* Includes all OPD appointments irrespective of whether attended or not and includes those cancelled by the patient

All comparisons between young and elderly groups have p<0.0001 except for ED attendances not ending in admission (p=0.99)

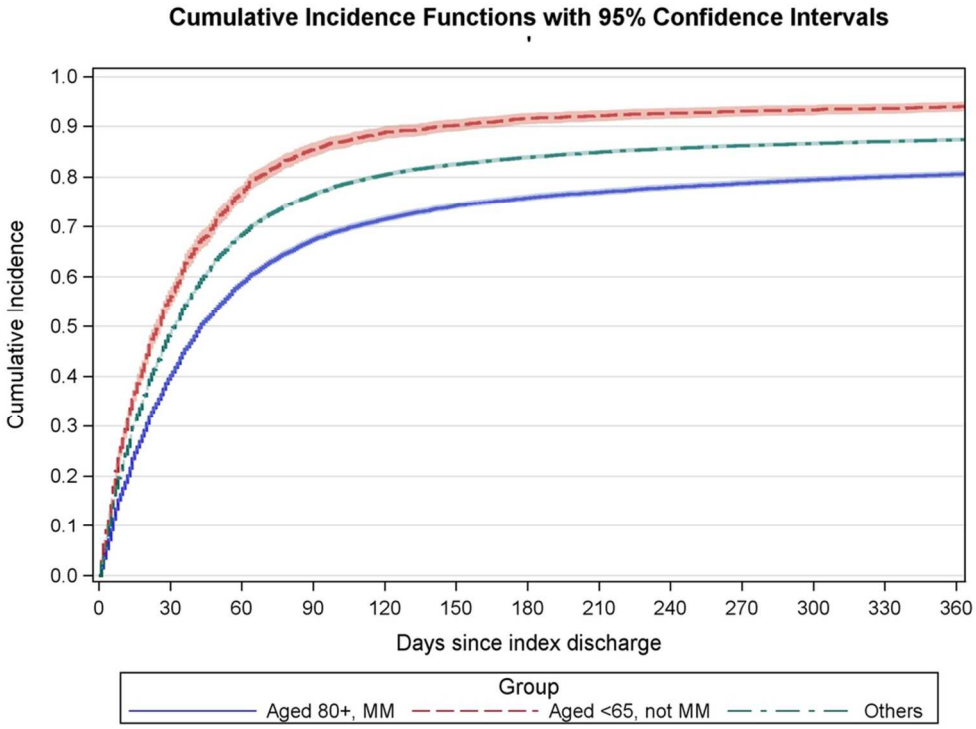

Figure 1
90x67mm (300 x 300 DPI)

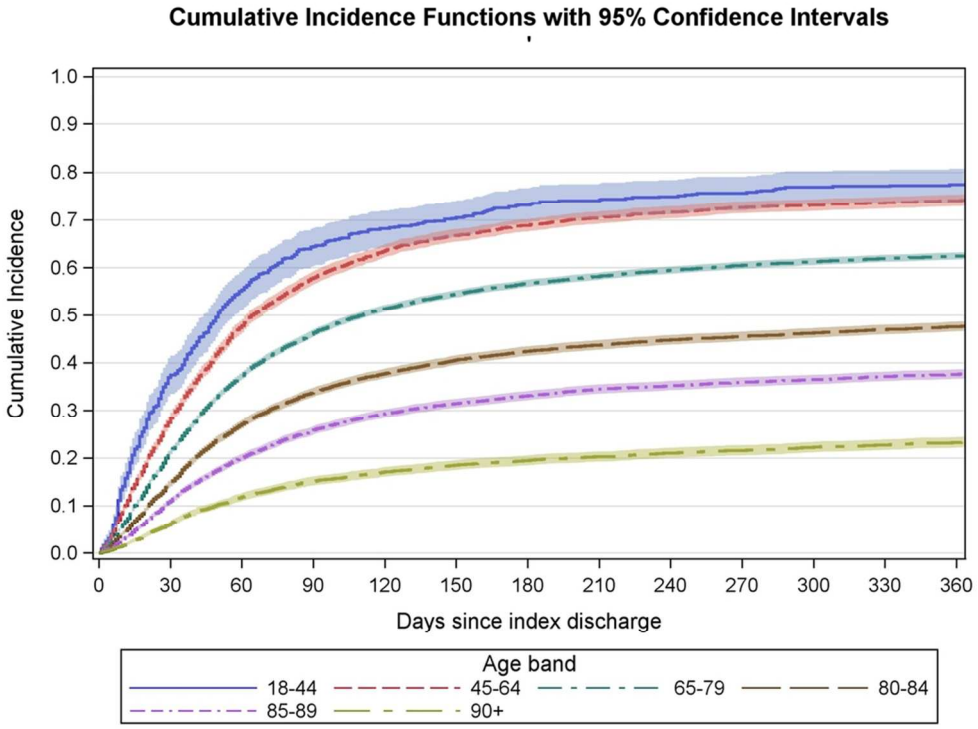

Figure 2
90x67mm (300 x 300 DPI)

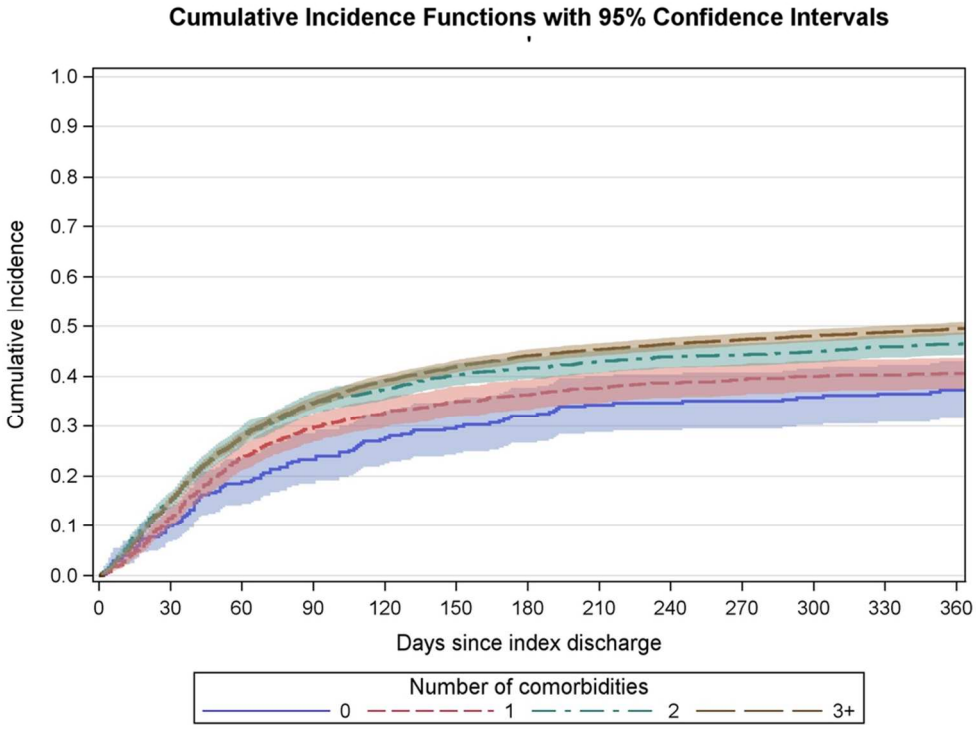

Figure 3
90x67mm (300 x 300 DPI)

Supplementary Table A1. List and descriptions of patient factors used in risk-adjustment regression models

Factor	Codes and/or description (ICD10 unless specified)
Age	Categorised at 18-44 then five-year bands from 45-49 to 85-89, then 90+
Sex	
Carstairs deprivation fifth	Measure of socio-economic status of small geographical area of residence
CABG in year before or during index HF admission	OPCS codes K40, K41, K42, K43, K44, K45, K46
PTCA in year before or during index HF admission	OPCS codes K49, K50, K75
Implantable cardioverter defibrillator implanted in year before or during index HF admission	OPCS codes K590, K591, K592, K593, K594, K596, K598, K599
Pacemaker (not CRT) inserted in year before or during index HF admission	OPCS codes K600, K601, K602, K603, K605, K606, K607, K608, K609, K610, K611,K612, K613, K615, K616, K617, K618, K619
CRT inserted in year before or during index HF admission	OPCS codes K607, K617
OPD appointments missed in year before index HF admission	

OPD appointments attended in year before index HF admission	
Comorbidity flags, all defined using ICD10 codes:	All comorbidity flags were based on information during the index admission or in any admission in previous year
Stroke	I60, I61, I62, I63, I64
Pneumonia	J12, J13, J14, J15, J16, J17, J18
Ischaemic heart disease	I20, I21, I22, I23, I25
Dementia	F00, F01, F02, F051
Arrhythmias	I441, I442, I443, I456, I459, I47, I48, I49, R000, R001, R008, T821, Z450, Z950
Heart valve disorders	A520, I05, I06, I07, I08, I091, I098, I34, I35, I36, I37, I38, I39, Q230, Q231, Q232, Q233, Z952, Z953, Z954
Peripheral vascular disease	I70, I71, I731, I738, I739, I771, I790, I792, K551, K558, K559, Z958, Z959
Hypertension	I10, I11, I12, I13, I15
Chronic lung diseases	I278, I279, J40, J41, J42, J43, J44, J45, J46, J47, J60, J61, J62, J63, J64, J65, J66, J67, J684, J701, J703
Diabetes	E10, E11, E12, E13, E14
Renal disease	I120, I131, N18, N19, N250, Z490, Z491, Z492, Z940, Z992

Obesity	E66
Any mental health condition (except dementia)	F06, F07, F09, then rest of F chapter from F20 onwards
Living alone	Z602

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page reference
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Use of hospital services by age and comorbidity after an index heart failure admission in England: observational study
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Pages 2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5 (End of Introduction)
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5 (end of introduction); pages 6-8 (method)
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 6-7 – Data sources and definitions of cohort and outcomes
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	Page 6 – definitions of cohorts, subgroups and outcomes
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	Not applicable
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 6 – definitions of cohorts, subgroups, outcomes and patient factors. Supplementary Table A1
Data sources/	8*	For each variable of interest, give	Page 6 – data sources

measurement		sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 6 – definitions of cohorts, outcomes and patient factors
Bias	9	Describe any efforts to address potential sources of bias	-
Study size	10	Explain how the study size was arrived at	Page 6 – data sources
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 8 – statistical analysis
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Page 8 – statistical analysis
		(*b*) Describe any methods used to examine subgroups and interactions	Page 6 (study cohort subgroups)
		(*c*) Explain how missing data were addressed	Page 6 – data sources
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	Not applicable
		(*e*) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Table 1; pages 8-9 (results)
		(b) Give reasons for non-participation at each stage	Not applicable
		(c) Consider use of a flow diagram	Not applicable
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Table 1
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable
		(c) *Cohort study*—Summarise follow-up time (e.g., average and total amount)	Page 6 – definitions of cohorts, outcomes and patient factors
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	Page 9 (results)

		Case-control study—Report numbers in each exposure category, or summary measures of exposure	Not applicable
		Cross-sectional study—Report numbers of outcome events or summary measures	Not applicable
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Page 6 – definitions of cohorts, outcomes and patient factors Page 8 – statistical analysis Page 9 (results) Figures 1-3 (stratified by age and comorbidity)
		(*b*) Report category boundaries when continuous variables were categorized	Supplementary Table A1
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not relevant
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Pages 10-11 (subgroup)
Discussion			
Key results	18	Summarise key results with reference to study objectives	Pages 11-12 – Summary of principal findings
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Pages 13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 12 – Comparison with previous work
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 15-16 – Clinical and policy implications
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Pages 17-18 – Funding source and role of funder etc

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.