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Effect of the British Red Cross 'Support at Home' service on hospital utilisation

Research report

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Supporting the care needs of older people is a key challenge faced by health services in the UK today. In the context of an ageing population and with statutory health and social care providers facing constraints on their funding, the role of voluntary sector organisations is set to become ever more important in enhancing the quality of care for individuals.

'Support at Home' is a programme run by the British Red Cross that provides practical and emotional support to older people to help them maintain their independence. One part of this programme supports individuals who are being discharged back to their homes after a stay in hospital. One of the programme's aims is to help prevent potentially unnecessary re-admissions in the weeks following the stay. Such re-admissions are often distressing for the person involved, as well as costly for the health service.

Here we report on an evaluation of the Support at Home service following discharge from hospital. We compared a cohort of people who received support from the Red Cross to a retrospectively selected group of controls who were discharged from the same hospitals. We aimed to test the impact of the Support at Home service by comparing the subsequent hospital use of the Support at Home cohort to that of the matched control group.

Acknowledgements

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The report was undertaken by the Nuffield Trust and commissioned by the British Red Cross, with rights to independent publication retained by the Nuffield Trust.

Key points

- Using data linkage techniques, we evaluated aspects of the British Red Cross Support at Home* service, identifying 1,573 patients referred to the service following an emergency admission to hospital, and a matched control group.
- We analysed data on hospital use in the six months after referral to Support at Home. The Red Cross group had a 19% higher rate of emergency admissions than the control group. Accident and emergency visits were also similarly higher. Non-emergency admissions, however, were 15% lower in the Red Cross group than in the matched control group. There was no significant difference between the two groups in terms of outpatient attendances.
- The total cost of emergency admissions was significantly higher among Red Cross patients than the matched controls during the six months after referral (by £940 per person). Non-emergency costs were significantly lower for the Red Cross group (by £345 per person). Overall hospital costs in the six months following referral were higher for the Red Cross patients than for the controls, but the difference was not statistically significant.
- The risk of a Red Cross patient having a first emergency admission after referral was not significantly different from the control group. This was the case for all types of hospital care.
- Those who received a Red Cross service in one of the seven study sites showed a higher risk of a future emergency admission than the matched controls. In the other six Red Cross service locations we found no significant difference in the risk of a future emergency admission.
- Individuals who received a 'significant service' from the Red Cross (either home visits or phone calls) had an increased risk of future emergency admissions compared with the control group. There was no difference in relative risk of emergency admissions for those who did not receive a significant service.
- Hospital use in the month after referral showed a distinctive pattern. The Red Cross group had almost half of the risk of a non-emergency admission than the control group, and costs of non-emergency admissions were lower by £127 per person. We found no difference between the two groups in other types of hospital care. Overall hospital costs, however, appeared to be significantly lower in the Red Cross group, by £261 per person.

** The British Red Cross 'Support at Home' service was renamed in December 2013. Prior to this date (and during the evaluation by the Nuffield Trust), it was known as the 'Care in the Home' service.*

Find out more online at: www.nuffieldtrust.org.uk/publications/british-red-cross-hospital-utilisation

Contents

1. Introduction

The care needs of older people with complex health and social problems have been widely recognised as one of the most important challenges for health services around the world. They are the focus of a number of national polices (NHS England, 2013). Many of the strategies emphasise the importance of preventive care that reduces the risk of a person succumbing to health crises which can often lead to emergency hospital admissions. Such crises are undesirable for the patient if they can be avoided and are costly in terms of the use of relatively expensive hospital care. There are therefore many ways in which public and voluntary health care sectors are seeking to reduce emergency admissions.

The Support at Home programme at the British Red Cross (referred to as the Red Cross throughout this report) offers short-term practical and emotional support to individuals at home in an effort to help build confidence and to regain independence. The programme comprises a diverse set of services which local teams can use to respond to particular local needs and commissioner priorities. Some Support at Home services provide befriending to individuals, or support to carers. Others work specifically alongside accident and emergency (A&E) teams to prevent people being admitted into hospital from A&E. The programme also includes a palliative care service which supports individuals who are near to death. One of the main Support at Home services, however, offers support to people being discharged home after a stay in hospital, and it is this specific service that is the focus of this report.

“ There are many ways in which public and voluntary health care sectors are seeking to reduce emergency admissions

The Support at Home service primarily employs the use of volunteers to undertake a variety of support interventions. The interventions have the overall aim of helping individuals to remain independent and, where possible, to avoid future unnecessary hospital visits. The interventions themselves may be any of a heterogeneous mix of activities, from accompanying individuals home after discharge, to helping with domestic tasks (making beds and light meals, or helping with practical aspects of bill payments), to offering advice and companionship. An extended list of typical support interventions offered by the Support at Home service is given in Appendix A.

The service may be provided for up to six weeks following discharge from hospital, and can be delivered with a combination of phone calls and home visits (sometimes with phone calls alone). The programme is designed to be responsive, with Red Cross volunteers carrying out whichever activities are deemed to be appropriate with respect to each individual's circumstances.

The referral criteria for recruitment into the Support at Home service vary from area to area. This may be due to particular targets and restrictions put in place by the commissioner of the service (the local authority or NHS organisations). For example, eligibility may be open to all those over certain age; those resident in a specific local authority area; or those deemed to be at risk of re-admission without support. In the hospital sites where Red Cross teams are based, a wide range of individuals are able to refer patients to the Red Cross for support during discharge. These include hospital ward and A&E staff, physiotherapists, occupational therapists, social services, community health services, other support charities or groups, as well as individuals themselves.

The Support at Home service as a whole is geared towards reaching those made vulnerable by their circumstances, and uptake of the service is voluntary. It is therefore likely that service users might be isolated and without robust support networks. According to a recent Red Cross evaluation of its Support at Home services, 40% of service users reported having little or no contact at all with family, friends or neighbours, and of these nearly two thirds said they wanted more contact with people (Joy and others, 2013).

The Nuffield Trust was commissioned by the Red Cross to evaluate aspects of its Support at Home service. The resulting evaluation focused on the impact of hospital discharge Support at Home services on overall hospital utilisation and associated costs. This study was not intended to be a comprehensive evaluation, but instead aimed to:

- exploit existing data and linkage methods, to avoid expensive and time-consuming data collection
- use matching techniques to look for control groups
- use anonymous data – avoiding the need to seek individual consent.

The aim of this study was to use data linkage techniques to test the hypothesis that future hospital use and associated costs were significantly reduced for patients who received hospital discharge Support at Home services, compared with a retrospectively matched control group.

This is an approach that we have used in more than 30 evaluations of community-based interventions, for example in a study of 'virtual wards' and an evaluation of the Marie Curie Nursing Service (Bardsley and others, 2013).

2. Methods

2.1 General approach

The aim of this study was to evaluate the potential impacts of the Red Cross Support at Home service by selecting a group of matched controls from the hospitals in which the Red Cross offered this service. The subsequent use of hospital care of the matched control group was compared with people who were referred to the Red Cross Support at Home service.

Our primary outcome measures included hospital use and costs following the first referral to the Support at Home service. We focused on four types of hospital contacts: urgent and unplanned ('emergency') inpatient admissions, non-emergency admissions (planned inpatient care), outpatient attendances, and A&E visits.

A pre-study calculation indicated that we would need to study approximately 2,100 Support at Home patients. This was on the assumption that:

- we wanted to detect a relative change in the rate of emergency hospital admissions over one year of 20% (should that order of change have occurred), at power 90% and two-sided p-value < 0.05
- in the absence of receiving Support at Home, patients would experience 1.0 emergency hospital admissions per year (standard deviation 1.85)
- 90% of Support at Home patients would be linked to the hospital administrative datasets used in this study.

With fewer people, only larger changes in rates of emergency admissions would be detectable (for example, approximately 1,350 people would give us power to detect a 25% change). We note, however, that these power calculations were done assuming that it would be possible to follow up patients for 12 months, whereas it was subsequently found that only six months' follow up was available.

The evaluation used pseudonymised datasets from sources outlined below. We received confirmation from the Ethics and Confidentiality Committee of the National Information Governance Board (NIGB) that individual consent was not required from participants for us to use pseudonymous data.

2.2 Datasets

Red Cross service activity dataset

The Red Cross provided the Nuffield Trust with a dataset consisting of records of individuals referred to the Support at Home service within nine sites in England. These referrals dated from January 2007 to July 2012. Table 2.1 shows basic information about these sites. All but one of the sites (site 1) were based in an NHS trust site in London.

Table 2.1. Red Cross Support at Home sites initially available for this study

Red Cross site label	Outer/inner London	Location of site	Earliest (last) dates of referrals collated for analyses
1	Not London	Community-based service	Late 2010
2	Outer	Acute trust	Late 2009
3	Outer	Acute trust	Late 2009
4	Inner	Acute trust	Late 2011
5	Inner	Acute trust	Late 2011
6	Inner	Acute trust	Late 2010
7	Outer	Acute trust	Early 2007 (last referral in late 2010)
8	Inner	Community hospital	Late 2011
9	Outer	Acute trust	Early 2007

For each referral to the Support at Home service, the dataset recorded information about the method of delivery of interventions (limited to groups of home visits, phone calls only, palliative care, or no substantial service), alongside additional information about the number of phone calls and visits, and dates of last visits and phone calls. Although some patients had been referred into Support at Home multiple times, we restricted our attention to hospital use following the first referral.

The Nuffield Trust received no person-identifiable information from the Red Cross. However, we received a study ID that was also provided to the NHS Information Centre for Health and Social Care (IC) for the purposes of linking patient records to hospital activity data (see section 2.3 below).

Hospital Episode Statistics

Our analyses made use of inpatient, outpatient and A&E Hospital Episode Statistics (HES) datasets. HES is a national database that covers all NHS-funded secondary care in England. The HES data in this project spanned the period January 2005 to October 2012.

Office for National Statistics mortality data

For this project, we used information on the date of death (available up to end August 2012) for all those who received Red Cross care and for the controls. This was obtained from the Office for National Statistics (ONS) HES-linked mortality record, which contains death information for every individual who has had a hospital contact in England since 2000. The Nuffield Trust holds approved researcher status with the ONS, and received approval to use HES-linked mortality data in this project.

2.3 Data linkage

In addition to the service activity dataset provided directly to the Nuffield Trust, the Red Cross supplied a second dataset of personal demographic information to the

Trusted Data Linkage Service (TDLS) at the IC[1]. This dataset consisted of a study ID generated by the Red Cross and the name, sex, date of birth, NHS Number (rarely, when available), address and postcode for those who were referred to the Red Cross Support at Home service in nine sites in England.

The IC used these data to attempt to trace NHS Numbers for the entire cohort via the Personal Demographics Service (PDS). Once the NHS Number tracing was complete, the IC linked the NHS Numbers to the identifiers used in the HES datasets. The IC then provided the Nuffield Trust with a pseudonymous mapping from study ID to HES ID for each participant (where an NHS Number and HES ID could be found). This method preserved participants' anonymity by ensuring that the Nuffield Trust did not have access to information that would allow individuals to be identified. However, it did allow us to link the HES ID to the service activity data already provided.

The IC also provided us with the Lower Super Output Area (LSOA) of residence of the successfully traced participants, which allowed for linkage to area deprivation data.

2.4 Red Cross patients and selection of controls

Red Cross Support at Home service users

As previously stated, the initial Red Cross cohort consisted of people who had received a Red Cross Support at Home referral from January 2007 to July 2012, managed by one of nine different Red Cross sites. We focused our attention on a subset of these sites, in order to study a group of interventions that were as similar as possible. This was important as sample size constraints meant that we needed to aggregate several of these interventions together when conducting the analysis.

The majority of the Support at Home services were provided for people on the event of a discharge from an inpatient hospital admission. Therefore, we excluded the following:

- A community-based service (site 1) that differed from the other eight services, which were based in hospitals. We did not have sufficient data to evaluate this Red Cross service separately, so we excluded it from further study.
- A site (site 8) that was based in a local community hospital with no inpatient hospital services and was, for similar reasons, also excluded from the study.
- A small group of individuals who were referred to a palliative care service provided by the Red Cross in site 9.

In the remaining seven sites, where we were able to identify Support at Home service users as inpatients prior to referral, we found that a large majority (over 92%) had been originally admitted to hospital in an emergency. We therefore chose to focus the evaluation on just these patients, excluding those who had been referred following non-emergency (planned) admissions. This helped standardise the characteristics of the patients in the study, making it easier to find matched controls.

1 In April 2013, the NHS Information Centre for Health and Social Care (IC) ceased to exist. Its functions, including those of data linkage, transferred to the Health and Social Care Information Centre (HSCIC), an executive non-departmental public body.

After data linkage of Red Cross data to NHS hospital data, a series of cleaning steps were applied to the dataset.

In site 6, Support at Home referral dates were only provided to the nearest month. To be eligible for inclusion in the study we therefore required Support at Home cases in site 6 to have had an emergency admission that was continuing on any day of the month of referral.

In the other sites we found that only 66% of individuals had an identifiable emergency inpatient stay in the expected hospital on the day of referral to the Red Cross, but that over three quarters had had an unplanned stay on the day, or in the two weeks prior to referral. Therefore, in order to be eligible for inclusion in the study, we required that Red Cross cases in these sites should have had an emergency admission stay in hospital that was continuing on the date of referral or that had ended a maximum of 14 days before referral.

We excluded a small group of people under the age of 45, as the potential control group for these individuals was comparatively very large.

Matched controls

As potential control individuals, we selected patients who had had an emergency hospital admission at the same hospital trusts during the periods of time in which the Red Cross service was being offered (Table 3.3, page 19). Although we could have selected control patients from other hospital trusts in England, the approach using local controls was thought to reduce the risk of bias. For example, it helped to standardise measurement of, for example, coding practices in HES, which vary across the country (Spencer and Davies, 2012).

Whilst the Red Cross service may have been offered only to people within specific hospital sites or even wards, this location information was not generally available to us, so we could not select potential controls from the same specific sites or wards as Red Cross patients.

A small number of exclusions were applied to the pool of possible controls before matching took place to make the group more comparable, in broad terms, to the Red Cross cohort. We removed those aged under 45 years, and those who were not discharged home (or to their usual place of residence) after the emergency admission. This final step removed individuals whose stay in hospital ended in a transfer for continued treatment elsewhere, in addition to those who had died.

From the group of potential controls, we selected a matched subset that was similar to the Red Cross patients in terms of a wide set of variables that we could observe. In the ideal situation, we would have known why some patients received Red Cross care and others did not, and then we would have selected the matched controls on the basis that they had the characteristics that were used to identify cases as being eligible for Red Cross care (Rubin, 2010). However, these criteria are not necessarily captured by information recorded in HES, so instead we used proxies. We matched cases and controls individually on a range of baseline variables, including demographic, diagnostic and prior hospital use variables.

We calculated baseline variables at the date of discharge following the emergency admission that made a patient eligible for this study. This date is referred to in this report as the 'study index date', while the admission spell that concludes with this discharge is referred to as the 'index spell'. We did not, therefore, directly use the referral date recorded in Red Cross operational data and all references to the referral date (except where stated otherwise) refer to the index date. The advantage of our approach was that it standardised the calculation of baseline variables between intervention and potential control patients, and allowed us to use all of the information attached to the indexed emergency admission. However, we assumed that the patient received the service from the Red Cross just before discharge.

Where a control individual had more than one emergency admission during the study periods, each emergency admission was available as a possible control spell. Baseline variables were created at each of the discharge dates.

The baseline variables included the following key prognostic variables (Billings and others, 2006):

- age and sex
- area-level socioeconomic deprivation score (Index of Multiple Deprivation (IMD) 2010 score for the LSOA of the postcode)
- number of emergency admissions before the index date
- number of outpatient attendances before the index date
- number of chronic conditions[2]
- length of the index (referral) spell
- recorded health care diagnoses.

The variables for recorded health care diagnoses were constructed using diagnoses recorded on hospital admissions in the two years preceding the study index date (note that this included diagnoses recorded on the index spell itself) and both primary and secondary diagnoses. Deprivation scores were linked by the LSOA of residence.

After constructing the baseline variables, we proceeded with the matching. This aimed to select, from the set of potential controls, a subgroup of matched controls on the basis of having similar baseline variables to the intervention group. The matching process was done separately for each site, so that control patients were selected from the same site. We were aware that it might not be possible to obtain perfect balance on all variables, but some were more important to balance than others – for example those known to be predictive of future emergency admissions (Billings and others, 2006) were a priority. Therefore, we proceeded iteratively starting with variables describing (but not limited to) age, number of chronic conditions, number of prior emergency admissions, and selected additional matching variables (prior history of specific diseases, length and primary diagnosis of referral spell, etc) to more closely ensure the control group characteristics reflected those of the Red Cross service users.

2 From a list consisting of: sickle cell anaemia, diabetes, hypertension, congestive heart failure, COPD (chronic obstructive pulmonary disease), ischaemic heart disease, asthma, angina, cerebrovascular disease, arthritis or other connective tissue disorder, and renal failure.

Formal statistical tests are not recommended to judge the adequacy of matching (Imai and others, 2008). Instead, assessment of balance was based on the 'standardised difference', defined as the difference in means divided by the pooled standard deviation (Austin, 2008). Standardised difference of greater than 10% was taken as implying substantive difference between groups (Normand and others, 2001). However, as the distribution is important as well as the mean, we also compared the intervention and matched control patients in terms of the distribution of continuous baseline variables, using empirical quantile-quantile plots.

Matches were selected using genetic matching (Sekhon and Grieve, 2012), which is a computer-intensive search algorithm that can produce more closely-matched control groups than more traditional approaches such as propensity scoring (Rosenbaum and Rubin, 1983). One control was selected per intervention patient. Controls were selected without replacement so that the control group would consist of unique admission spells.

2.5 Hospital costs

For each intervention patient and matched control we estimated all hospital costs in the six months following the index date. Costs were taken from the Payment by Results (PbR) national tariff or Reference Costs[3], and so do not directly reflect the costs paid by commissioners.

Inpatient spells

Admitted patient care spells were primarily costed on a Healthcare Resource Group (HRG) basis using the 2010/11 mandatory and non-mandatory national tariffs. Where national tariff prices were not available, 2007/08 national Reference Costs (adjusted for inflation) were used, as they formed the basis of the 2010/11 national tariff. If neither of these sources provided costs for a HRG, average specialty costs were applied. The spell cost was then converted to a daily figure, and this daily amount was summed over the number of days within the reporting period covered by the spell.

Critical care costs were included and were modelled rather than applied directly due to concerns about the completeness of the Critical Care Minimum Data Set (CCMDS). The rate of critical care utilisation by HRG was derived from HES records for 2005/06, prior to the introduction of CCMDS. This rate of critical care days per ordinary care days was then applied to activity in the HES inpatient datasets. Critical care costs were estimated using national Reference Costs as outlined above.

Outpatient attendances

We only included outpatient appointments that were attended by the patient. As with inpatient costs, prices were either taken from the 2010/11 national tariff where there was a mandatory HRG or treatment specialty price, or otherwise derived from the 2007/08 Reference Costs. Costs of additional payments beyond those of the standard HRG (from so-called unbundled activity) were included where applicable.

Radiotherapy, chemotherapy and some high-cost drugs generate an unbundled HRG but are excluded from the national tariff and in 2010/11 did not have a non-mandatory tariff. These elements (particularly the former two) are likely to represent

3 Reference Costs are the unit costs to the NHS of providing specified types of care. They are submitted by NHS providers and form the basis of the PbR national tariff.

a significant proportion of the costs of care for people with cancer. In order to capture these costs, we applied the 2007/08 Reference Costs (adjusted for inflation) for all unbundled HRGs whose costs were not included in the spell or attendance core HRG price as set out in PbR guidance (Department of Health, 2010).

Accident and emergency attendances

A&E visits were all costed using the 2010/11 national mandatory tariff. This provides a limited set of costs, based on the version 3.2 HRG code of the visit.

2.6 Statistical methods

As previously stated, this study aimed to assess the impact of the Support at Home service on hospital use. However, rates of hospital use can be assessed in several different ways. In this study, our primary outcome measures were two-fold:

A) Per person rates (and costs) of emergency admissions and other hospital activity in the six months following referral to the Support at Home service. This assessed differences in the average number of admissions from hospital discharge to six months.

B) Hazard ratios denoting the relative risk of a first emergency admission. This addressed a different question, namely about whether the Support at Home service delayed re-admission to hospital.

The two analyses differed in a number of ways. For example, as the first analysis required six months of follow up, it could only be performed for a subgroup of patients. In contrast, it is possible to calculate hazard ratios for people with very short periods of follow up.

After having shared details of primary results and in response to requests from the Red Cross, we carried out further analyses to investigate differences in the relative use of hospital care in the first few weeks after referral. First, we focused on hospital use in the 30 days after the index date. Second, we looked at the risk of hospital contacts during and after the periods in which Support at Home services were known to have been provided to individuals.

Rates and costs of hospital use

When testing for an impact on rates of hospital use (A above), we used multivariable Poisson regression models. The advantage of this approach was that it adjusted for residual differences (after matching) between intervention and matched control patients in terms of age, deprivation, sex, number of chronic conditions, a series of morbidity groupings and diagnoses associated with ageing, numbers of prior emergency and outpatient attendances.

We also adjusted for residual differences in various properties of the indexed emergency admission: length, date, and the treatment specialty and primary diagnosis of the initial episode of care. These models were only used for pairs of Red Cross and matched control patients with at least six months of follow-on data from hospital discharge (that is with discharge at least six months before the most recent HES data on 31 October 2012).

Differences in hospital costs were analysed using ordinary least-squares regression, adjusting for the same residual differences as those listed above and for the same group of Red Cross cases and controls.

Regression analyses contained random effects at the level of the Red Cross-matched control pair, to account for the paired nature of the data.

Risk of event analyses

The analysis of the time to first emergency admission (B above) could be done on the whole cohort of Red Cross patients and matched controls. To begin with, graphical analysis of time-to-event variables was done using Kaplan-Meier curves (Kaplan and Meier, 1958). These showed the proportion of patients who had not experienced a further emergency admission over a period of time following the initial hospital discharge.

In addition, we present hazard ratios obtained by Cox regression (Cox and Oakes, 1984). These hazard ratios describe the relative risk of an outcome (for example emergency admission) occurring in some interval conditional on an individual having survived to that time. The analysis was adjusted for residual differences in baseline variables between intervention and matched control groups.

Risk of emergency admission subgroup analyses

We assessed whether the hazard ratio for emergency hospital admission varied between groups receiving home visits or phone visits, versus those receiving no significant service. Subgroup analysis was also done by site. Control individuals were assigned to the same subgroups as their Red Cross cohort paired member.

Further analysis of the period shortly after Red Cross Support at Home referral

In order to better understand the impact on hospitalisation and associated costs of the Support at Home service, the Red Cross asked for further analyses to explore differences in the shorter term immediately following referral to the service.

Therefore, we repeated the analysis of hospital rates and costs described above, but included activity only in the first month after referral to the Support at Home service. This was carried out on a group of pairs of Support at Home and matched control patients with at least 30 days of follow-up data from the index spell hospital discharge. As well as repeating the Poisson analysis, we also repeated the analysis of hazard ratios, this time censoring all data after 30 days so that only hospital activity in this period was accounted for.

Finally, we examined differences in hospital utilisation separately during the period when patients were actively receiving home visits or telephone calls, and in the period following the end of the home visits and telephone calls. We used the Red Cross service activity data to define the date at which the Support at Home service ceased, by taking the latest of either the final visit date or the final phone call date. We used this date to determine hazard ratios in two periods – in the period during which a service was being received by individuals, and in the period after discharge from the Support at Home service. The first of these was calculated by censoring hospital data at the date of discharge from the Red Cross service. The second was calculated by looking at hospital activity occurring after date of Red Cross discharge relative to this day of discharge. The effective date of discharge used for matched controls was defined by the length of the Support at Home service received by the paired Red Cross individual.

3. Results

3.1 Red Cross Support at Home cohort

Data linkage and cleaning

The Red Cross supplied records of 5,076 people to the NHS IC, however only 70% could be linked to a HES ID, leaving 3,528 available for the analysis.

A series of cleaning steps were applied to remove records with missing or inconsistent data (Table 3.1). Following these steps, there remained 1,573 individuals in the final Red Cross cohort.

Table 3.1. Data cleaning process for creating the final Support at Home study cohort

Description	Number of patients excluded	Number remaining in cohort
People (unique person IDs) in Red Cross activity file	–	5,076
People receiving service from sites 1 or 8 (not acute trust-based)	985	4,091
People receiving palliative care service	145	3,946
People who could not be linked to a HES ID	1,240	2,706
People with an unknown (or invalid) Support at Home service referral date	145	2,561
People whose HES ID mapped to two or more Red Cross ID individuals	74	2,487
People with no emergency inpatient spell on day or two weeks prior to referral (or in same month; site 6), in expected hospital	582	1,905
People aged under 45 years	30	1,875
People who died in hospital or who were not discharged home (or to usual place of residence)	175	1,700
People whose referral spell was a planned, rather than emergency, admission	127	1,573
Final cohort for analysis		1,573

Cohort characteristics

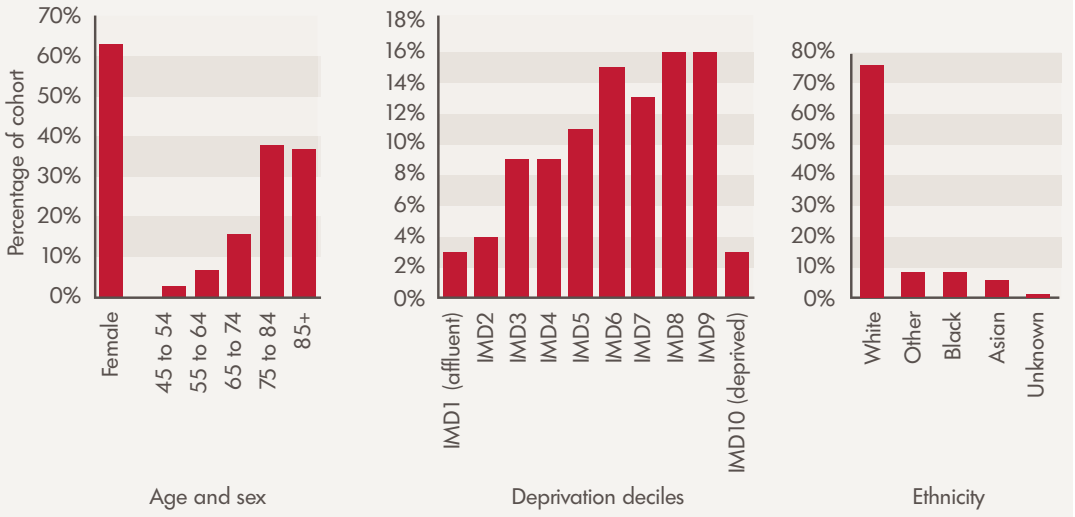
Table 3.2 and Figure 3.1 summarise some key characteristics of the Red Cross cohort. The average age of patients was 79.5 years (standard deviation 10.7 years), with 62.7% being female. The length of the index spell (that is, the emergency spell associated with the Support at Home referral) was an average of 17.7 days (standard deviation 20.7 days).

Table 3.2. Characteristics of Red Cross Support at Home cohort

Measure	Mean (standard deviation)
Age (years)	79.5 (10.7)
Aged 85+	37.4%
Female	62.7%
Resident in most deprived quintile of IMD	19.3%
Ethnic group white categories	76.9%
Number of chronic conditions	2.2 (1.6)
Length of index (referral to Red Cross) spell in days	17.7 (20.7)

N=1,573

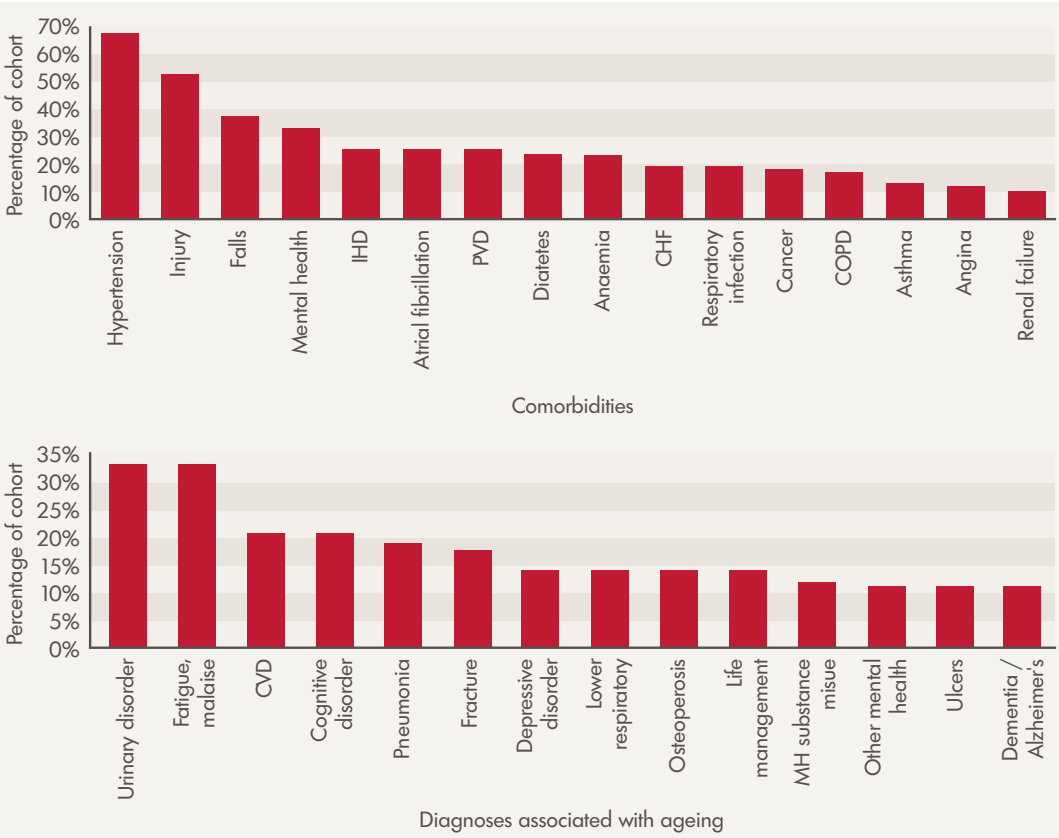
Figure 3.1. Demographic characteristics of Support at Home cohort



N=1,573
IMD: Index of Multiple Deprivation

Figure 3.2 summarises the clinical characteristics of those who were referred to a Support at Home service. The most common diagnoses included hypertension (66.8%), injuries (51.9%) and falls (37.4%). Conditions associated with ageing were relatively common, with 34.2% of the cases having had a hospital admission where a urinary tract infection was recorded as a diagnosis, and 21.0% having cerebrovascular disorders and cognitive disorders.

Figure 3.2. Clinical characteristics of Support at Home cohort (N=1,573)

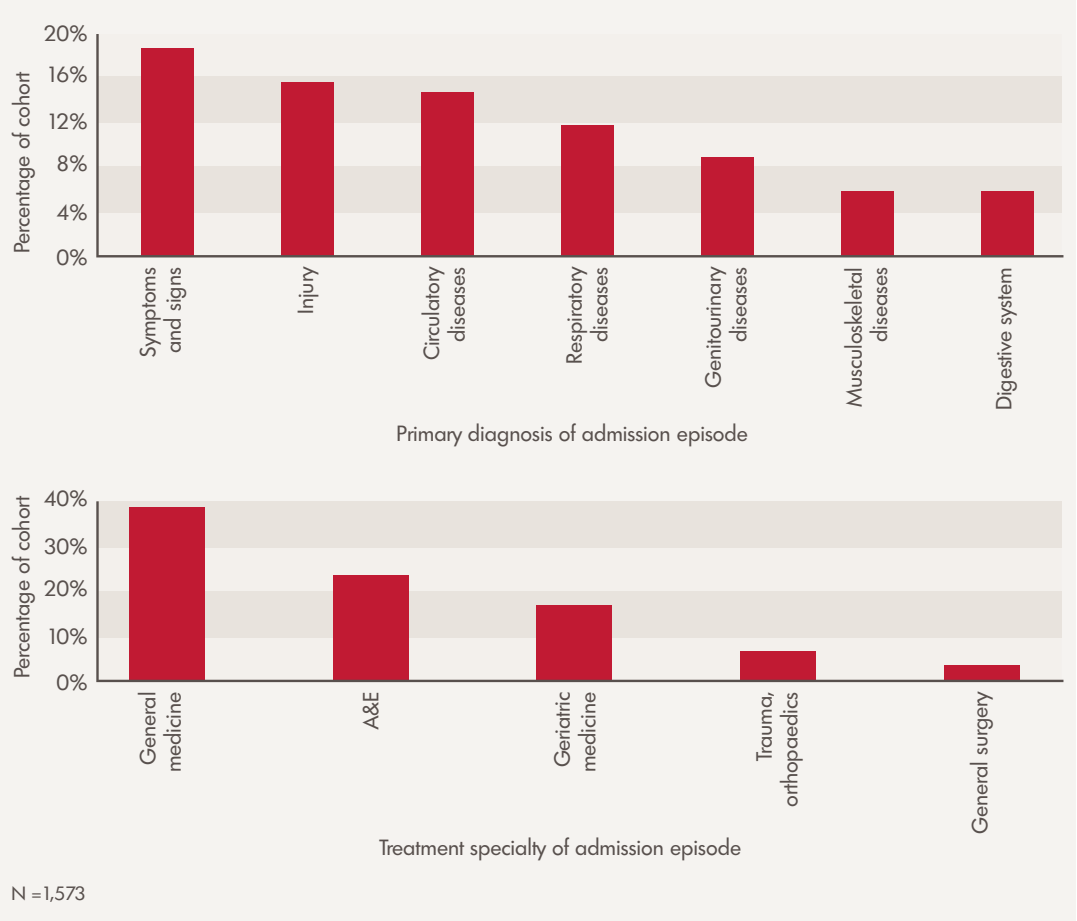


N=1,573
*CHF: Congestive heart failure; CVD: Cardiovascular disease; IHD: Ischaemic heart disease; PVD: Peripheral vascular disease; MH: Mental health.

Characteristics of the index spell

Figure 3.3 displays key characteristics of the hospital spell identified as that which prompted the Red Cross Support at Home referral (that is, the index spell). The most common primary diagnosis (this can broadly be taken to be the reason for the admission) was 'signs and symptoms' (18.7%; this most commonly comprises senility, syncope and collapse, unspecified chest pain and other symptoms). The next most common primary diagnoses were injuries (15.5%) and circulatory conditions (14.6%). The most common hospital specialties under which initial treatment was given were general medicine (39.2%), A&E (24.0%) and geriatric medicine (17.4%).

Figure 3.3. Index (referral to Support at Home) spell: most common primary diagnosis and treatment specialties of Support at Home cohort



Cohort characteristics by site

Table 3.3 outlines the characteristics of the study cohort for each of the seven remaining sites. Site 9 provided the largest number of patients (442, or 28.1%).

Site 6 had the youngest individuals on average (mean age 77.6) in addition to having the most equal balance of genders (56.6% female). Patients in site 2 were the oldest on average (mean age 81.1).

Individuals in the Red Cross cohort in sites 5 and 6 lived in the most deprived areas, and were more likely to be of a non-white ethnic group. In addition, the individuals in site 5 had the highest number of chronic conditions per person (2.6 versus 2.2 for all sites (both groups having standard deviations of 1.6)).

The mean length of the index spell in site 9 was long compared with other sites (29.3 days versus 17.7 days average for all seven sites).

Table 3.3. Characteristics of Support at Home cohort

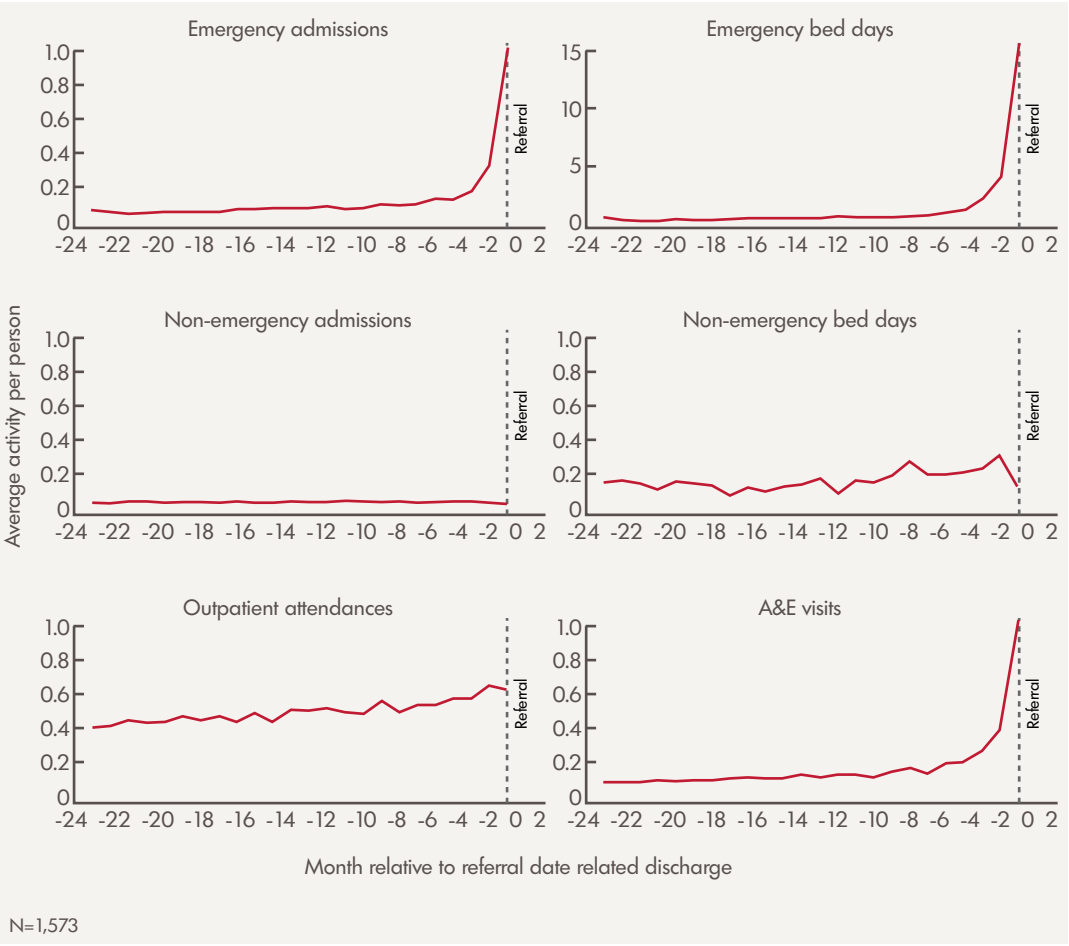
Measure	Mean (standard deviation)						
Red Cross Site	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 9
Number of people	269	156	79	111	364	152	442
Earliest referral (month)	Sept 2009	Dec 2008	Oct 2011	Nov 2011	Nov 2010	April 2007	April 2007
Last referral (month)	June 2012	May 2012	July 2012	July 2012	July 2012	Sept 2010	May 2012
Age, years	81.1 (9.4)	80.3 (10.0)	79.6 (11.7)	80.0 (10.5)	77.6 (11.6)	79.7 (9.6)	79.6 (10.9)
Aged 85+	41.6%	40.4%	35.4%	38.7%	31.6%	36.8%	38.9%
Female	59.9%	64.7%	75.9%	68.5%	56.6%	61.2%	65.4%
Resident in most deprived quintile of IMD	3.3%	1.3%	8.9%	43.2%	42.3%	2.0%	18.3%
Ethnic group white categories	74.0%	87.8%	83.5%	69.4%	69.2%	72.4%	83.3%
Number of chronic conditions	2.3 (1.6)	2.1 (1.5)	2.1 (1.6)	2.6 (1.6)	2.2 (1.7)	2.3 (1.6)	1.9 (1.6)
Length of index spell in days	12.2 (12.4)	11.3 (11.7)	17.4 (22.3)	16.0 (15.3)	10.2 (15.3)	19.8 (27.6)	29.3 (23.8)

N = 1,573

What was the pattern of hospital use before receiving Red Cross care?

Figure 3.4 plots the average hospital activity per person by month for the 24 months before the index date. The last month therefore includes the admission that resulted in being referred to Support at Home. The pattern of hospital use is characterised by fairly stable (low) rates of non-emergency admissions and bed days, and gradually rising rates of outpatient attendances. In the month prior to the index date, emergency admissions and bed days and A&E visits are unsurprisingly high. But, before this, emergency activity had been rising fairly steadily before accelerating in the final three months.

Figure 3.4. Hospital activity in the two years prior to Support at Home service



3.2 Matching

Characteristics of Red Cross patients and matched controls

There were 297,488 available spells in the control pool (belonging to 172,359 potential control individuals).

Before matching, there were a large number of significant differences in the baseline variables between the groups (see Appendix B). Compared with the potential controls, those who received Red Cross Support at Home service were more likely to be women (62.7% versus 51.3%) and older (mean age 79.5 years versus 70.0). There were particular differences in the number of the very oldest (85 years and over), which made up of 37.4% of Support at Home patients, but only 17.9% of potential controls. They were also diagnosed with a larger number of chronic conditions on average (2.17 versus 1.78). Support at Home patients were much more likely to have had falls than potential control patients (37.4% versus 18.9%).

After matching, the controls and Support at Home patients were very much more similar in terms of demographic, morbidity and prior hospital use variables (see Table 3.4, and Figures 3.5 and 3.6). For example, both groups had a mean age of 79.5, and had experienced 2.3 emergency hospital admissions in the year before the index date. While there are small differences in demographic and clinical characteristics of the

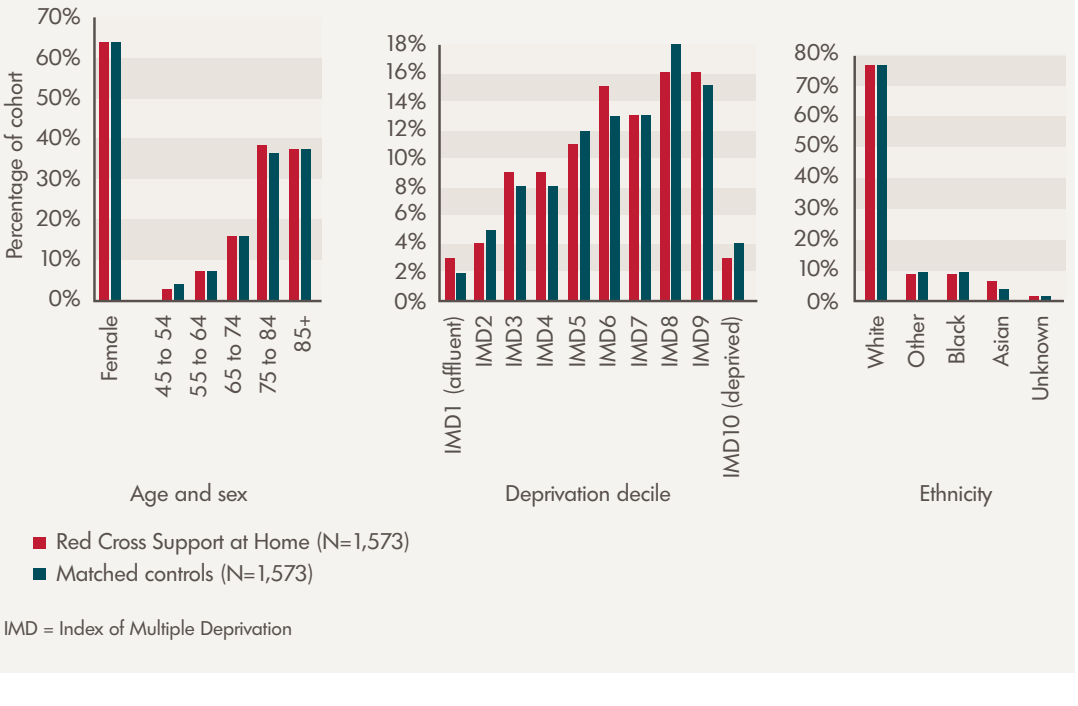
cases and matched controls, only two standardised differences remained greater than 10% (see Appendix B). These related to paralytic syndromes and musculoskeletal and connective tissue diseases.

Table 3.4. Characteristics of Red Cross cohort and matched controls

Measure	Mean (standard deviation)		Standardised difference
	Red Cross Support at Home	Matched controls	
Age (years)	79.5 (10.7)	79.5 (10.3)	0.1%
Aged 85+	37.4%	36.6%	1.8%
Female	62.7%	62.8%	0.3%
Resident in most deprived quintile of IMD	19.3%	19.1%	0.6%
Ethnic group white	76.9%	77.1%	0.6%
Number of chronic conditions	2.2 (1.6)	2.2 (1.6)	0.7%

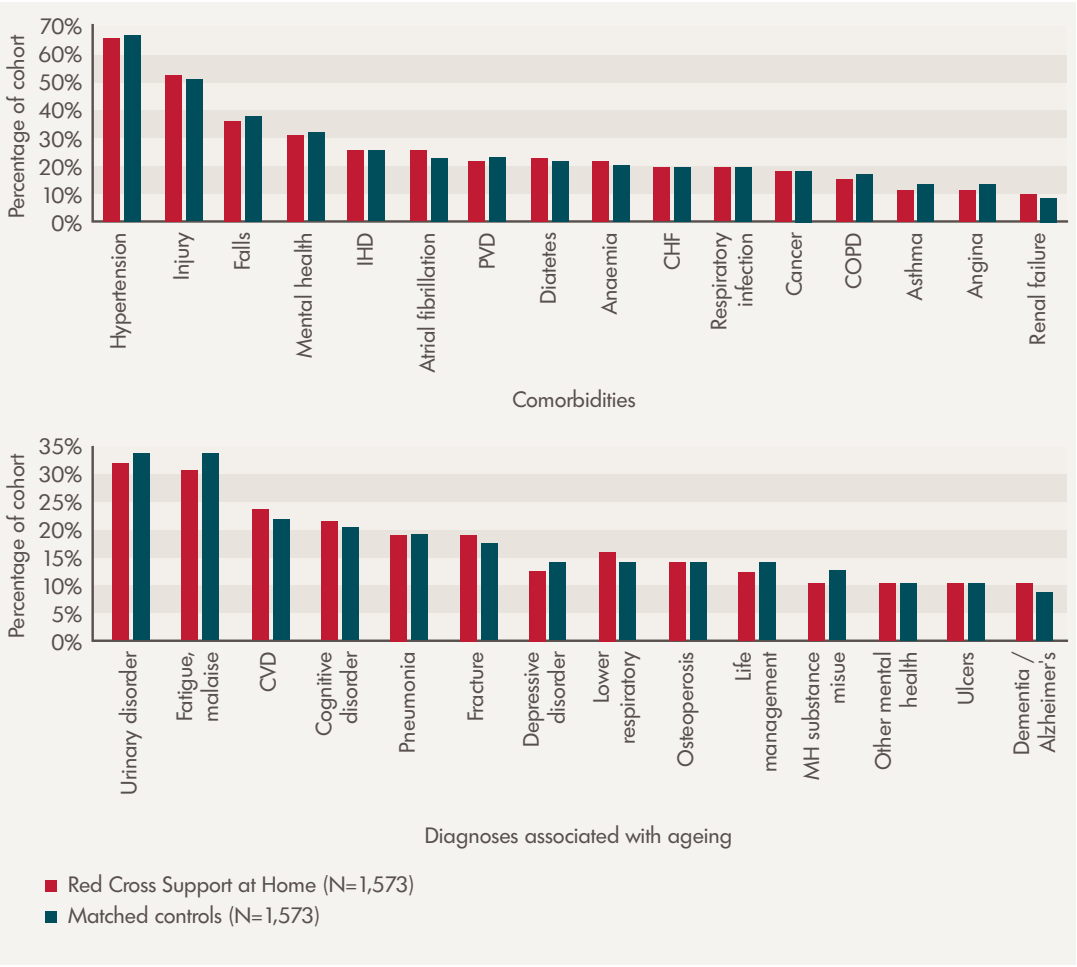
N=1,573 in each group

Figure 3.5. Demographic characteristics of Support at Home cohort and matched controls



IMD = Index of Multiple Deprivation

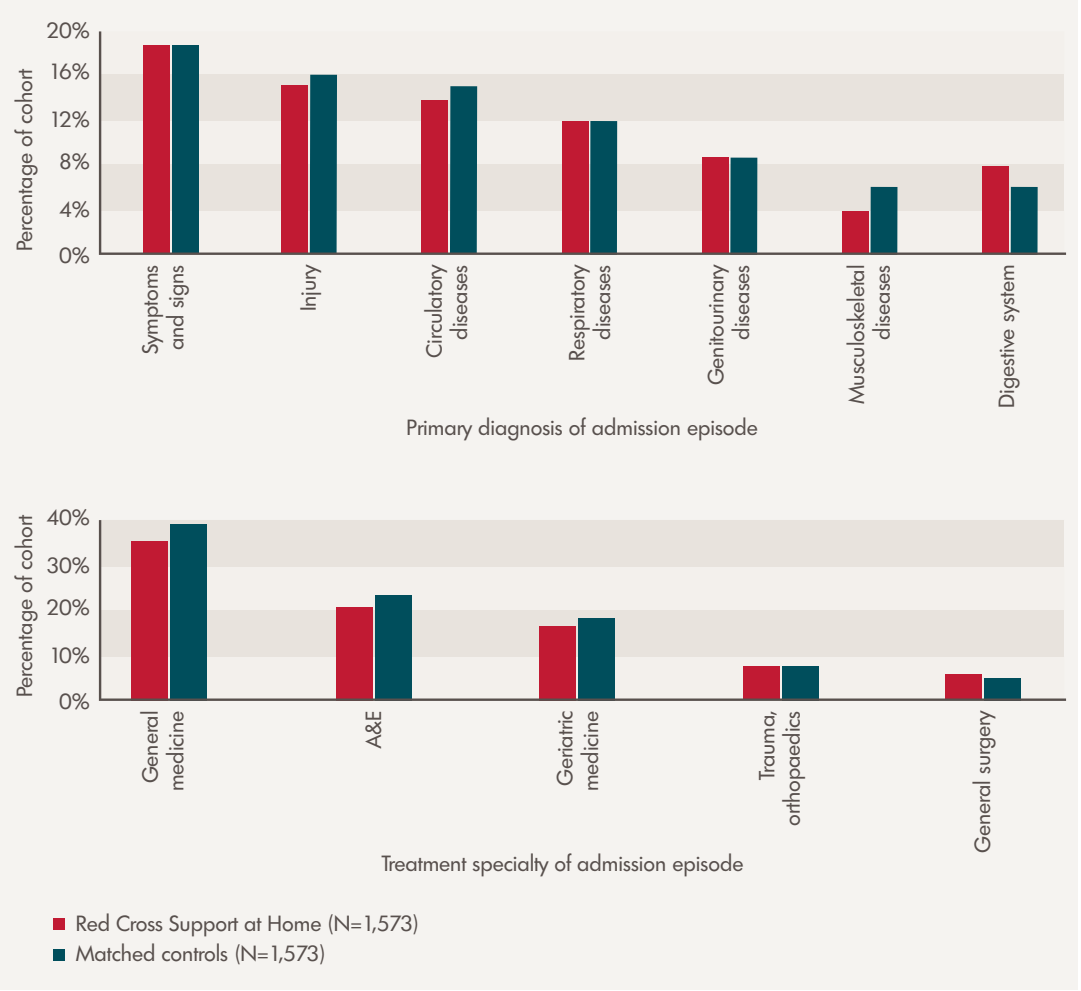
Figure 3.6. Clinical characteristics of Support at Home cohort and matched controls



Characteristics of the index spell, Red Cross patients and matched controls

In terms of the primary diagnosis and the treatment specialty of the index admission, the Support at Home cases and controls matched well on the whole (Figure 3.7), although musculoskeletal primary diagnoses and general medical specialties had standardised differences near the 10% level (see Appendix B).

Figure 3.7. Index spell properties: most common primary diagnosis and treatment specialties. Support at Home cohort and matched controls



Prior hospital use and costs of Red Cross cohort and matched controls

The Support at Home service users and controls were very well matched in terms of all types of hospital use in the year prior to the index date, although those who subsequently received Red Cross care had slightly fewer elective admissions (Figure 3.8). However, the size of these differences was small (see Appendix B).

Although we did not include cost variables in the matching, Support at Home patients and controls were very similar in terms of hospital costs across all types of care in the year before the index date (Figure 3.9).

Figure 3.8. Hospital activity for Support at Home cohort and controls, two years preceding index date

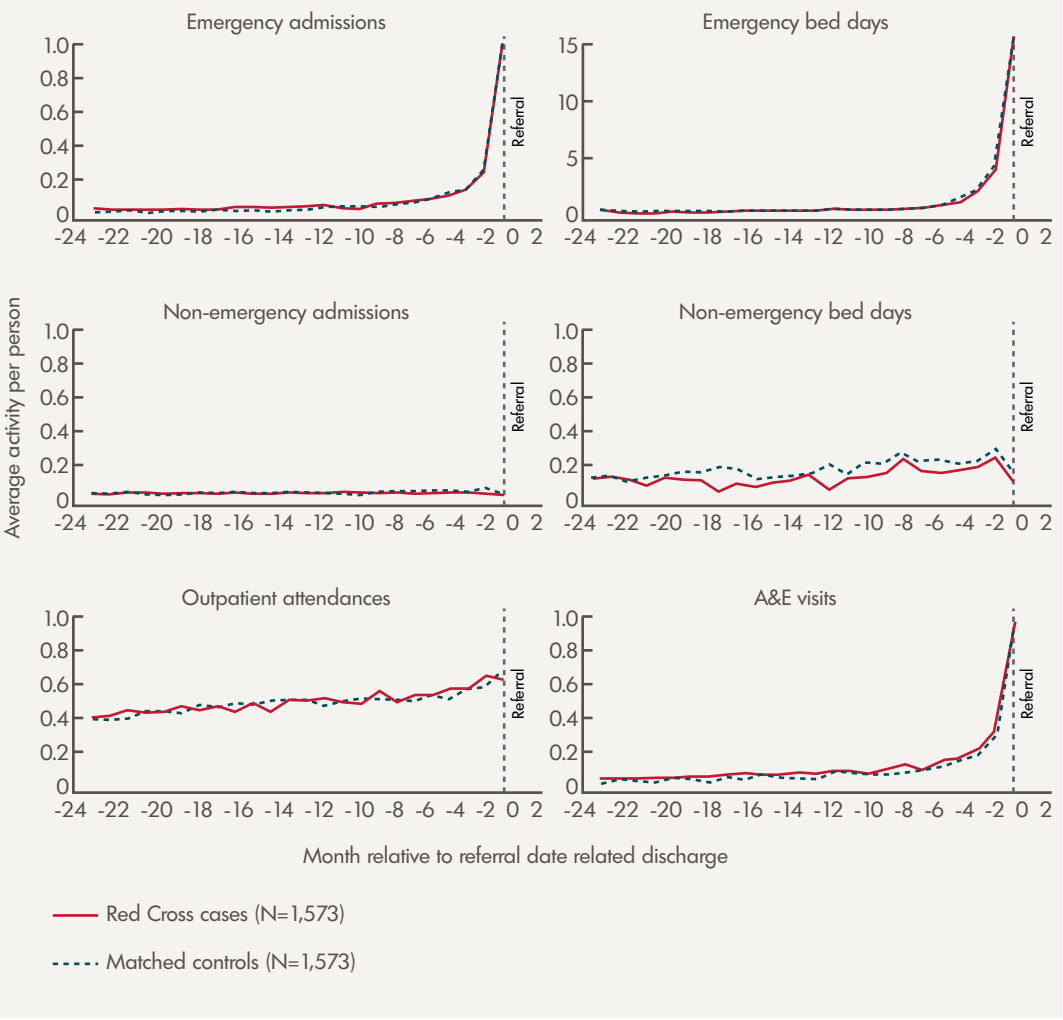
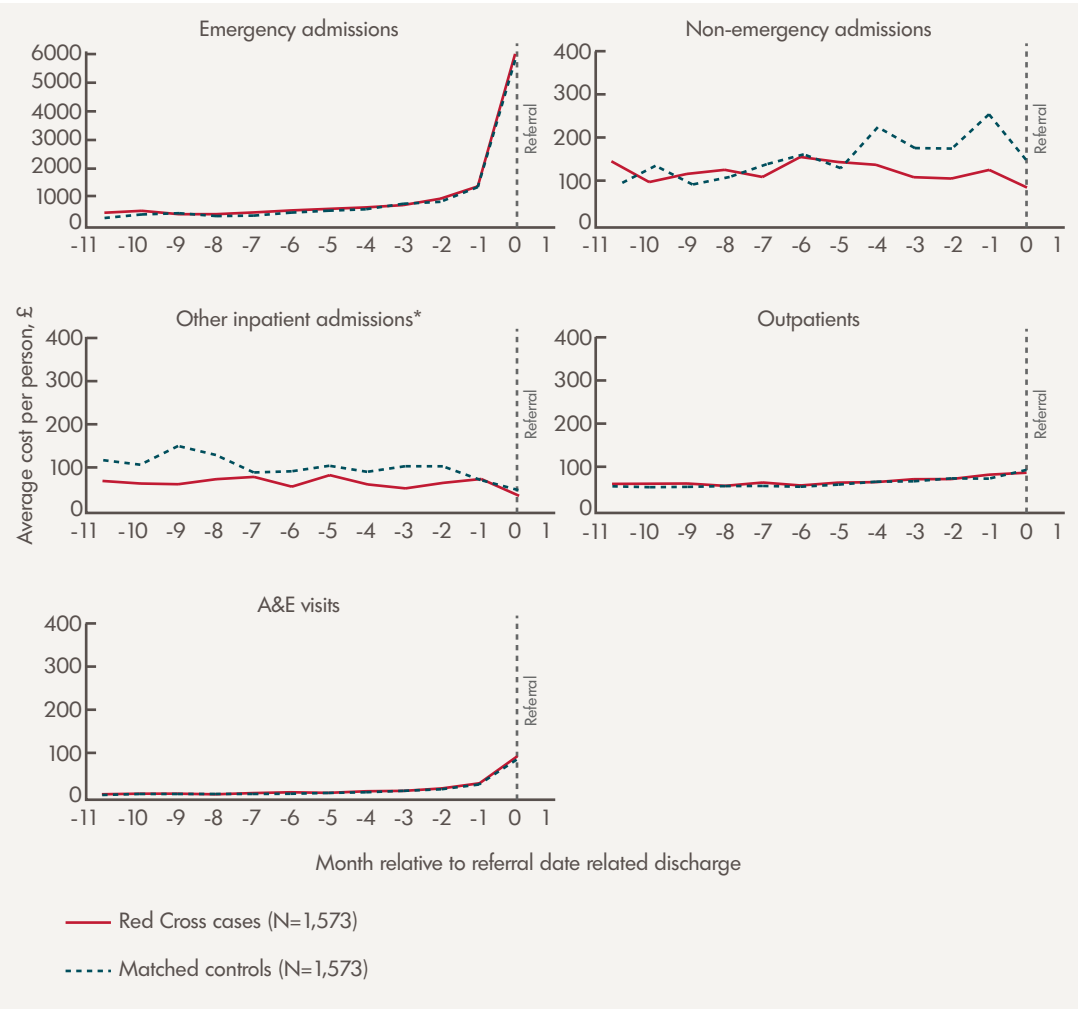


Figure 3.9. Average hospital costs of Support at Home cohort and controls, year before the index date



* 'Other inpatient admissions' includes so-called regular attender admissions (primarily chemotherapy and renal dialysis)

3.3 Differences in subsequent hospital use between the Red Cross Support at Home cohort and the matched control group

Did the use of hospital services differ between cases and controls post-index date?

In the first analysis, we selected pairs of Support at Home cases and controls with at least six months' worth of hospital activity data following the index date (N=1,315 pairs). These patients had an index date on or before 4 May 2012 (180 days before latest HES data). Figure 3.10 shows the average counts of activity by month for the 24 months prior to and the six months following the index date.

In the first month after the index date, emergency admissions, bed days and A&E visits appeared to be similar in the two groups. Thereafter, the matched cohort appears to have had slightly fewer admissions and A&E visits than the Support at Home cohort,

and fewer emergency bed days from the third month. The Support at Home cohort had consistently fewer non-emergency bed days than the matched control cohort in the period after the index date.

The statistical analysis aimed to test whether these differences could be the result of chance. Table 3.5 and Figure 3.11 summarise the hospital activity over these six months. After adjusting for remaining baseline differences that existed between the two groups after matching, there were 19% more emergency admissions (ratio 1.19; 95% confidence interval 1.10 to 1.30) and 17% more emergency bed days (ratio 1.17; 95% confidence interval 1.14 to 1.20) in the Red Cross cohort than in the control group in the six months following the index date (A&E visits were also higher by 21% (ratio 1.21; 95% confidence interval 1.12 to 1.30)). These differences were statistically significant at the 95% level.

Non-emergency admissions and outpatient attendances were less common in the Support at Home group (by 15% and 4% respectively; just significant at the 95% level in the former case but not in the latter). Non-emergency bed days were 27% lower in the Support at Home group than in the matched controls.

Figure 3.10. Hospital activity for Support at Home cohort and controls in the two years preceding the index date, and in the six months following referral. Subgroup with six months' follow-up

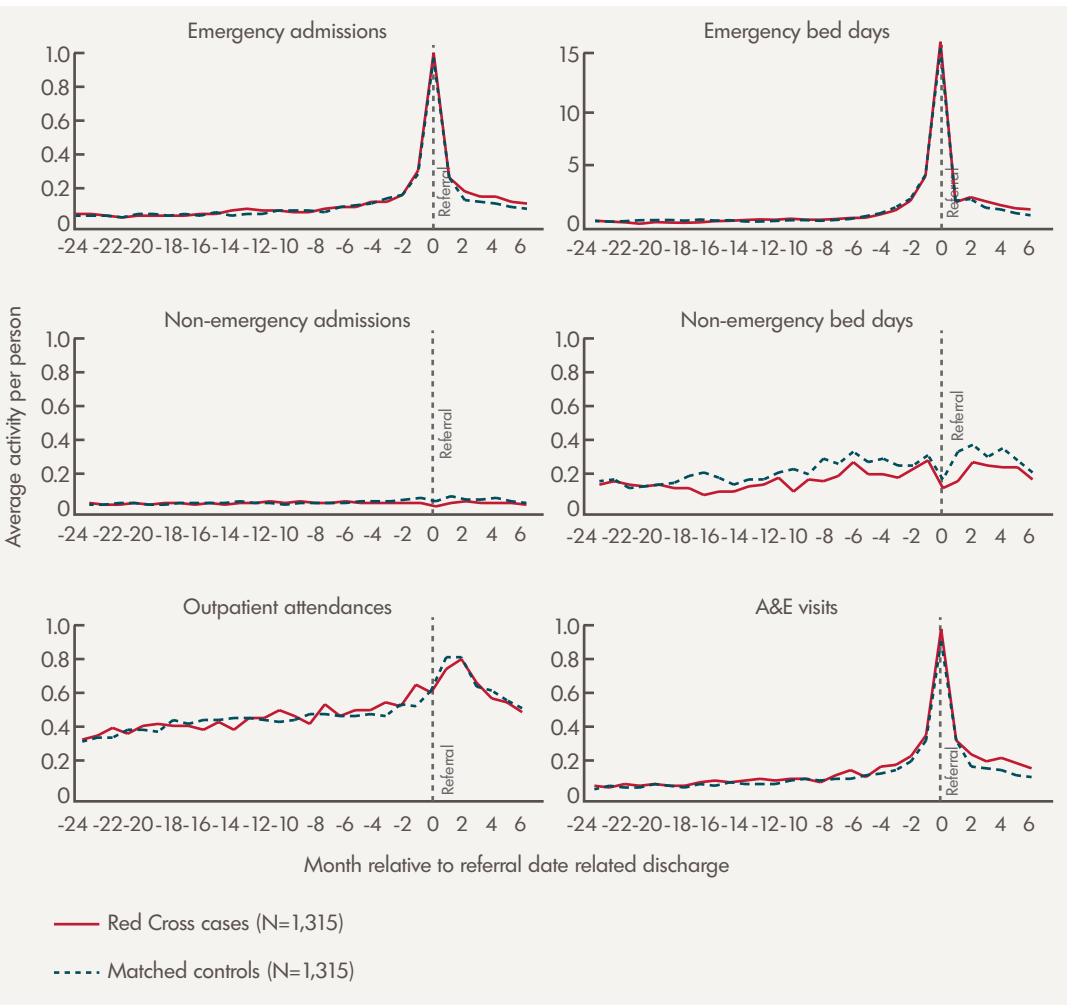
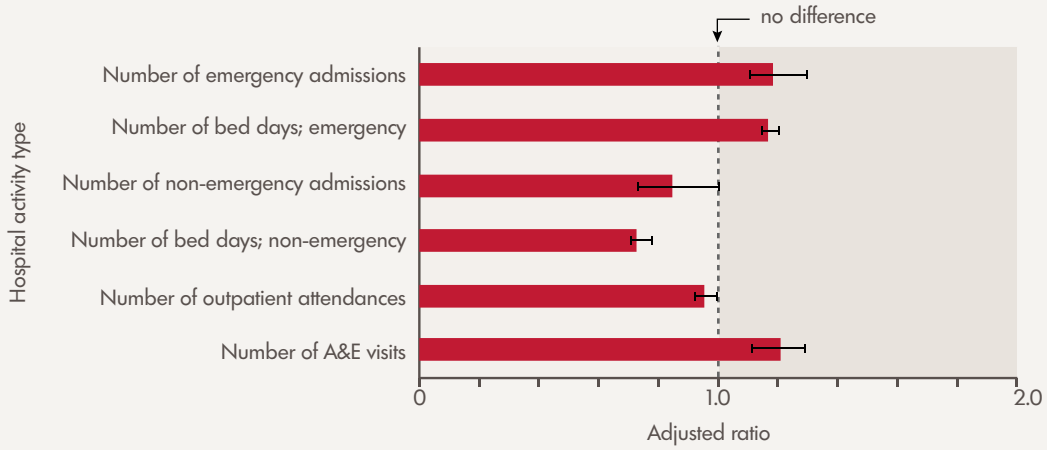


Table 3.5. Hospital activity for Support at Home cohort and controls in the six months following referral. Subgroup with six months' follow-up

Type of hospital care	Mean		Rate ratio Support at Home/ controls (95% confidence intervals)	Adjusted rate ratio (95% confidence intervals)
	Support at Home cases (N=1,315)	Matched controls (N=1,315)		
Number of emergency admissions	1.04	0.85	1.22 (1.13,1.32)	1.19 (1.10,1.30)
Number of bed days; emergency	12.20	10.35	1.18 (1.15,1.21)	1.17 (1.14,1.2)
Number of non-emergency admissions	0.25	0.32	0.80 (0.69,0.92)	0.85 (0.73,0.99)
Number of bed days; non-emergency	1.33	1.82	0.73 (0.68,0.77)	0.73 (0.69,0.78)
Number of outpatient attendances	3.81	3.94	0.97 (0.93,1.01)	0.96 (0.92,1.00)
Number of A&E visits	1.44	1.14	1.27 (1.18,1.36)	1.21 (1.12,1.3)

N = 1,315 pairs

Figure 3.11. Adjusted ratio of rates of activity in the six months following index date. Subgroup with six months' follow up with 95% confidence limits plotted



N =1,315 pairs

Did hospital costs differ between cases and controls post-index date?

Table 3.6 summarises the average costs per person of hospital care in the six months after the index date. Figure 3.12 displays the difference in average costs per individual for Red Cross cases compared with matched controls, for different types of hospital services and for overall costs. These differences have been adjusted for remaining baseline differences that existed between the Support at Home and control groups

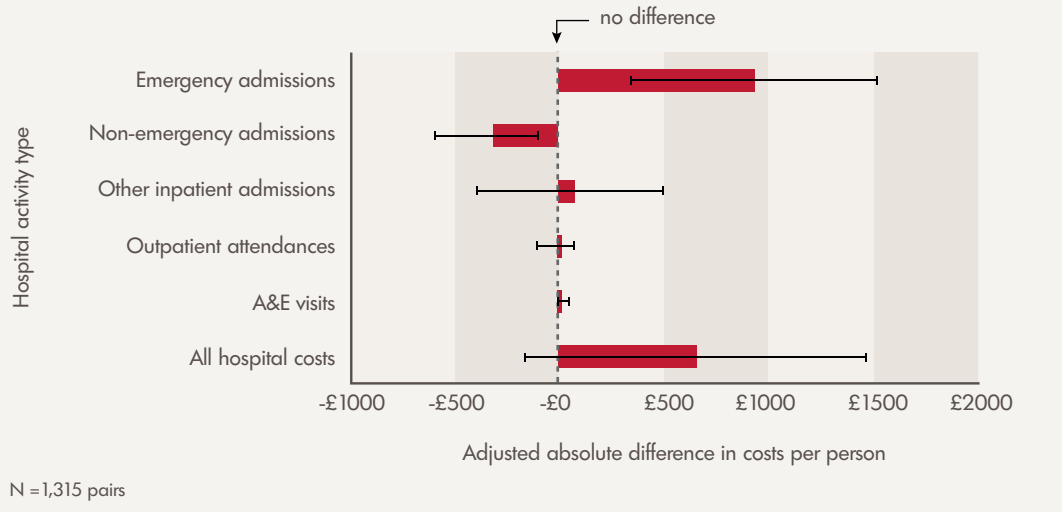
after matching. The analyses showed that a person who received a Support at Home service incurred £940 more costs due to emergency admissions in the six months following the index date (95% confidence interval £348 to £1,531), but £345 less due to non-emergency inpatient activity (95% confidence interval £102 to £589). Both of these differences were statistically significant. There was no significant difference in costs between the Red Cross Support at Home group and the controls for outpatient attendances or for 'other inpatient admissions' (regular attendances for chemotherapy and dialysis). Overall hospital costs during these six months were higher for the Red Cross group, but this difference was not significant.

Table 3.6. Costs of hospital care in six months following referral. Subgroup with six months' follow up

Type of hospital care	Mean cost, £ per person		Ratio of Support at Home/ controls	Absolute difference, £ per person (95% confidence intervals)	Adjusted absolute difference, £ per person (95% confidence intervals)
	Support at Home cases (N=1,315)	Matched controls (N=1,315)			
Emergency admissions	5,133.3	4,137.2	1.24	996.1 (409.8,1582.5)	939.8 (348.4,1531.1)
Non-emergency admissions	739.2	1,111.9	0.66	-372.6 (-613.6, -131.6)	-345.4 (-588.5,-102.3)
Other inpatient admissions*	403.2	478.1	0.84	-74.9 (-515.2,365.5)	58.5 (-381.5,498.5)
Outpatient attendances	465.5	483.9	0.96	-18.4 (-72.2,35.5)	-15.9 (-69.9,38.2)
A&E visits	130.0	105.3	1.23	24.7 (10,39.3)	20.3 (5.8,34.9)
All hospital costs	6,871.3	6,316.3	1.09	555 (-251.4,1361.3)	657.1 (-150.6,1464.9)

N=1,315
*'Other inpatient admissions' are the set of inpatient episodes classified as 'regular attendances', primarily used for chemotherapy and dialysis activity

Figure 3.12. Adjusted differences between Support at Home cases and matched controls in average hospital costs in six months following referral. Subgroup with six months' follow up with 95% confidence limits



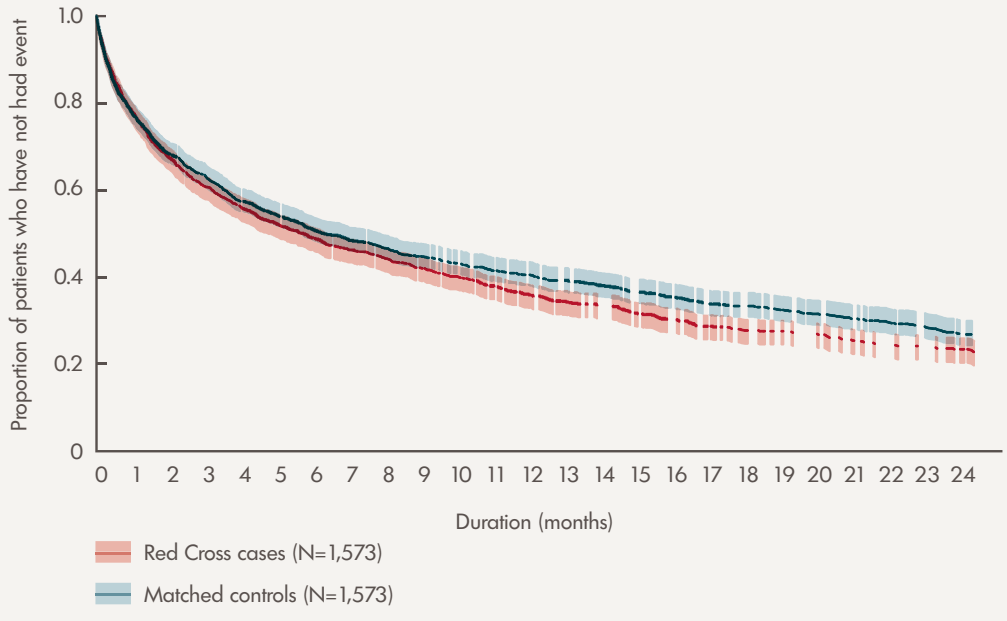
Did risk of a first emergency admission (and other hospital contacts) differ between the two groups post-index date?

The second analysis tested whether there were differences in the time to first admission following the index date. Figure 3.13 shows a survival curve for emergency admissions for the whole group of cases and controls (N=1,573 pairs). The curve shows the proportion of patients who had not experienced an emergency admission by various points in time after referral to Support at Home. As the Support at Home service aimed to prevent hospital admissions, we might have expected that the line for Support at Home patients would be above the line for matched controls.

In the first two months after the index date, the two groups' lines are very similar – both groups having had around a third of individuals with at least one emergency admission by the end of this period. The lines diverge slightly after the second month, with the Red Cross Support at Home group having had a greater proportion of individuals with at least one emergency admission. However, as shown by the overlapping nature of the shaded 95% confidence intervals, these differences are rarely significant at any point in time post-index date.

Figure 3.14 shows similar survival curves for non-emergency admissions, outpatient attendances and A&E visits. The greatest differences between the two groups were observed in non-emergency admissions, with matched controls being more likely to have had an admission in the months following the index date than those in the Support at Home cohort.

Figure 3.13. Survival curve – emergency admission following index date



Shaded areas show 95% confidence limits.

Figure 3.14a. Survival curve - non-emergency admission following index date

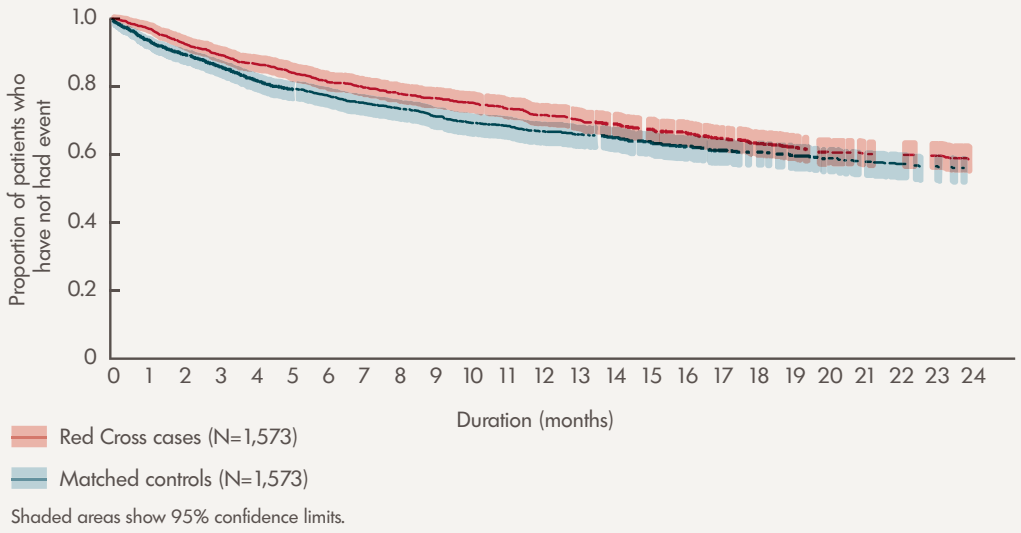


Figure 3.14b. Survival curve - outpatient attendance

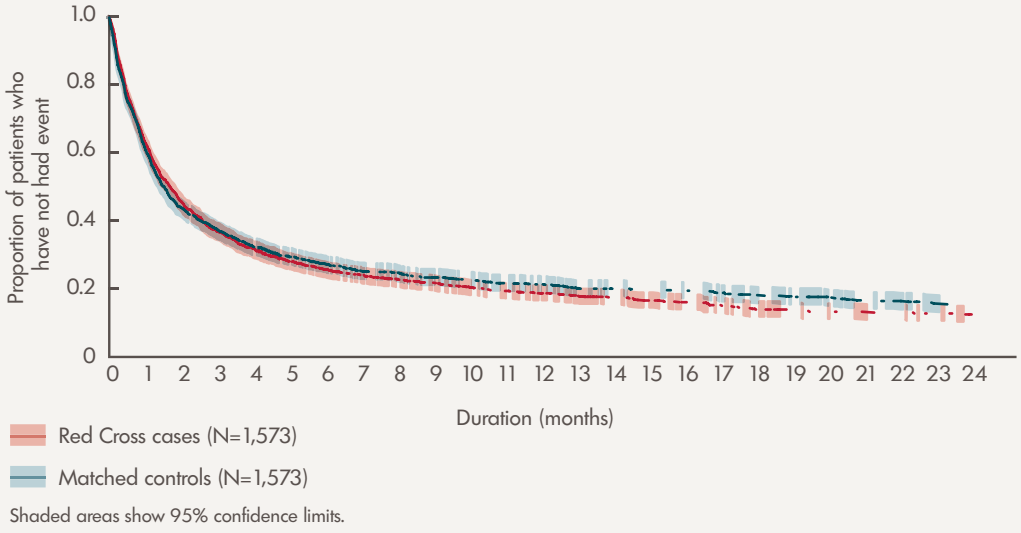
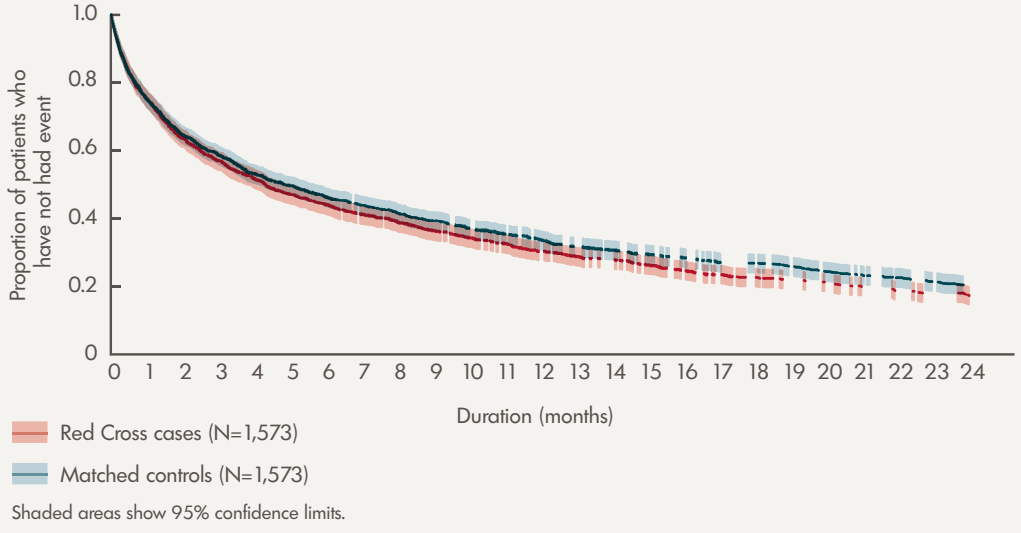


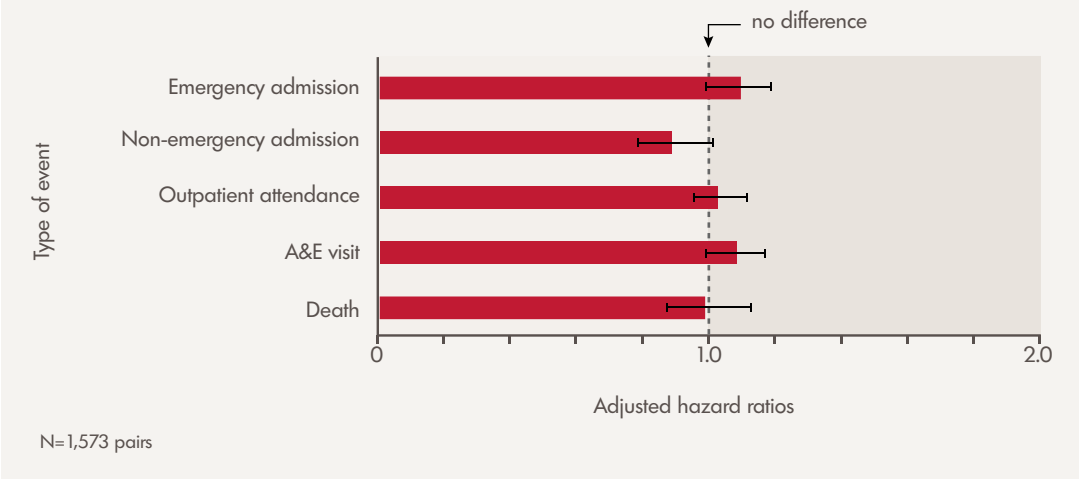
Figure 3.14c. Survival curve - A&E visit following index date



The differences shown in the survival curves are summarised by the hazard ratio, which represents the ratio between the admission rates over time. We present these in Figure 3.15 alongside a hazard ratio detailing relative risk of death (these are adjusted for remaining baseline differences using Cox regression). There was a higher risk of an emergency admission in the Support at Home cohort, although the results were not statistically significant (hazard ratio of 1.08, 95% confidence interval 0.99 to 1.19). The risks of A&E visits and outpatient attendances were similarly higher among the intervention than control groups and not significant. Non-emergency admissions showed a non-significant trend of a lower risk of future admission. In summary, this indicates that there was no significant difference in the risk of a Support at Home service user having had a hospital contact after the index date compared with the matched control group.

The risk of death was very similar for the two groups (hazard ratio 0.99, 95% confidence interval 0.87 to 1.13). By 31 August 2012, 493 control group members had died, compared with 487 Support at Home individuals.

Figure 3.15. Adjusted hazard ratios for types of hospital contact and death after index date, all individuals with 95% confidence limits plotted



3.4 Differences in subsequent hospital use for different groups of service users

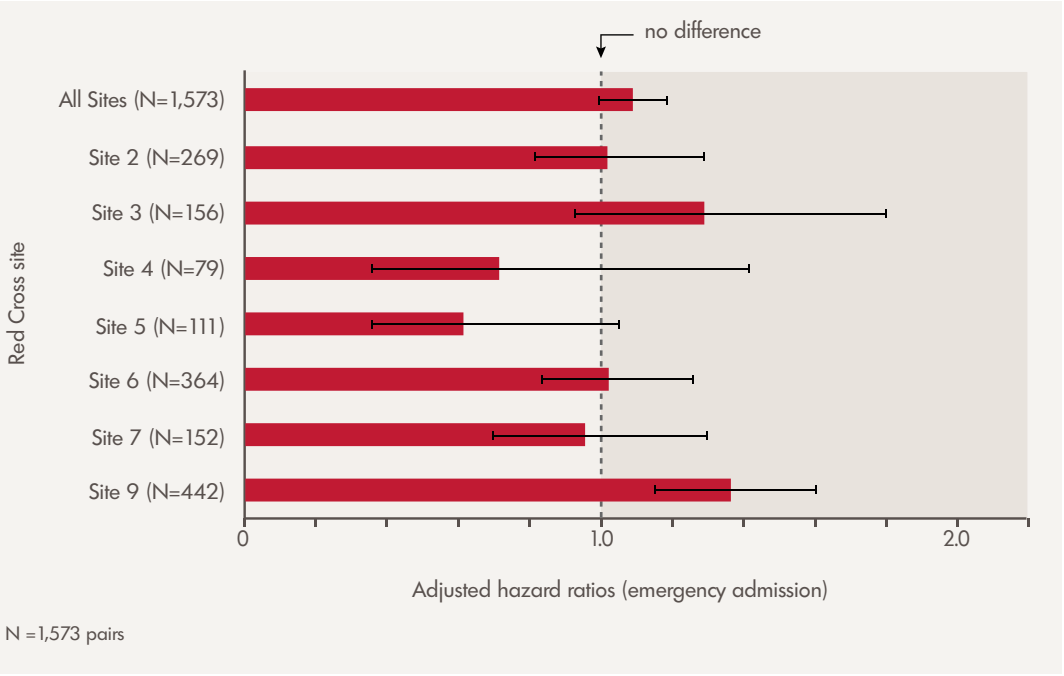
Did risk of a first emergency admission differ by Red Cross site?

We did further analysis to explore whether the effect of the Support at Home service, relative to matched controls, differed for patients with different characteristics. This was done using the hazard ratio. Figure 3.16 presents hazard ratios detailing risk of emergency admission, for different groups defined by the site of the Red Cross service.

We were not powered to detect differences in hospitalisation by site. Therefore, confidence intervals in Figure 3.16 were wide. Only one site had a hazard ratio which was significantly different from a ratio of 1. This was the largest site (site 9), in which Support at Home patients had a significantly higher risk (hazard ratio 1.36; 95% confidence interval 1.15 to 1.61) of at least one emergency admission after referral to the Red Cross. No other sites showed a significant difference between Red Cross cases and controls, but some of the numbers were small. Two sites (sites 4 and 5) showed

a non-significant trend towards having lower admissions among Support at Home patients, but these were the smallest sites.

Figure 3.16. Adjusted hazard ratios for emergency admissions, by Support at Home site. All individuals with 95% confidence limits



Did risk of a first emergency admission differ by Support at Home method of intervention?

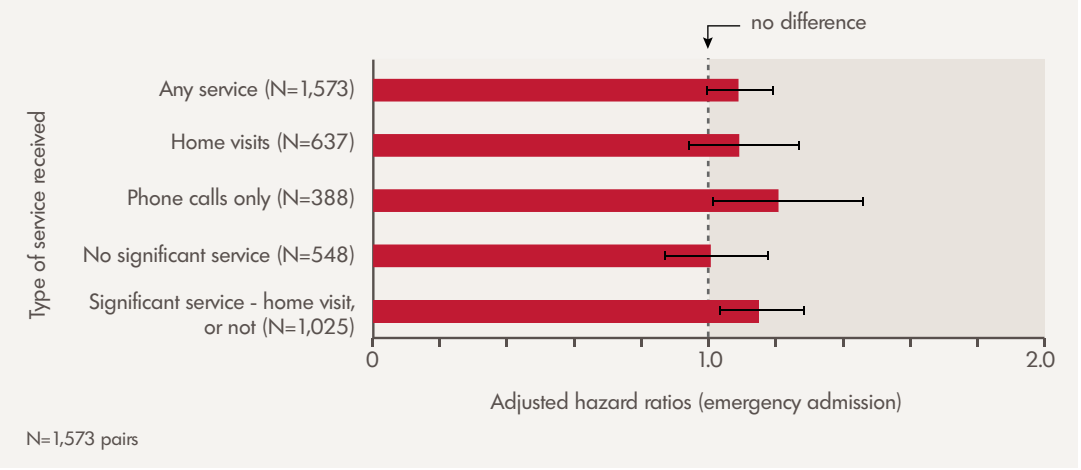
Figure 3.17 presents hazard ratios detailing risk of emergency admission for different groups defined by the type of Support at Home intervention provided to the Red Cross service user.

Of the three types of intervention, the phone calls only service showed a significantly high hazard ratio, with 21% higher risk of future emergency admission in the Support at Home cohort (hazard ratio 1.21, 95% confidence limits 1.06 to 1.46). The home visit intervention indicated slightly higher risk of emergency admissions, but did not reach statistical significance.

Support at Home service users who received no significant service were no different in terms of risk of emergency admission to those in the matched control group. The hazard ratio was very close to 1, at 1.01 (95% confidence interval: 0.87 to 1.18).

A fourth grouping, made up of those with either of the two 'significant' interventions (home visits and phone calls), had a significantly higher hazard ratio (1.15; 95% confidence interval 1.03 to 1.29) of future emergency admissions in the Support at Home group than in the control group.

Figure 3.17. Adjusted hazard ratios for emergency admissions, by the method of Support at Home intervention. All individuals with 95% confidence limits



3.5 Differences in subsequent hospital use in the shorter term

Did use of hospital services differ between cases and controls in the first month post-index date?

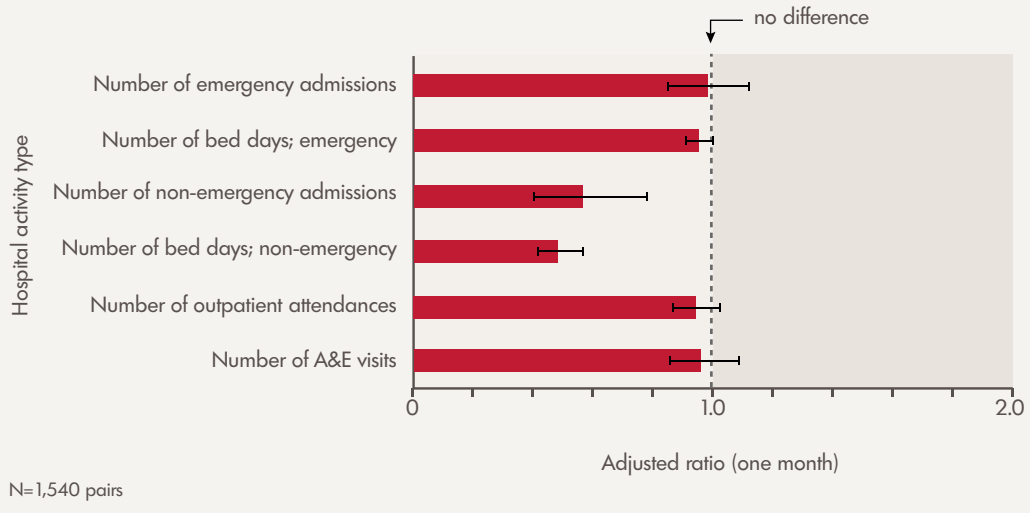
In this analysis, we selected pairs of Support at Home cases and controls with at least 30 days' worth of hospital activity data following the index date (N=1,540 pairs).

Table 3.7 and Figure 3.18 summarise average hospital activity for this group in the first 30 days post-index date. During this period, Support at Home patients experienced 0.27 emergency admissions per head on average, compared with 0.28 for matched controls. This corresponded to a rate ratio of 0.98 (95% confidence interval 0.85 to 1.12), which was not statistically significant. After adjusting for remaining differences between the two groups, we found 44% fewer non-emergency admissions (ratio 0.56, 95% confidence interval 0.40 to 0.78) and 52% lower non-emergency bed days (ratio 0.48, confidence interval 0.41 to 0.56) in the Support at Home cohort than in the control group. Other differences in activity between the two groups were not statistically significant.

Table 3.7. Hospital activity for Support at Home cases and controls in the month (30 days) post-index date. Subgroup with 30 days' follow up

Type of hospital care	Mean		Rate ratio Support at Home/ controls (95% confidence intervals)	Adjusted rate ratio (95% confidence intervals)
	Support at Home cases (N=1,540)	Matched controls (N=1,540)		
Number of emergency admissions	0.27	0.28	0.98 (0.86,1.12)	0.98 (0.85,1.12)
Number of bed days; emergency	2.19	2.30	0.95 (0.91,1)	0.95 (0.91,1)
Number of non-emergency admissions	0.04	0.07	0.55 (0.4,0.76)	0.56 (0.4,0.78)
Number of bed days; non-emergency	0.16	0.38	0.42 (0.36,0.48)	0.48 (0.41,0.56)
Number of outpatient attendances	0.77	0.84	0.91 (0.84,0.99)	0.94 (0.86,1.02)
Number of A&E visits	0.34	0.36	0.96 (0.85,1.08)	0.96 (0.85,1.08)

Figure 3.18. Adjusted ratios for rates of hospital activity in the month (30 days) post-index date. Subgroup with 30 days' follow up with 95% confidence limits



Did hospital costs differ between cases and controls in the first month post-index date?

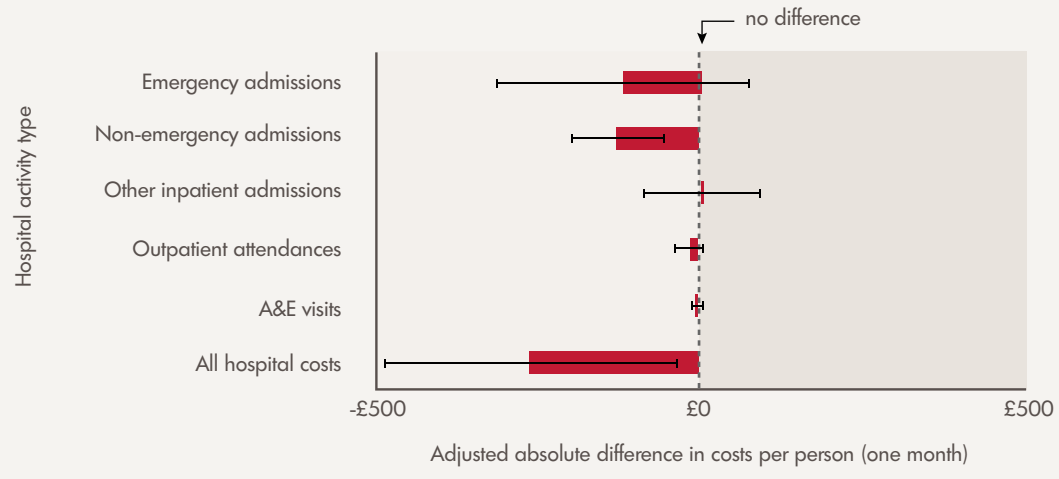
Table 3.8 shows the average costs of hospital care in the 30 days after the index date for pairs of Red Cross cases and controls with at least 30 days' worth of hospital activity data (N=1,540 pairs). Figure 3.19 displays the difference in average costs per individual for Support at Home cases compared with matched controls, adjusted for differences between the two groups.

Control individuals incurred costs due to non-emergency admissions that were £119 higher per person than Support at Home cases (95% confidence intervals £55 to £200). We observed no significant differences in costs between the Support at Home group and the controls for other types of hospital care. Overall hospital costs in the first month post-referral were lower for the Support at Home group by £261, a statistically significant difference.

Table 3.8. Costs of hospital care in the 30 days following referral. Subgroup with 30 days' follow up

Type of hospital care	Mean cost, £ per person		Ratio Support at Home/ Controls	Absolute difference, £ per person (95% confidence intervals)	Adjusted absolute difference, £ per person (95% confidence intervals)
	Support at Home cases (N=1,540)	Matched Controls (N=1,540)			
Emergency admissions	1,002.9	1,082.8	0.93	-79.9 (-269.3,109.6)	-118.9 (-311.8,74)
Non-emergency admissions	90.4	230.4	0.39	-140 (-211.1,-68.8)	-127.2 (-199.7,-54.6)
Other inpatient admissions	84.1	116.4	0.72	-32.3 (-119.1,54.5)	3.1 (-83.9,90.1)
Outpatient attendances	99.7	114.0	0.87	-14.3 (-34.3,5.6)	-15 0 (-35.1,5.1)
A&E visits	31.6	32.6	0.97	-1 0 (-5.8,3.9)	-3 0 (-7.9,1.9)
All hospital costs	1,308.7	1,576.1	0.83	-118.9 (-311.8,74)	-260.9 (-488.1,-33.7)

Figure 3.19. Adjusted differences between Support at Home cases and matched controls in average hospital costs in the 30 days after index date. Subgroup with 30 days' follow up with 95% limits

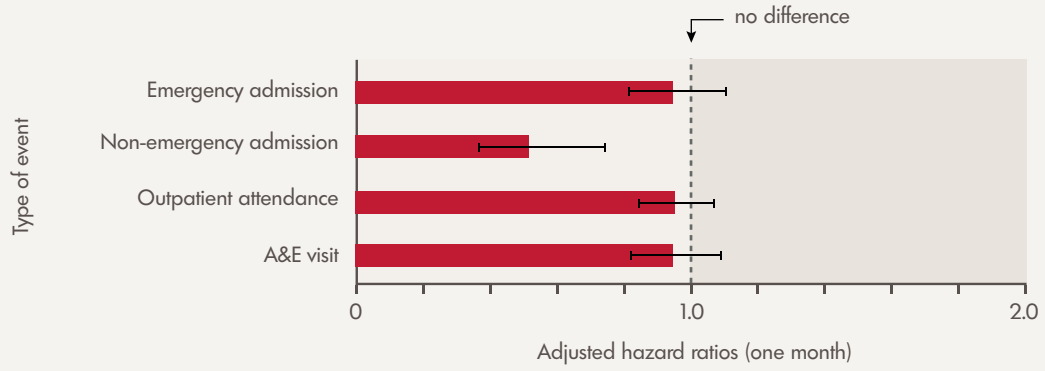


N=1,540 pairs

Did risk of a first emergency admission (and other hospital contacts) differ between the two groups in the first month post-index date?

We obtained hazard ratios by Cox regression (displayed in Figure 3.20), censoring the data 30 days after the index date, to include only hospital activity during this time. Non-emergency admissions showed a hazard ratio significantly below 1 (0.52; 95% confidence interval 0.36 to 0.74), indicating a reduced risk of non-emergency admissions for Support at Home patients compared with controls. We observed no other significant differences in risk of admissions or other hospital contacts.

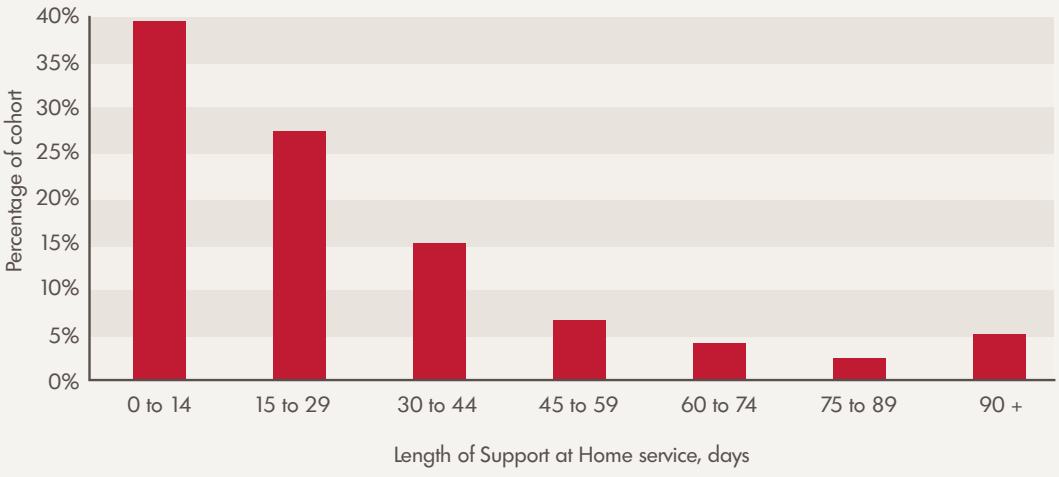
Figure 3.20. Adjusted hazard ratios for hospital events in the month (30 days) post-index date, with 95% confidence limits. All individuals



Did risk of emergency admission (and other hospital contacts) differ during receipt of a Support at Home service? Did it differ once the service stopped?

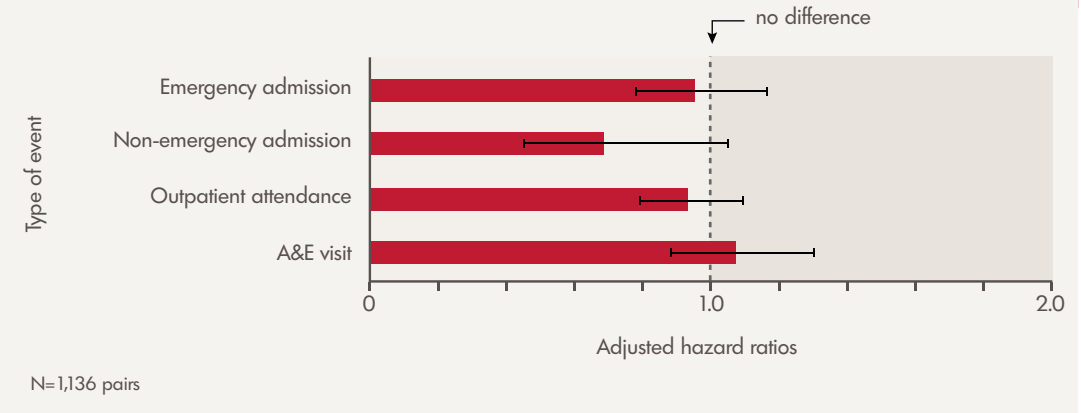
Of the all Support at Home cohort members, 72.2% had either a valid final visit date or a final phone call date. Figure 3.21 shows the length of service received post-index date for this group (N=1,136). The length of the Support at Home service was shorter than 15 days for 39.3%, and shorter than 30 days for 66.7% of the group. In total, 4.8% of individuals received a service that was longer than 90 days.

Figure 3.21. Red Cross Support at Home service length (index date to final Support at Home contact date) for individuals with a final service date



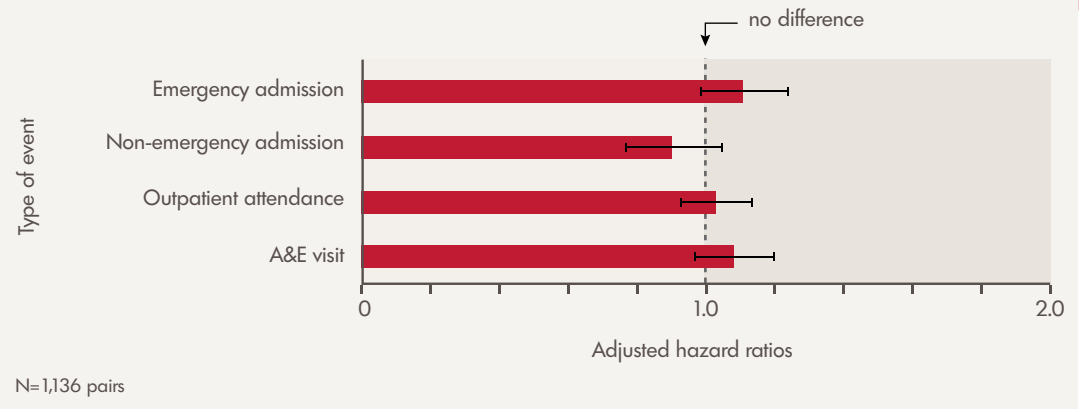
We obtained hazard ratios for hospital activity after the index date (shown in Figure 3.22), censoring the data at the last Support at Home contact date. Only hospital activity in the period during which a Support at Home service was being received would have been taken into account in this analysis. For all types of hospital care, except for A&E visits, the hazard ratios were below 1 (signifying reduced risk in the Support at Home group), but none of these ratios were statistically significant.

Figure 3.22. Adjusted hazard ratios for hospital events during Red Cross Support at Home service with 95% confidence limits



We also obtained hazard ratios for first hospital contacts after the final service date, that is after discharge from the Support at Home service (Figure 3.23). There were some indications that the Support at Home patients had a higher rate of emergency admission in this period, although it did not quite reach statistical significance (hazard ratio 1.11, 95% confidence interval 0.99 to 1.24). As before, no ratios varied significantly from 1, however, the trend was to an increased risk of all types of hospital contacts in the Red Cross group after discharge from the Red Cross service.

Figure 3.23. Adjusted hazard ratios for hospital events following end of Red Cross Support at Home service, with 95% confidence limits



4. Discussion

Main findings

The British Red Cross Support at Home services studied in this report provide practical help to people following a stay in hospital, to help individuals to remain independent and, where possible, to avoid future unnecessary hospital visits.

This study investigated a group of 1,573 individuals who were referred to the service in seven sites in London. We compared the subsequent hospital use of this group to that of a matched control group. The control group came from the same NHS trusts as the Support at Home patients, and had similar demographic characteristics, recorded health care diagnoses and prior hospital admissions. Our findings were somewhat mixed.

A key concern of the study was the future risk of a re-admission to hospital after referral to the Support at Home service. We focused on the risk of any future emergency admission (as these are costly and often preventable) and found no statistically robust evidence of a difference between the Support at Home cohort and the control group in terms of future risk (hazard ratio: 1.08, 95% confidence interval 0.99 to 1.19). However, even though these differences were not statistically significant, there were indications to suggest that Support at Home service users were at a slightly higher risk of future emergency admissions (and A&E visits), and at a slightly lower risk of non-emergency admissions.

While the main analysis focused on the first re-admission to hospital, we also looked at per-person rates, and associated costs, of hospital use in the six months following referral to the Support at Home service. For a subgroup of 1,315 Support at Home users we found a significantly higher rate of emergency admissions and bed days than in the matched control pairs (by 19% and 17%, respectively). A&E visits were also similarly higher for the Support at Home group (by 21%). There was evidence, however, that non-emergency admissions were lower for the Support at Home group (with 27% fewer bed days). In terms of the overall costs of hospital care in this period, there was no significant difference between the Support at Home group and the control group, as differences for emergency and non-emergency activity broadly offset each other.

So, whilst we found the Support at Home group and the control group to be similar in terms of the risk of having had an emergency admission (or other contact) at some time after referral, we also found that the subsequent amount of emergency care (and non-emergency inpatient care) differed. The measure of risk we used related to a future admission and, as such, looked to only a first admission. The measures of rates (and total costs), however, included all activity and so counted multiple admissions where these occurred. Differences between the two groups in terms of multiple admissions may have explained some of this discrepancy (for example, although similar proportions of patients in the two groups had been to hospital by any given date, the intervention group might have been more likely to have gone to hospital multiple times). A second explanation might lie in changes observed in the relative pattern of hospital use between the two groups after the referral date. We observed that in the

month immediately following Support at Home referral, emergency admissions were more similar than they were in all subsequent months (Figure 3.10, page 26). First emergency re-admissions were most likely to occur in the few weeks after referral (Figure 3.13, page 29), and this is the time in which the two groups are more evenly balanced. A final possible explanation is that, although the Support at Home service might act to reduce admissions in the short term, admission rates might subsequently have increased after discharge from Support at Home. There was some evidence for this, as the risk of emergency admission was less than 1 during the service, but greater after discharge from Support at Home; these differences were not statistically significant, but could be investigated in a further study.

The finding that there appeared to be a higher rate of future emergency activity (and of lower non-emergency inpatient activity) needs to be considered in light of the accuracy of the matching process itself. Ideally, the selected control group would have consisted of people who would have been eligible for referral to the Support at Home service, as determined by local service teams. However, eligibility criteria did not seem to have been precisely defined, and in any case did not map naturally onto the administrative data on which this analysis was based.

We showed that we were able to build a large set of variables describing individuals' hospital use and health status, and the matched control group was known to be well matched on these factors. However, it might have been that the groups differed systematically in terms of other key factors which could have distorted the analysis, but which we were not able to observe. It has already been stated that users of the Red Cross service were likely to be somewhat socially isolated. It is possible, however, that individuals in the matched control group were less likely to live alone than individuals referred to the Support at Home service, or less likely to have particular problems around managing their own health care needs. This is information that was lacking to us. A further study could attempt to include datasets from additional sources to try to improve the matching. This would require more precise information on the reasons why some patients were recruited into the service and others were not.

Subgroup analyses: Support at Home site and method of intervention

With relatively few study participants, we were limited in the range of subgroup analyses we could carry out, but we looked at the how the risk of future emergency admissions differed in the seven sites. There appeared to be variation in the impact of Support at Home on emergency admissions between sites, although individual confidence intervals often crossed the line of no difference. Only in one site (site 9, the largest) did we find that there was a higher risk of a future emergency admission for those who received a Support at Home service (by 36%). Just because figures were not significant, however, does not mean that differences did not occur, as numbers in some of the sites were small.

Indeed, there were indications that in at least one other site (site 5, and potentially in site 4) this picture might be reversed (that is, in a lower risk of a future admission), although there was large uncertainty in our results due to the very small subgroups being analysed. It would be valuable to repeat the site-based analyses with a greater numbers of participants, as being able to identify better performing services would offer an opportunity to learn about, and disseminate, examples of good practice.

A second subgroup analysis looked at the method of intervention by which a service had been provided to individuals. The group with 'no significant service' (that is, those who appeared to have received neither a substantial number of phone calls nor home visits) made up over one third of the final study cohort, and was included in the study on the advice of the Red Cross. We understand that this group would have included a mix of people – those who were offered a service by the Red Cross and declined, in addition to those who only received a very small number of phone calls. It was therefore interesting to find that there was no difference at all in the risk of a future emergency admission for this subgroup (compared with the matched controls). If these individuals had been excluded from the study, we would have found a significantly high risk of future emergency admissions for the Support at Home group.

Strengths and weaknesses of analysis

A significant strength of this study was that we were able to link records about Red Cross service users to national hospital data to build detailed pictures of the health status of service users at the person level. The use of a matched control group helped adjust for the tendency of patients who have a history of frequent hospital admissions to show reductions in admissions over time ('regression to the mean') (Roland and others, 2005).

A weakness of the study was that we investigated the hospital use of only 1,573 people, and not the 5,000+ individuals who had been referred to the Support at Home service. There were services that we could not evaluate with the methods proposed for use in this study (sites serving non-acute inpatient settings – sites 1 and 8, and the relatively small palliative care service in site 9), but even excluding these we had a potential study group of almost 4,000 people (meaning the final analysis cohort was made up of only 40% of available individuals).

The main loss of individuals was caused by poor rates of linkage to national HES data. Over 30% of Red Cross service users could not be linked to HES identifiers (in sites 7 and 9 this figure was nearer to, or greater than, 40%). It was reported to us by the Red Cross that addresses, postcodes and dates of birth were frequently incomplete for Support at Home users who had not been linked to the HES IDs. Therefore, the data linkage rate probably reflects incomplete person identifiers in the records gathered by the Red Cross. Other incomplete or conflicting data in the Red Cross services dataset (particularly around unknown or invalid referral dates) led to a further loss of individuals of around 6%.

In addition, where HES IDs had been found, we expected to be able to find the individual as an admitted patient in the relevant hospital at the date of referral, but could not actually do so in over one fifth of cases.

The study therefore investigated a relatively modest subset of those who received a Support at Home referral. The loss of individuals from the study was large enough that some of our analyses were underpowered when they otherwise might not have been. This was especially the case as we studied hospitalisation over six months, rather than 12 months, as originally planned (although we note that the alternative Cox regressions used often have relatively high statistical power).

In addition, it was not possible to determine whether biases might have been introduced as a result of poor linkage. This might have occurred if, for example, those

with poorer records had different levels of needs than those we studied. Future research of this kind would be greatly aided by an improvement in the quality of data recording Support at Home service provision.

It should be noted that an additional consequence of the relatively poor linkage to the HES data meant that it was possible that the control pool contained some individuals who had received a Support at Home service, but who we were unable to identify. We believe that this would have been a relatively rare occurrence considering the very large pool of potential controls available in each of the sites.

The largest threat to validity in observational studies is confounding – the possibility that differences in hospital admissions were due to differences between the groups at baseline. Our matching algorithms appeared successful at producing groups that were similar in observed person-level variables, and they also standardised for NHS trust (each Red Cross service user and matched control were discharged from the same hospital). However, it is possible that there were unobserved differences in the characteristics of people in the intervention and matched control groups. Possibilities include differences in social support and isolation, attitudes towards using health services, and level of support from primary care. As we had no information on hospital wards, it is also possible that matched control patients had different experiences in hospitals than intervention patients.

Unobserved confounding cannot be assessed directly. We were reassured that we found very similar emergency admission rates between Support at Home patients who did not receive phone calls or home visits, and their matched controls (hazard ratio 1.01, 95% confidence interval 0.87 to 1.18). These patients were offered Support at Home but declined to participate or did not receive a service for another reason. We did not expect there to be an impact of the service on these patients, which is indeed what we found. We also did not expect any impact on death rates following referral, and so we welcomed the finding that there was no difference in the risk of death between the two groups (hazard ratio 0.99, 95% confidence interval 0.87 to 1.13).

We also note that we conducted many analyses in this study but assessed statistical significance at the 5% level. We would expect one in 20 results to be significant by chance, which reduces our confidence in the statistical impacts we observed.

Finally, this study focused on impacts on hospitalisation, but the service may have had important impacts elsewhere, for example on patient outcomes such as quality of life or on use of primary care.

Further analysis – the month after referral

We carried out further analyses at the request of the Red Cross to focus on the first month after referral. As the majority of their service users received help from the Support at Home programme for fewer than 30 days, the service could perhaps have more of an impact in the first month than in later months. As previously discussed, it was clear that in this first month – at least in terms of emergency activity – hospital use was more evenly balanced between the two groups (Figure 3.10, page 26).

We indeed found no significant difference in the risk of an emergency admission between the Support at Home group and the matched controls in the first month, nor was there any significant difference in the number of admissions, bed days or costs of

emergency care. Similar results were observed for A&E visits and outpatient care. We did find large and significant differences, however, in non-emergency activity in the month after referral. In fact, the risk of a non-emergency admission for the Support at Home group was almost half that of the control group, and rates of admissions, bed days and costs appeared to be significantly lower for Support at Home service users. For all types of hospital activity other than non-emergency admissions, Red Cross users were slightly less costly than the control group (though not significantly so); this led to significantly lower hospital costs for Support at Home users overall (by £261 per person). In our full analysis we observed that the Support at Home group had broadly lower levels of non-emergency activity and higher levels of emergency activity after referral. This further analysis confirms that in the first month after referral, emergency care is much more closely balanced than it is in later months. Non-emergency care, meanwhile, becomes more evenly balanced in the later months, but with consistently lower activity in the Support at Home group.

The observation that the Support at Home service seemed to impact on short-term non-emergency (that is, planned) inpatient care was an unexpected finding. The possible mechanism by which an intervention such as Support at Home would have resulted in fewer episodes of planned care is unclear. Rather, the differences observed in non-emergency inpatient care lead us to question whether there were confounding factors signifying somewhat inappropriate matches in the control group.

Concluding thoughts

Overall, we conclude that the Support at Home service did not reduce hospitalisation among a subset of users who had been referred following an emergency admission. Possible explanations include problems with the content theory (that is, the activities performed were not sufficient to reduce hospitalisation) or problems with execution (that is, the steps to ensure that these activities took place were not successful). The effect of interventions is likely to depend on many factors, including the selection of the patients and health care settings, the activities of the Red Cross, and the context in which the services operated.

Future work might:

- apply these methods in an ongoing way to monitor progress against the aim of reducing admissions
- examine differences between the seven sites (service models, context, patient selection) to try and understand the reasons for the apparent variation in effectiveness – this could form part of a learning and improvement exercise to spread good practice between different Red Cross teams
- revisit the theory of change that specified how the elements of the service were going to influence rates of hospital admissions, and adapt the content and execution theory as needed to increase effectiveness (Bardsley and others, 2013).

This study found indications that, although admissions were not substantially different from matched controls during the Support at Home programme, admissions rates increased after patients stopped receiving the home visits and telephone calls. We regard the evidence for this as being relatively weak, given the level of statistical significance observed in the presence of multiple tests.

Appendix A – Examples of recorded Support at Home interventions

Accompaniment to appointments

Accompaniment to appointments and on walks

Accompany home – by hospital transport – for Dementia escort scheme

Accompany home – by public transport

Accompany home – by taxi

Accompany to bank

Accompanying on walks

Alert social worker or occupational therapist – critical situation

Arrange for grant from Dresden Fund (for food)

Arrange with local shop to deliver

Arranging GP appointments and access to health services

Assistance with booking appointment

Assistance with completing forms

Assistance with form filling/bills/set-up direct debits and organise paperwork

Assistance with letter writing and posting

Assisting with eye/ear drops/ anti-embolism stockings

Assisting with mobility equipment

Befriending and companionship

Carrying out essential shopping on behalf of beneficiaries or accompanying them

Carrying out light household tasks, e.g. tidying, washing up

Charge up patient's mobile

Check-up at home and on ward

Cheque/cash deposited in bank

Collect lost bus pass, takeaway meal

Collecting prescriptions or GP letters

Companionship/check up

Contact British Telecom re: fault

Contact British Telecom to install landline

Contact Comet for new telephone

Contact GP re: prescription

Contact Lifeline re: malfunction

Contact pharmacy and deliver/ensure medications

Contact social worker – no carers coming

Contact social worker re: care package

Deliver anti-embolism stockings to service user at home

Deliver letter to bank

Deliver Lifeline application to carer

Drop off item at GP/letter

Escort to café, shops, post office, chiropodist, women's clinic

Escort to library and buy phonecard

Fill in Lifeline application form

Fill in Taxicard application

Find lost hearing aid

Get anti-embolism stockings from ward

Get prescription dispensed at chemist

Go to A&E – relay messages to family

Go to audiology to fit hearing aid batteries/take to service user on ward

Go to GP for prescription

Go to post office – pay rent

Help service user apply for Community Care Grant

Hospital transport for appointment

Instruct on use of microwave

Keys cut

Lend carer mobile phone (on ward)

Liaising with carers/housing agencies

Liaising with family and friends to ensure continuity of support

Liaising with therapy and health services to raise health concerns or issues affecting health and mobility

Light household work/bed-making

Light meal/drink preparation

Make phone booking for partially sighted service user

Meet at home upon discharge

Meet service user in hospital clinic – reassurance

Pet care/empty litter tray

Phone Department for Work and Pensions to see if service user is on benefits

Picking up and delivering hearing aid batteries

Post letters

Prescription and pension collection

Read letters (to partially sighted service user)

Reminding to take medication/fluids

Shopping on service users' behalf

Signposting to other local statutory, community and voluntary organisations

Support occupational therapist on access visit

Support service user – citizens advice bureau/disability advice bureau fill in attendance allowance form

Support to carers

Switch on storage heaters in service user's home – day before discharge

Take documents for photocopying

Take items to recycling

Taking service users shopping

Telephone assistance, 'check and chat'

Top up electricity key, gas card/contact British Gas

Topping up gas/electricity and helping to assist paying bills

Visit landlord and get light bulbs put in flat

Visit service user – not contactable so leave letter

Ward shopping before discharge

Appendix B – Information on matching

This table summarises the differences between Red Cross Support at Home patients and controls, a) before matching, and b) after matching.

Table B1. Standardised differences between Red Cross cases and a) pool of potential controls before matching, and b) the final matched control cohort. Proportions/means(standard deviation)

Type	Measure	Support at Home cases (N=1,573)	A) Potential controls (N=297,488)		B) Matched controls (N=1,573)	
			Proportions/ means (standard deviations)	Standardised difference	Proportions/ means (standard deviations)	Standardised difference
Age	Mean age	79.49 (10.68)	69.94 (14.1)	76.4%	79.48 (10.34)	0.1%
	Between 45 and 54	3.6%	18.9%	50.0%	2.9%	3.6%
	Between 55 and 64	7.4%	18.4%	33.3%	7.2%	0.7%
	Between 65 and 74	15.6%	20.6%	13.0%	15.8%	0.3%
	Between 75 and 84	36.0%	24.3%	25.8%	37.6%	3.3%
	85 and over	37.4%	17.9%	44.8%	36.6%	1.8%
Sex	% Female	62.7%	51.3%	23.2%	62.8%	0.3%
Ethnicity	% White	76.9%	67.1%	22.0%	77.1%	0.6%
	% Other	8.7%	11.9%	10.4%	8.3%	1.6%
	% Black	9.2%	9.9%	2.3%	7.9%	4.5%
	% Asian	3.8%	8.7%	20.7%	5.5%	8.5%
Deprivation	Mean Index of Multiple Deprivation (high = more deprived)	23.33 (11.49)	22.49 (11.61)	7.3%	23.11 (11.16)	2.0%
Number of conditions	Number of chronic condition	2.17 (1.62)	1.78 (1.66)	23.7%	2.16 (1.57)	0.7%
	Number of cancers	0.24 (0.7)	0.2 (0.62)	6.4%	0.22 (0.62)	3.0%

Table B1. Standardised differences, continued

Type	Measure	Support at Home cases (N=1,573)	A) Potential controls (N=297,488)		B) Matched controls (N=1,573)	
			Proportions/ means (standard deviations)	Standardised difference	Proportions/ means (standard deviations)	Standardised difference
Comorbidities	Cancer	18.4%	15.5%	7.9%	18.1%	0.8%
	Diabetes	23.4%	22.3%	2.5%	24.2%	1.8%
	Alcohol misuse	7.5%	6.4%	4.5%	5.8%	6.9%
	Hypertension	66.8%	53.6%	27.0%	66.0%	1.6%
	Congestive heart failure	19.2%	11.9%	20.2%	18.6%	1.6%
	COPD	17.2%	12.9%	12.1%	16.1%	2.9%
	Injury	51.9%	36.7%	31.0%	53.0%	2.0%
	Iatrogenic	8.5%	11.4%	9.8%	10.9%	8.2%
	Falls	37.4%	18.9%	42.0%	35.9%	3.3%
	Non-rheumatic valve disorder	7.5%	4.5%	12.7%	6.6%	3.5%
	Mental health problems	33.3%	24.2%	20.2%	31.5%	3.9%
	Ischaemic heart disease	25.5%	24.7%	1.9%	25.4%	0.1%
	Asthma	13.2%	11.8%	4.4%	11.8%	4.4%
	Angina	12.3%	11.6%	2.4%	10.9%	4.6%
	Anaemia	20.9%	15.2%	14.8%	21.9%	2.5%
	Atrial fibrillation	25.4%	17.8%	18.4%	27.0%	3.6%
	Cardiovascular disease	22.6%	15.0%	19.7%	25.9%	7.6%
	Connective tissue disorder/ rheumatoid arthritis	6.3%	4.2%	9.3%	6.2%	0.5%
	Mild liver disorders	2.9%	3.5%	3.0%	3.1%	0.7%
	Peripheral vascular disease	24.5%	15.4%	23.0%	22.8%	4.0%
	Renal failure	9.9%	9.3%	1.7%	10.6%	2.3%
	Respiratory/ influenza	19.2%	12.9%	17.3%	19.3%	0.2%

Table B1. Standardised differences, continued

Type	Measure	Support at Home cases (N=1,573)	A) Potential controls (N=297,488)		B) Matched controls (N=1,573)	
			Proportions/ means (standard deviations)	Standardised difference	Proportions/ means (standard deviations)	Standardised difference
Diagnoses associated with ageing	Dementia	7.9%	7.0%	3.3%	9.2%	4.8%
	Mental health and substance misuse	12.4%	10.9%	4.8%	11.3%	3.3%
	Depressive disorder	13.7%	9.2%	13.9%	12.5%	3.6%
	Other mental health problems	11.4%	6.4%	17.6%	10.9%	1.8%
	Parkinson's disease	3.1%	2.1%	5.9%	3.9%	4.5%
	Other movement disorders	1.0%	0.6%	3.5%	0.9%	0.7%
	Alzheimer's disease	3.5%	2.4%	6.3%	3.1%	2.1%
	Other degenerative disease	1.2%	1.4%	1.9%	1.8%	5.2%
	Paralytic syndromes	4.5%	4.5%	0.0%	7.3%	11.9%
	Cerebrovascular illness	21.3%	13.4%	21.1%	23.5%	5.3%
	Pneumonia	18.8%	13.7%	14.0%	18.6%	0.7%
	Lower respiratory infections	13.7%	10.6%	9.7%	15.8%	5.9%
	Ulcers	11.1%	6.0%	18.4%	11.0%	0.4%
	Osteopathies	13.9%	8.2%	18.2%	13.9%	0.2%
	Urinary disorders	34.2%	20.1%	32.2%	32.4%	3.8%
	Other cognitive disorders	21.0%	12.9%	21.8%	21.8%	1.9%
	Fatigue, collapse, senility	33.5%	17.1%	38.4%	31.0%	5.4%
	Fractures	18.4%	10.2%	23.7%	19.3%	2.1%
	Rehabilitation	4.8%	4.8%	0.1%	6.9%	9.0%
	Life management	14.3%	6.5%	25.6%	13.0%	3.9%

Table B1. Standardised differences, continued

Type	Measure	Support at Home cases (N=1,573)	A) Potential controls (N=297,488)		B) Matched controls (N=1,573)	
			Proportions/ means (standard deviations)	Standardised difference	Proportions/ means (standard deviations)	Standardised difference
Prior hospital activity	No. emergency admissions prior year	2.33 (2.4)	2.33 (4.41)	0.0%	2.28 (2.32)	2.0%
	No. emergency admissions two years prior	0.73 (1.67)	0.75 (2.67)	1.0%	0.68 (1.6)	3.1%
	No. non-emergency admissions prior year	0.49 (1.12)	0.74 (2.95)	11.1%	0.61 (3.77)	4.2%
	No. non-emergency admissions two years prior	0.44 (1.28)	0.55 (2.74)	5.4%	0.45 (1.43)	0.7%
	No. outpatient attendances prior year	6.48 (9.07)	6.21 (9.59)	3.0%	6.16 (8.82)	3.7%
	No. outpatient attendances two years prior	5.25 (7.98)	4.82 (7.86)	5.4%	5.23 (8.2)	0.2%
	No. A&E visits prior year	2.88 (5.26)	2.59 (5.61)	5.3%	2.61 (3.88)	5.7%
	No. A&E visits two years prior	1.14 (3.26)	1.03 (4.32)	2.9%	0.97 (2.81)	5.7%

Table B1. Standardised differences, continued

Type	Measure	Support at Home cases (N=1,573)	A) Potential controls (N=297,488)		B) Matched controls (N=1,573)	
			Proportions/ means (standard deviations)	Standardised difference	Proportions/ means (standard deviations)	Standardised difference
Index spell properties	Length of spell	17.71 (20.7)	7.23 (13.45)	60.1%	16.97 (20.74)	3.6%
	Date of spell	19 Nov 2010 (551.1)	23 July 2010 (557.8)	21.5%	10 Oct 2010 (552.4)	7.2%
	Treatment specialty – General medicine	39.2%	36.8%	4.8%	34.6%	9.5%
	Treatment specialty – A&E	24.0%	22.0%	4.7%	20.9%	7.6%
	Treatment specialty – Geriatric medicine	17.4%	10.8%	19.2%	16.3%	2.9%
	Treatment specialty – Trauma and orthopaedics	6.9%	4.4%	10.7%	6.9%	0.0%
	Treatment specialty – General surgery	3.9%	7.7%	16.3%	5.6%	7.8%
	Primary diagnosis – 'Signs and symptoms'	18.7%	24.4%	13.9%	18.6%	0.3%
	Primary diagnosis – 'Circulatory diseases'	14.6%	13.1%	4.5%	14.3%	0.9%
	Primary diagnosis – 'Injury'	15.5%	9.6%	18.0%	15.2%	0.9%
	Primary diagnosis – 'Respiratory diseases'	11.8%	10.8%	2.9%	11.7%	0.2%
	Primary diagnosis – 'Musculoskeletal and connective tissue diseases'	6.2%	4.9%	5.9%	3.9%	10.4%
	Primary diagnosis – 'Genitourinary diseases'	9.0%	6.9%	7.6%	8.7%	0.9%
	Primary diagnosis – 'Digestive system diseases'	6.5%	9.2%	10.1%	7.9%	5.4%

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