Supplement

Evaluation of past and present implementation of Telemonitoring NI: Telecare component

1. Background

As described in the main Telehealth Northern Ireland report, the Telecare NI programme uses a different approach to the telehealth programme and serves a different purpose (Figure 1). It involves the use of sensors in patients' homes to detect events, such as smoke in the kitchen, front door left open or patient has had a fall. Outputs from these sensors are monitored remotely by the telecare team who can provide assistance, as required, either by telephone or via the emergency services. Facilitation of such rapid responses has the aim of promoting early intervention and therefore maintaining patient wellbeing.

The focus of this supplement is on documenting telecare provision through analysis of patient data held by the service provider (TF3) and via linkage to data held by the Health and Social Care (HSC) Trusts on healthcare usage, including: hospital admission data, outpatient data, and accident and emergency (A&E) data. Due to financial and time constraints, unlike the telehealth evaluation, this work did not involve any focus groups or interviews with patients, their carers or healthcare professionals or the completion of any questionnaires by patients. It was restricted to collation and analysis of existing datasets. Furthermore there were no control (service recommended but not installed) data and as such the report provides only descriptive data about the service.

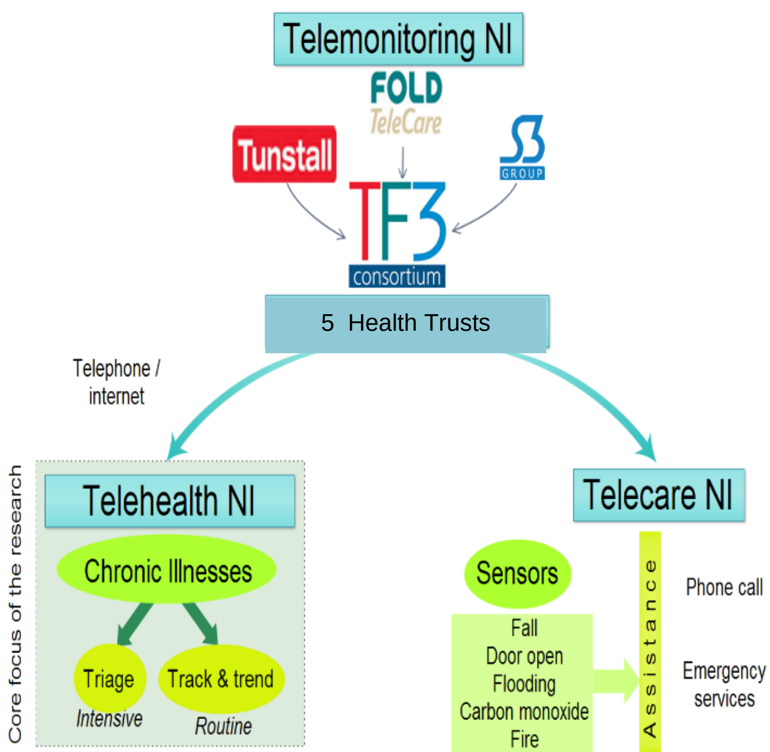

Figure 1 Diagrammatic representation of the services delivered under the Telemonitoring N. Ireland umbrella

2. Aim of the study

The primary aim was to carry out a preliminary evaluation of the telecare provision across N. Ireland.
The specific objective was to carry out a descriptive analysis of data held by TF3 and the HSC Trusts on the Telecare NI programme.

3. Research overview

3.1 Permissions required

Similar to the telehealth project, the telecare evaluation involved research relating to individual patients and required a range of permissions to allow access to patient specific data. These permissions were applied for in parallel to the telehealth permissions (see main report): ethical approval from the Office of Research Ethics Committee Northern Ireland (ORECNI), Trust governance approvals and Data Access Agreements approved by all Trust Information Governance teams. Honest Broker Service approvals and Change Control Requests (to allow data extraction from TF3 datasets) were approved in September 2015 and January 2016, respectively.

3.2 General principles of the evaluation

The same principles used for the descriptive component in the telehealth study were applied. Anonymised routine healthcare utilisation data or administrative data already collected by the Telemonitoring NI team were used.

4. Methodology

4.1 Descriptive summary of the uptake of the telecare service

The objective of this aspect of the research was to use routine data collected by the provider (TF3) as part of the service provision, together with datasets held in the Business Services Organisation Information Technology Services (BSO ITS), to provide a descriptive summary of the services delivered from the earliest data available electronically to the present time. Patient-level data obtained from TF3 were anonymised by BSO ITS and made available to researchers in the Honest Broker Service (HBS).

4.1.1 Data acquisition

Following detailed discussions with TF3 on the data held by them and following clearance by the data guardians at the five HSC Trusts, TF3 provided datasets to the HBS for access by the research team.

All five HSC Trusts assisted in preliminary work to populate health and social care numbers (HCNs) against data entries because this was historically not mandatory and the majority were not available in the

TF3 data. The HCN is a unique identifier for all patients registered to receive national health services in Northern Ireland and was crucial for data linkage. This process was critical to the analysis of basic demographic data, including age and gender as these latter data were not always collected as part of the delivery of the telecare service.

4.1.2 Data analysis

Two datasets were used in the evaluation. In the first part of the results section (descriptive study), the complete dataset for which electronic records were available was used to review the uptake of the service and included 2387 patients (Results – section 5.1). The second dataset (quantitative study) involved 1883 patients (Results – section 5.2). In this latter dataset, in which we examined, for example, hospitalisations pre- and post-installation of the telecare equipment, the following patients were excluded: (i) Patients who had no installation date specified in the data sets, (ii) Patients who had telecare installation within the first 6 months from the starting date (26 February 2010) and (iii) Patients who had telecare installation within the last 6 before the end date (22 February 2016). These exclusions were required to allow calculation of events per year (with a six month period the minimum observation period on which to base the calculations).

Individual patients were matched with their routine healthcare utilisation data. The ***date of installation*** was used as the cut point to demarcate pre- and post-telecare use. Healthcare utilisation data were available for the period 26 February 2010 until 22 February 2016. Data were computed for each patient within this timeframe for the period before the installation date and for the period after the installation date (a minimum of 6 months data pre and post installation were required for patient inclusion, as detailed above). If a patient died after installation, date of death was inserted as the endpoint for that individual.

5. Results

5.1 Descriptive summary of the uptake of the telecare service (2387 patients)

This section provides a descriptive overview of patients referred to the telecare service. Data are reported at the individual patient level as far as possible, but where appropriate, data are presented on a referral basis (bearing in mind that some patients were referred more than once). Demographic data were available for a total of 2387 individual patients (Table 1), but some of these patients did not have telecare related data available. Of those who were referred to the service, 205 people (8.5%) were recorded as deceased.

5.1.1 Demographic information

Age: Based on the recorded data, patients ranged from 4 to 114 years of age at the time of enrolment, with a mean of 77.8 (standard deviation: 12.2) and median of 81 years.

Table 1 Age distribution of participating patients

Age	N	%	Cumulative %
0-39	34	1.4	1.4
40-49	54	2.3	3.7
50-59	135	5.7	9.4
60-64	72	3.0	12.4
65-69	118	4.9	17.3
70-74	258	10.8	28.1
75-79	421	17.6	45.7
80-84	577	24.2	69.9
85-89	466	19.5	89.4
90-94	216	9.1	98.5
95+	36	1.5	100.0
Total	2387	100.0	100.0

Gender: More females (1617 or 67.7%) than males (770 or 32.3%) were enrolled in the telecare service.

Keywords: The main keywords recorded in relation to telecare usage were: medical, urgent, mobility and mind-state.

5.1.2 Call information

Calls: 2330 patients had call information and 57 did not. There were between 1 to 7183 calls per patient, with a mean of 86.8 calls (standard deviation: 235.7) and a median of 33 calls.

5.1.3 Equipment

Equipment: there were between 1 to 10 items of equipment installed in patients' homes, with a mean of 2.6 (standard deviation: 1.7) and median of 2 items of equipment per patient. Table 2 indicates the number of items of equipment provided to patients. Information about equipment was missing for 169 patients.

Table 2 Number of items of equipment provided to patients

Number of items of equipment	Patients (n)	%
1	858	35.9
2	422	17.7
3	332	13.9
4	282	11.8
5	176	7.4
6	84	3.5
7	30	1.3
8	24	1.0
9 or 10	10	0.4
Missing	169	7.1
Total	2387	100.0

5.1.4 Referral information

Referring Trusts: the number of patients by Trust (from highest to lowest) are: BHSCT (478 patients), NHSCT (416), WHSCT (226), SEHSCT (119) and finally 'unknown', which also includes patients from the SHSCT (1148). The latter two groups (unknown and SHSCT) were combined because there were so few participating patients within the SHSCT that the Honest Broker Service, according to its house rules, would not permit the SHSCT data to be analysed separately.

Multiple referrals: 14 patients were referred twice.

Service user priority: service user priority information was missing for 1147 patients due to a lack of referral information being available for these Study IDs. Of the remainder, most referrals (808) involved 'normal' service user priority and 446 referrals were categorised as 'urgent.'

Termination reasons: the vast majority of patients whose service had been terminated had no reason given for termination (1119). Reasons that were given were: removed from PNC (64), gone into care (27), deceased (25) and no longer needed/cancelled (19). There were 1147 patients with missing termination reasons, which may be because their referral has not been terminated. The 14 people who were referred twice had also had their service terminated twice.

Service type referred for: Patients were referred to receive different 'bands' (bundles) of equipment (A, B, C and E), which are described in Appendix 1. The numbers of patients receiving the different equipment bundles were as follows: RTNI B band equipment (518 patients), RTNI C band equipment (468), RTNI E band equipment (132) and RTNI A band equipment (43). There were 93 patients with an unassigned service type band and 1147 with missing information on their bundle.

5.1.5 Patient deprivation and proximity to services

The 2011 Super Output Areas (SOAs) were used to examine the distribution of the addresses of telecare service users in accordance with deprivation indices. In particular, we used the Multiple Deprivation Measure (MDM) and the proximity to services subscale within this measure. All 2387 patients had an address recorded. If an even distribution was present, there should be equal distribution across all ten deciles on each of the scales. Figure 2 shows that there was an under-representation of patients from the least deprived deciles for MDM rank, however, there was an over-representation in the 1st, 2nd, 8th and 10th deciles with all other deciles being under-represented for proximity to services subscale.

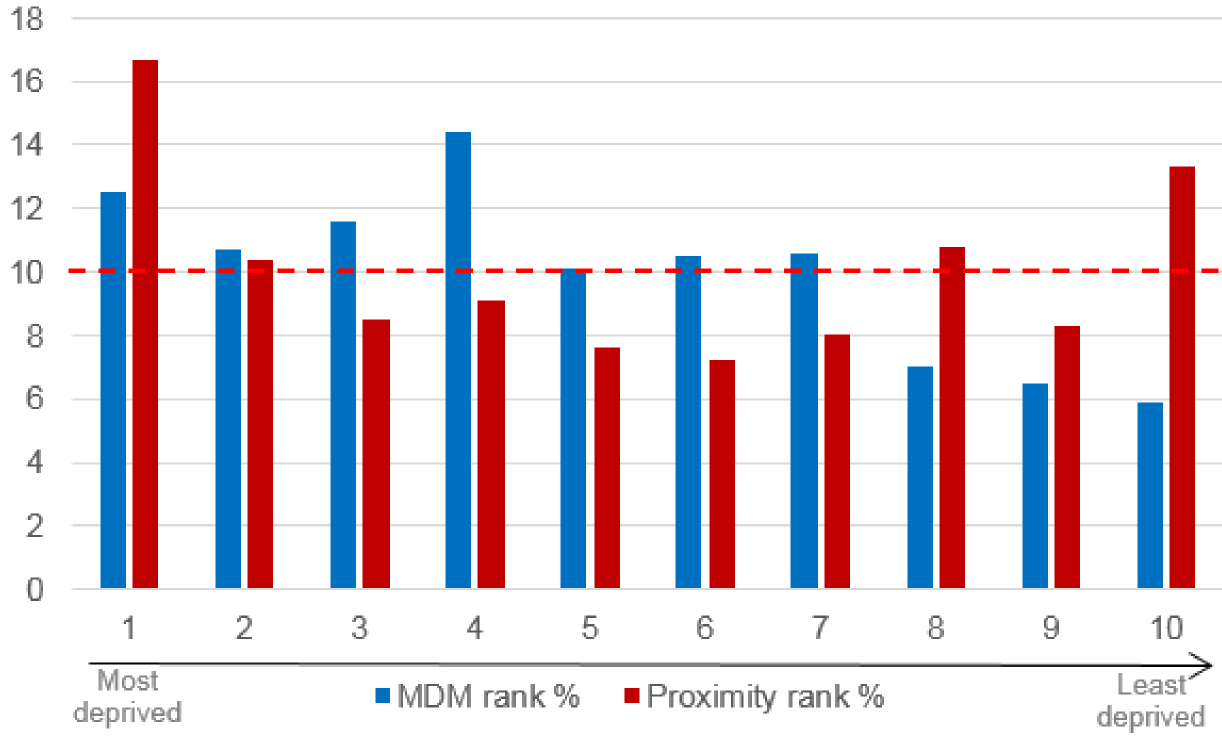

Figure 2 Distribution of patient deprivation in terms of overall MDM rank and proximity to services subscale

5.1.6 Relationships between variables

A number of cross tabulations were done to characterise the distribution across the different Trusts and patient groupings. Exemplars of the findings are presented in Figures 3-7. The Y-axis in all cases is number of individual patients.

(i) Age group by gender

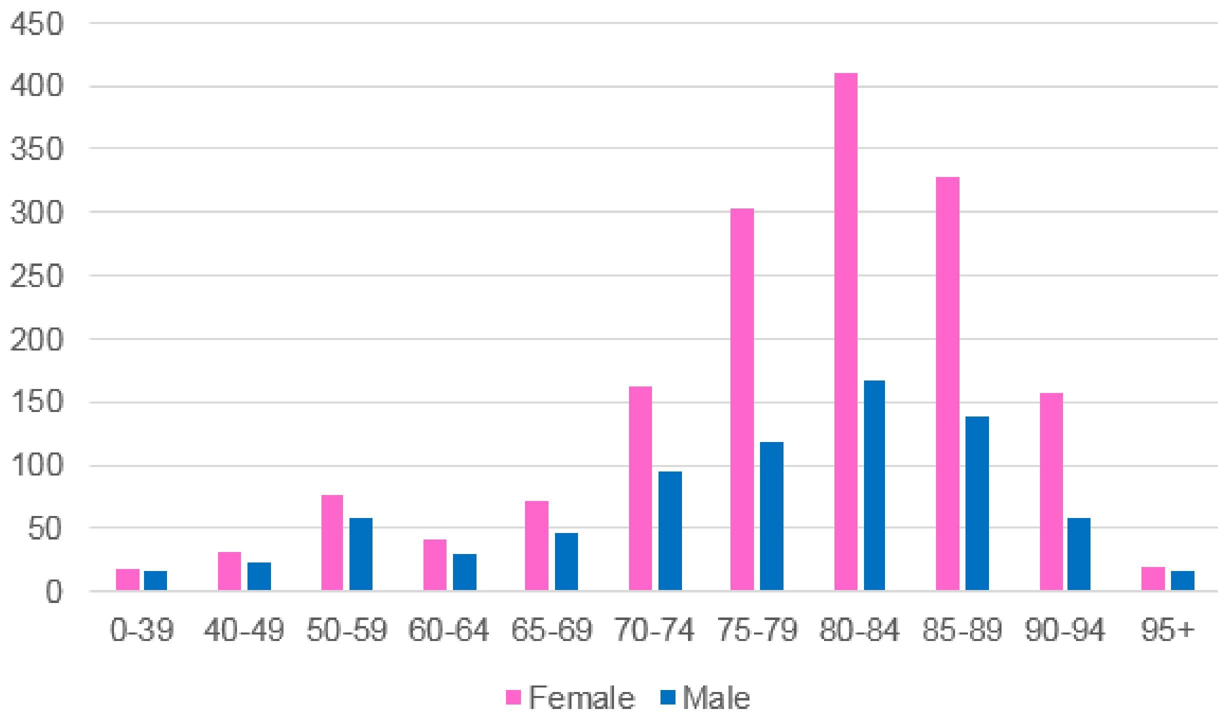

Figure 3 Groups of patients who received the telecare service by age and gender

Figure 3 shows that there were more female referrals compared to males across all age groups. This imbalance is particularly manifest in the patients aged 70-94 years.

(ii) Gender by Trust (RTNI authority)

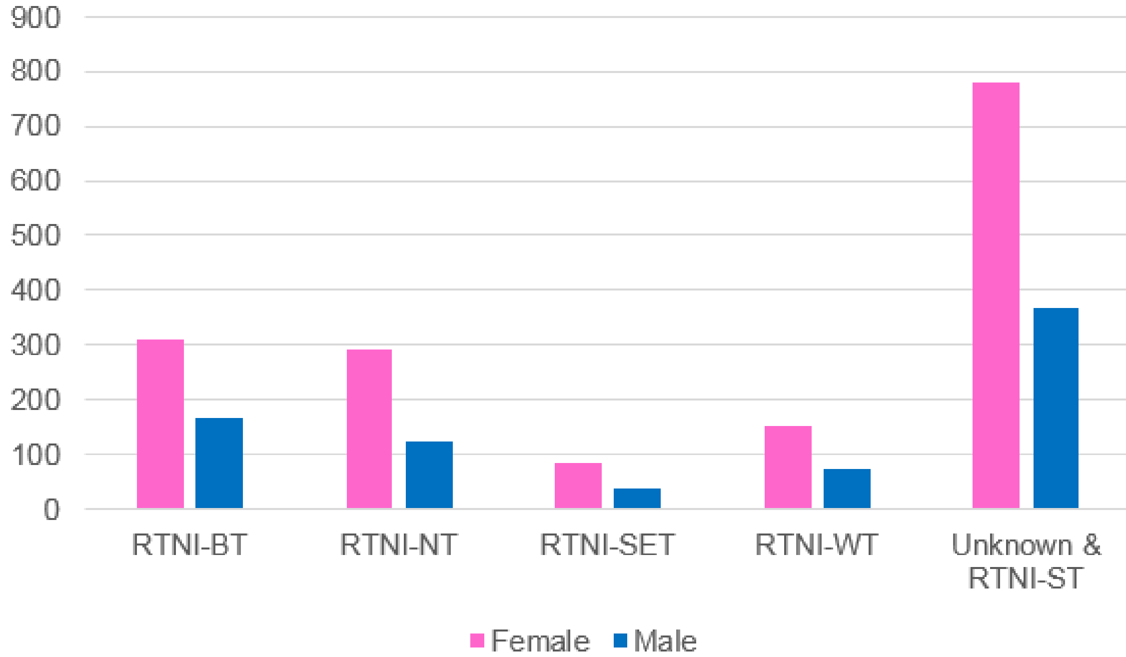

Figure 4 Gender of patients who were managed via the telecare service by Trust

There was also more females than males in each Trust.

(iii) Age group by Trust (RTNI authority)

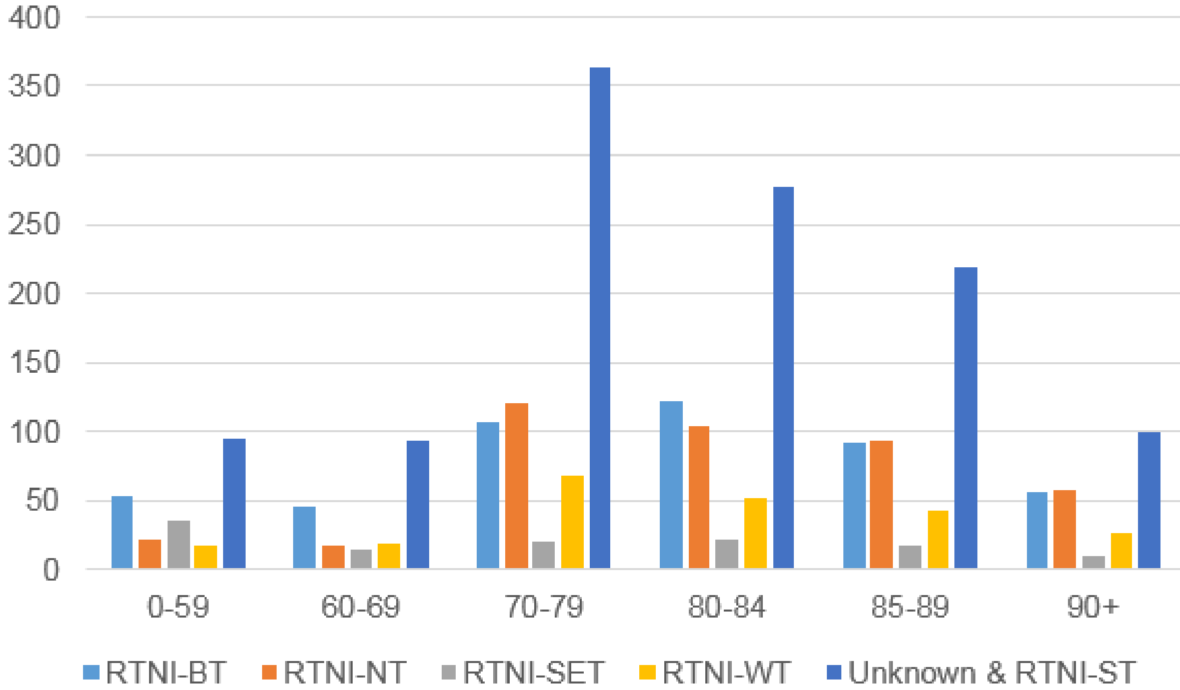

Figure 5 Age groups of patients who were managed via the telecare service by Trust

(iv) Mortality by age group

As expected, mortality rates were highest in patients older than 85 years.

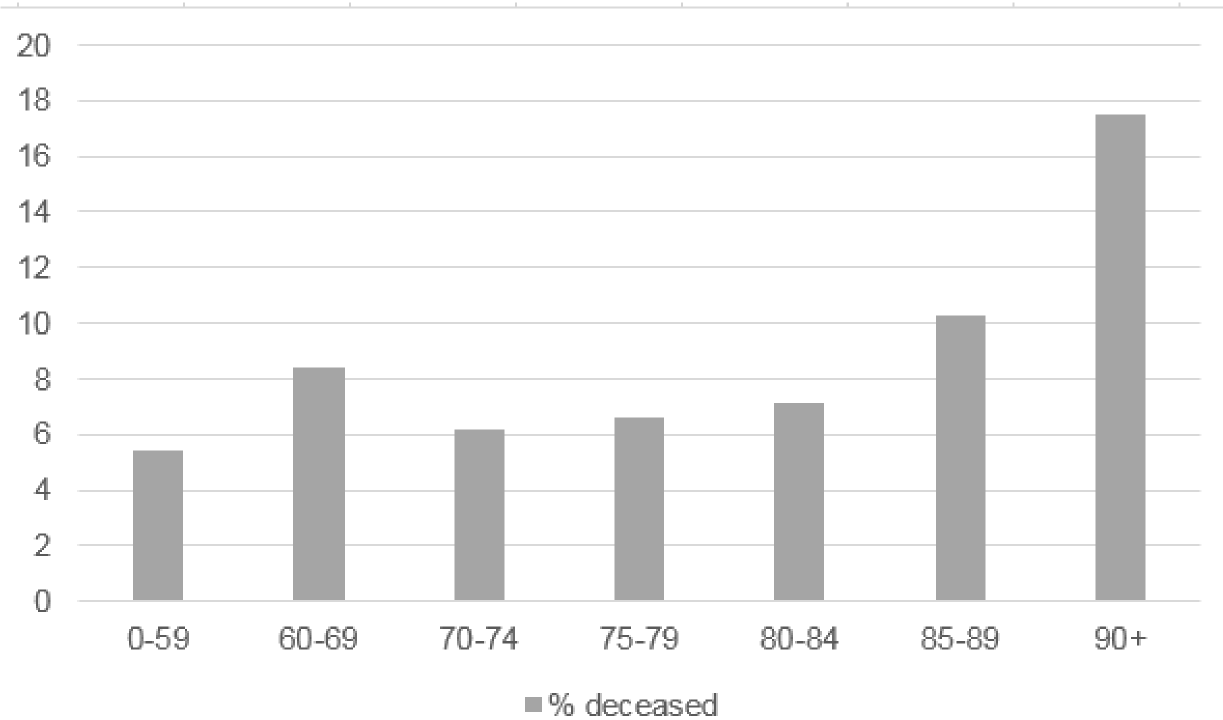

Figure 6 Mortality (% deceased) of patients on the telecare service by age group

(v) Mortality by gender

Mortality was higher in males than in females.

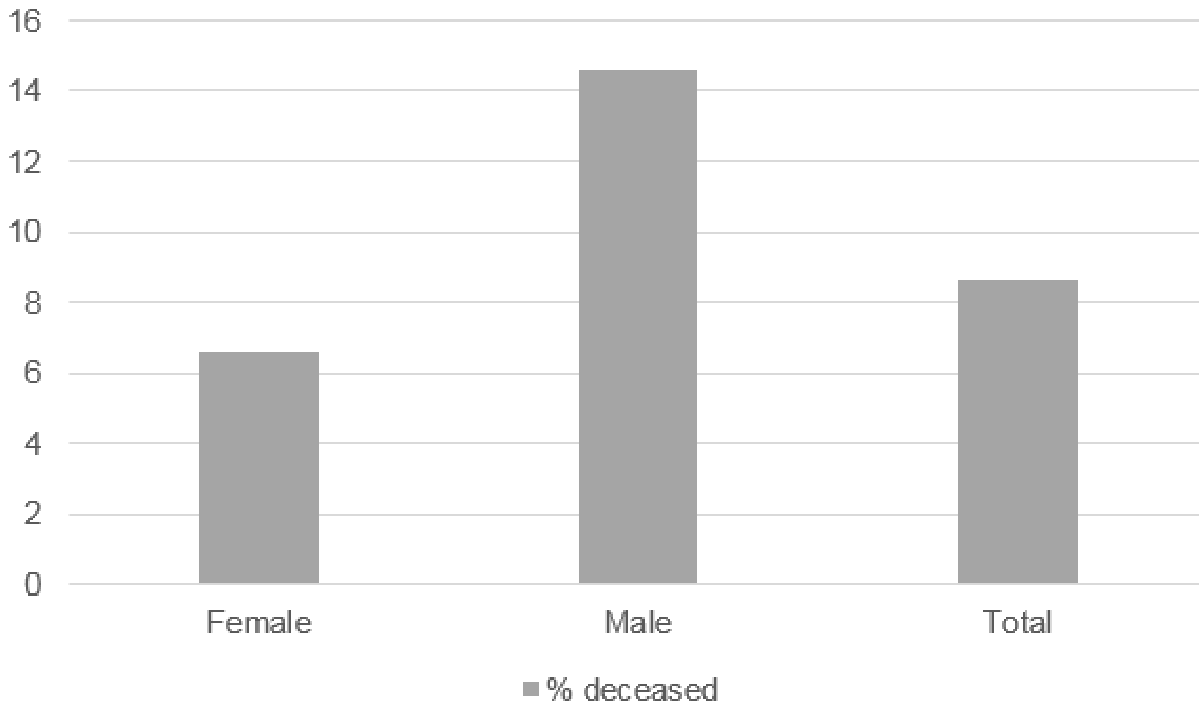

Figure 7 Mortality rate (% deceased) of patients on the telecare service by gender

5.2 Quantitative analysis (1883 patients)

5.2.1 Frequency of installation of telecare equipment

Data were available for 1883 individuals who were referred during the study period from 26 February 2010 to 22 February 2016 and had data covering a minimum of 6 months pre and post their installation date. Almost all users (99%) had a call advisor unit installed in their homes, 44% had a fall detector device, 23% had an alarm (for any reason) and 15% had fire detectors installed. Installation of the other pieces of telecare equipment was less common (Figure 8).

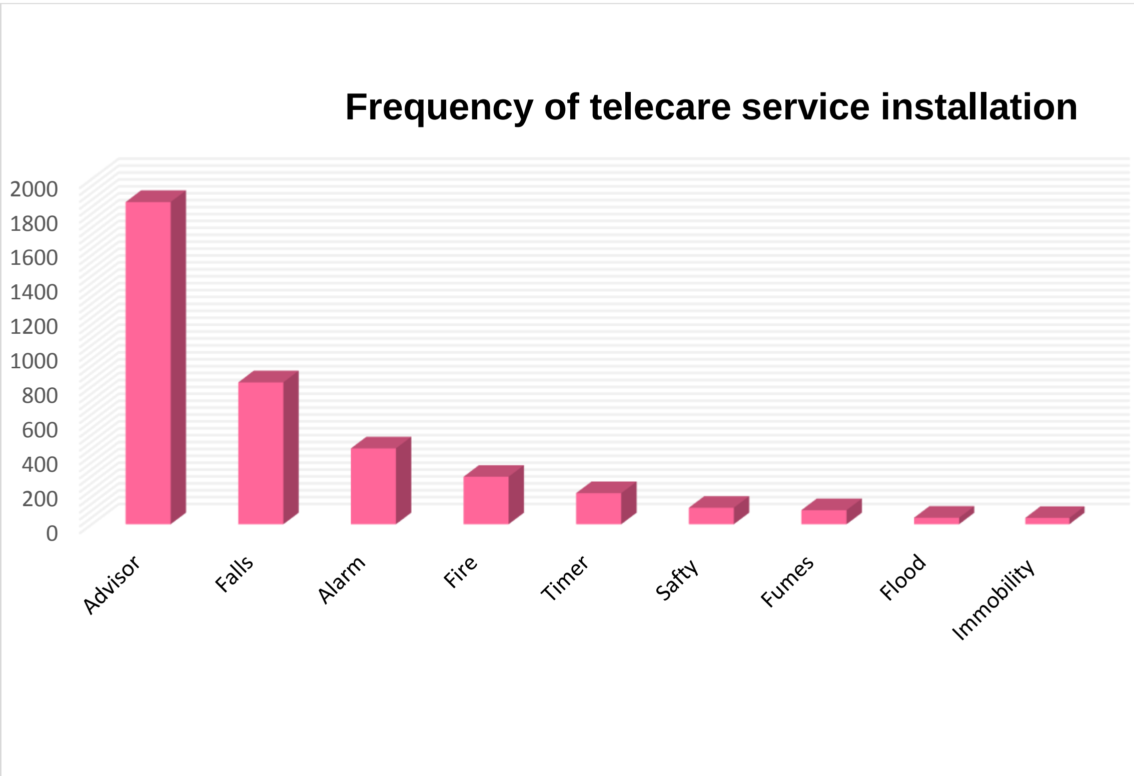

Figure 8 Frequency of telecare monitoring equipment installed for telecare users

5.2.2 Frequency of telecare equipment band (bundle) installations

The total number of individuals who had one of the telecare equipment bands A, B, C and D installed was 790. Bands B and C were the most popular (42% and 41% respectively), while band E and A had fewer users (11% and 5% respectively) (Figure 9).

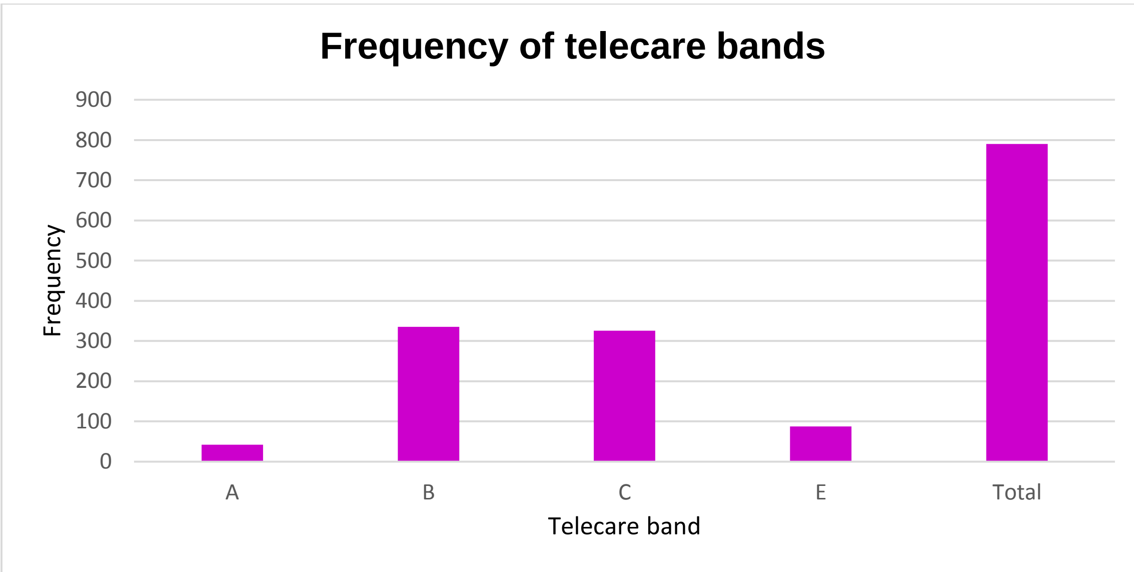

Figure 9 Frequency of installation of telecare equipment bands (bundles)

5.2.3 Frequency of telecare bands by age group

In order to meet Honest Broker System rules (i.e. cannot report groups with less than 10 individuals), age groups 0-64 years and 65 to 74 years had to be combined for the presentation of results for this comparison. The reformatted data indicated that telecare bands B and C were by far the most common installation for patients across all age groups (Figure 10). Bands A and E had fewer users.

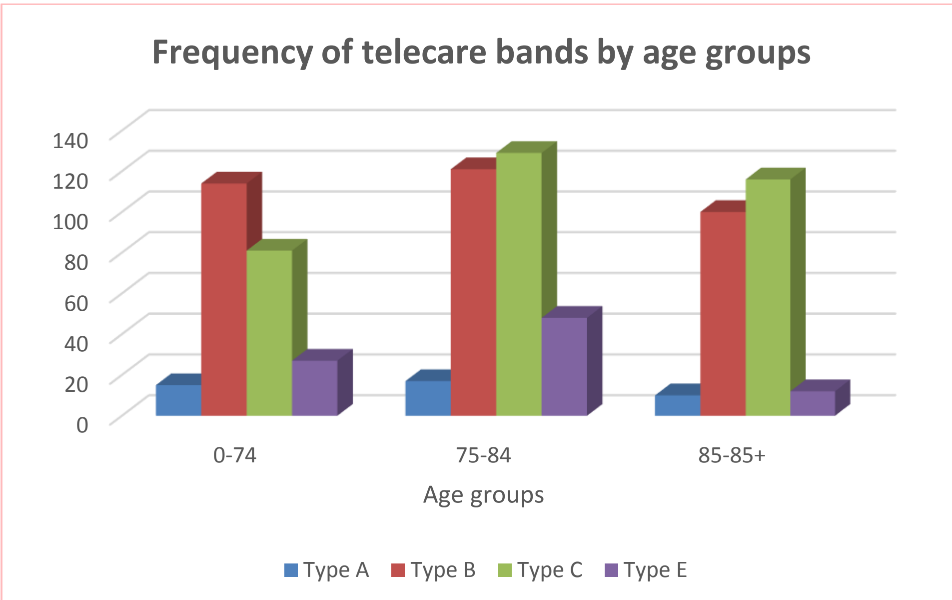

Figure 10 Frequency of telecare band installations by age group

5.2.4 Average number of calls by age group

The average number of calls per year was highest for patients aged ≥ 85 years old, with an average of 86 calls/year received in this group (Figure 11).

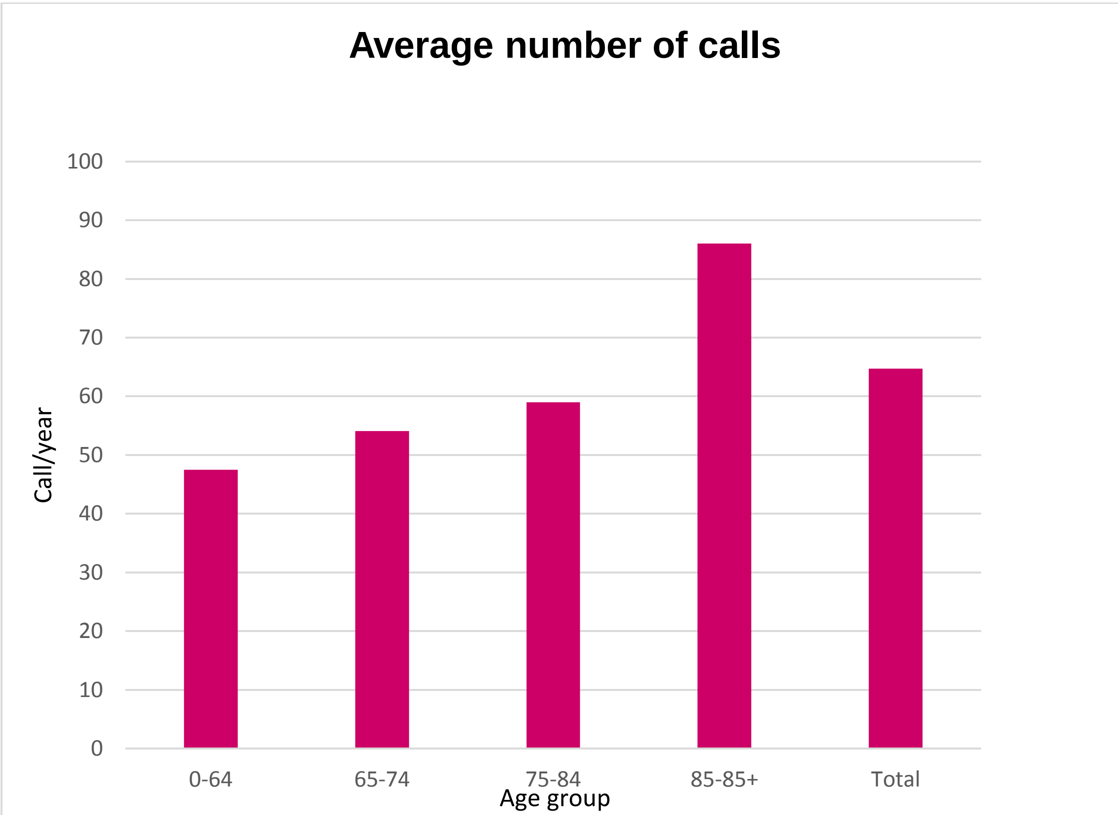

Figure 11 Average number of calls per year by age group

5.2.5 Average number of calls by gender

The average number of calls per year was similar for males and females (Figure 12).

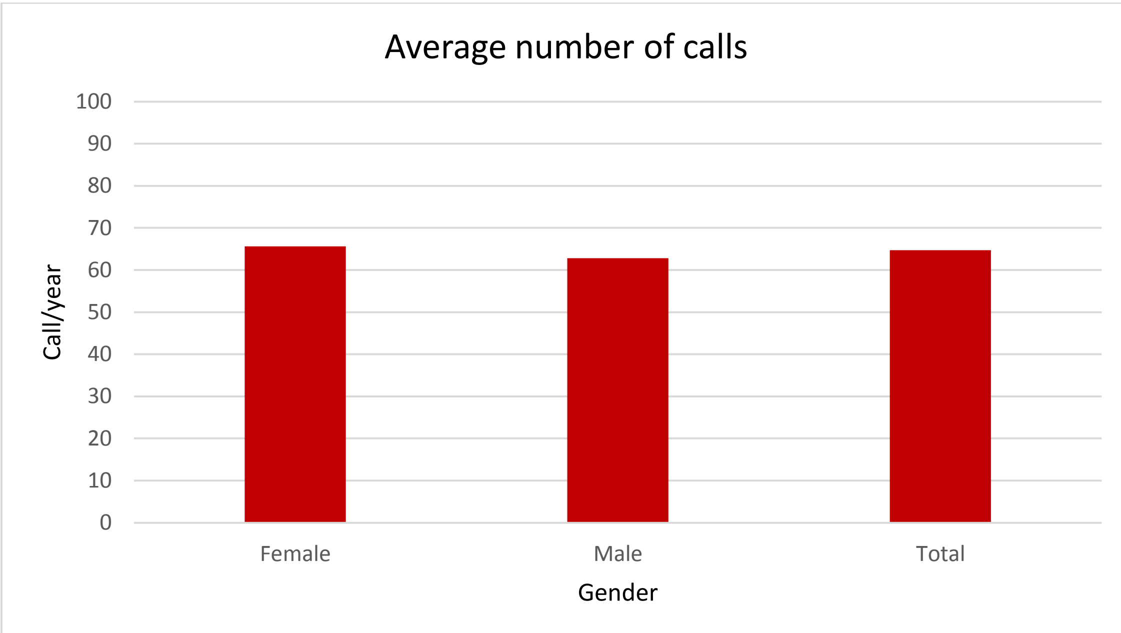

Figure 12 Average number of calls per year by gender

5.2.6 Mortality

Approximately 6% of the patients within this cohort died during the follow-up period. A Kaplan-Meier plot (Figure13) indicated that the mortality rate remained constant over the follow up period.

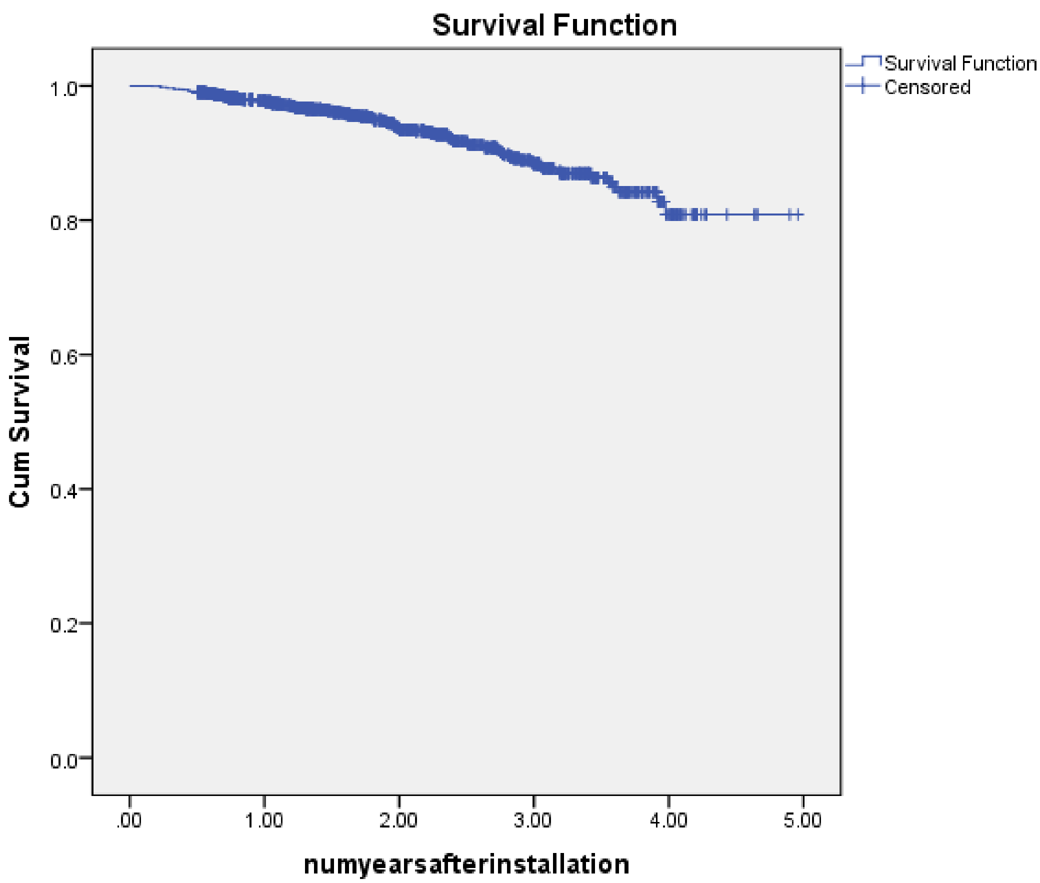

Figure 13 Kaplan-Meier survival plot for patients who had telecare equipment installed

5.2.7 Non-elective hospital admissions (by telecare equipment type)

The average number of non-elective admissions to hospital increased from 0.5 (SD: 0.6) admissions/year to 1.0 (1.5) admissions/year after the index (installation) dates. There was a statistical significant increase in the average number of admissions after installation of telecare services ($p<0.05$) as shown in Figure 14.

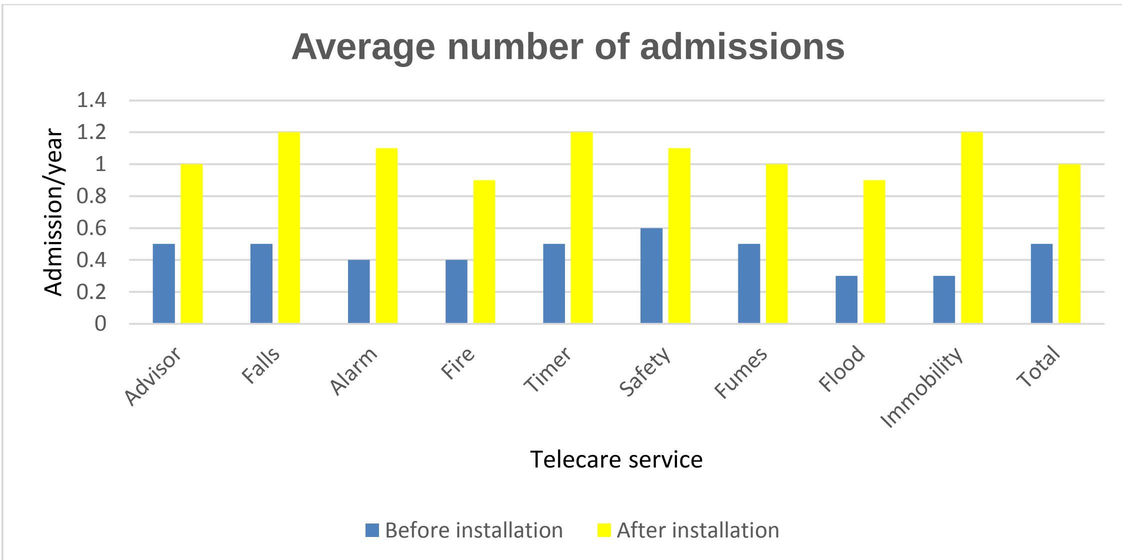

Figure 14 Non-elective admissions for differing telecare services, pre and post installation

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.8 Hospital admissions for different telecare bands

Data were available on hospital admissions for 790 patients by telecare band. These data are shown in Figure 15 as the mean number of admission per year, pre and post the installation of telecare equipment for the four bands (equipment bundles) A, B, C and E. The average number of hospital admissions increased after telecare installation in all bands.

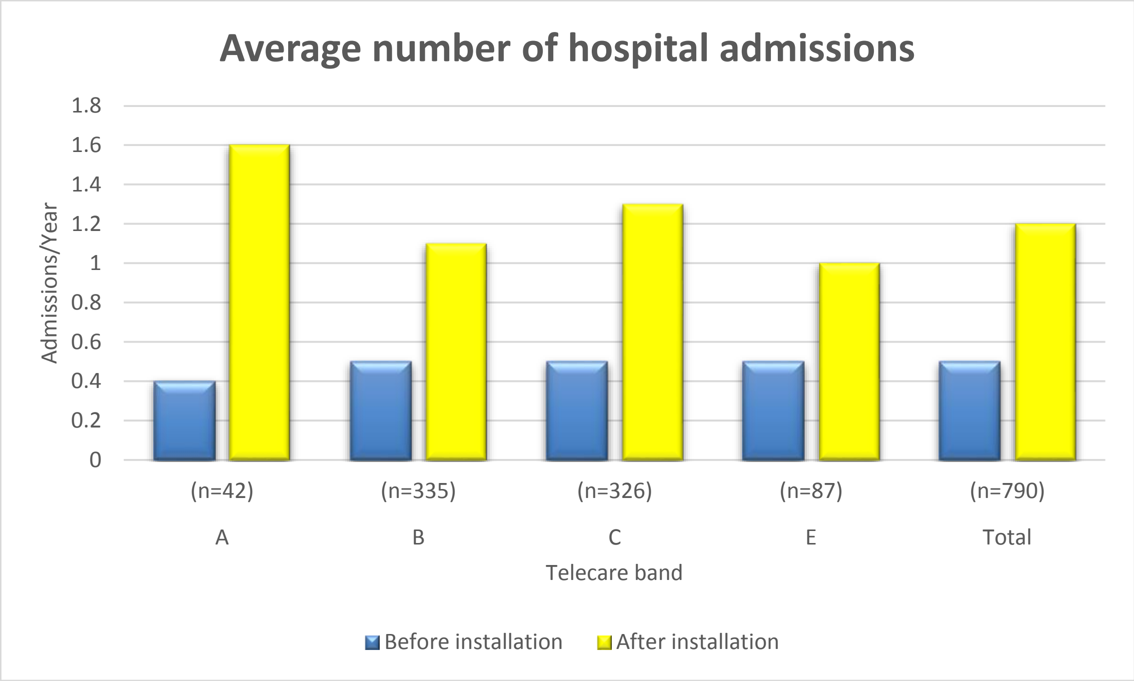

Figure 15 Non-elective admissions according to telecare band installations

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.9 Hospital stay (by telecare equipment type)

Data for length of hospital stay, presented as mean number of hours per year, pre and post the implementation of telecare services for the nine different types of telecare equipment are shown in Figure 16. The average length of hospital stay increased for all types of telecare services, with an overall increase from 115.3 (SD: 190.6) hours/year per patient to 232.2 (485.2) hours/year after the installation ($P<0.05$).

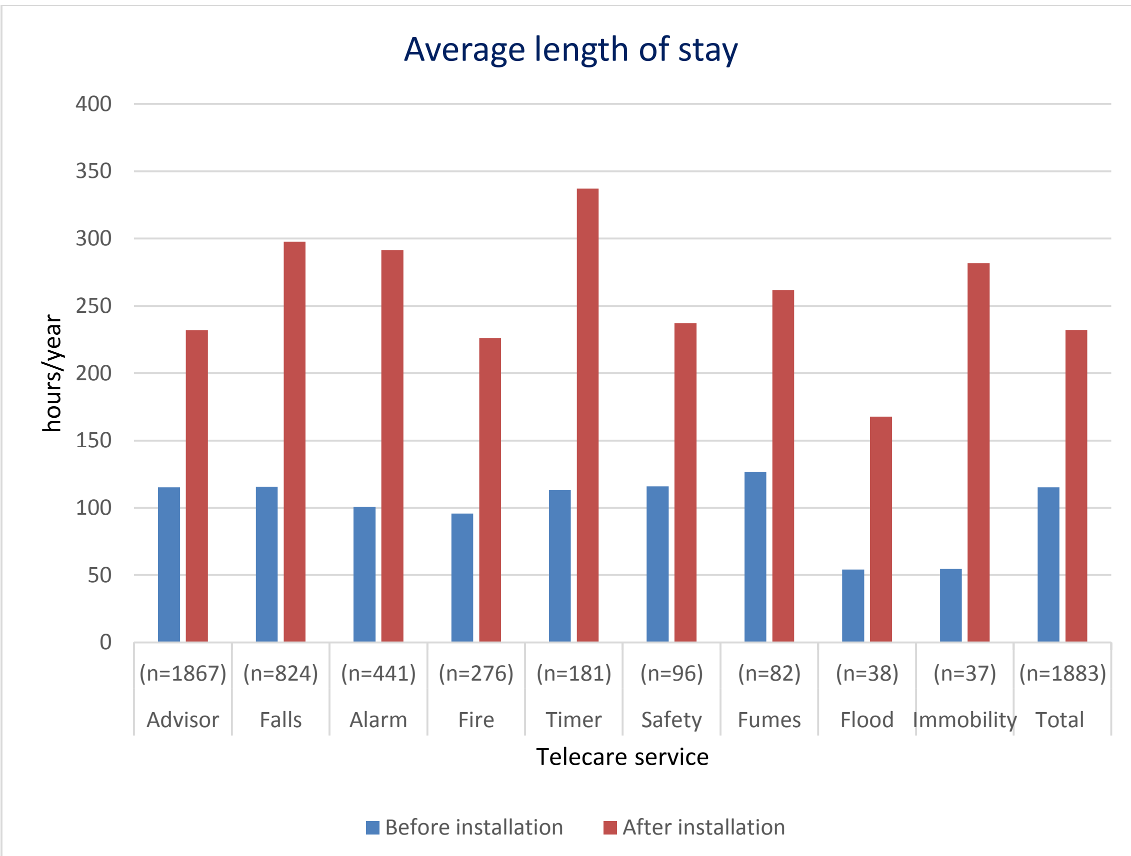

Figure 16 Average length of hospital stay, pre and post installation of telecare equipment types

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.10 Hospital stay for different telecare bands

Data for length of hospital stay, presented as mean number of hours per year, pre and post the implementation of telecare services for the four telecare equipment bands are presented in Figure 17. The average length of hospital stay increased for all telecare bands after installation ($P<0.05$).

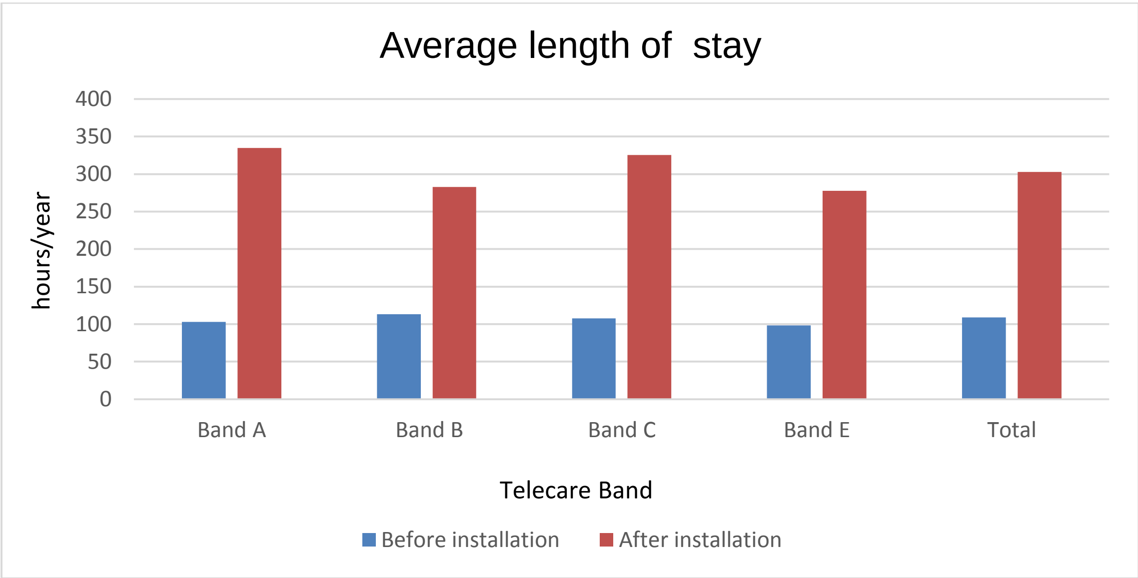

Figure 17 Average length of stay, pre and post installation of telecare bands

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.11 Emergency room visits (by telecare equipment type)

Data for the number of emergency room visits per year, pre and post the implementation of telecare services for the nine target services are presented in Figure 18. The average number of emergency room visits increased for all of the nine equipment types with a total increase from 1.1 (SD: 1.7) visits/year per patient to 1.6 (2.5) visits/year after installation (P<0.05).

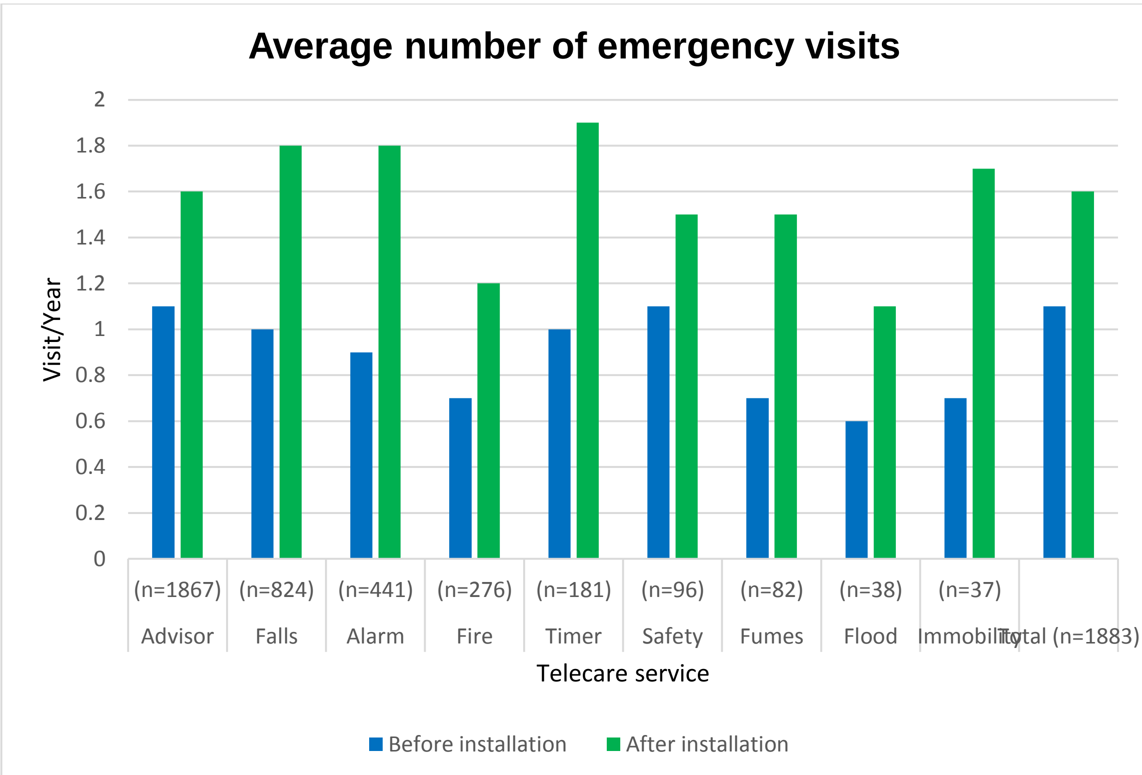

Figure 18 Average number of emergency visits, pre and post installation of telecare equipment types

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.12 Emergency visits for different telecare bands

Data for emergency room visits per year, pre and post the implementation of telecare for the four telecare bands are presented in Figure 19. The average number of emergency room visits/year increased after telecare installation for all bands. For patients with data on band, the average number increased from 0.92 (SD: 1.1) visits/year per patient to 1.9 (3.0) visit/year after the installation ($P<0.05$).

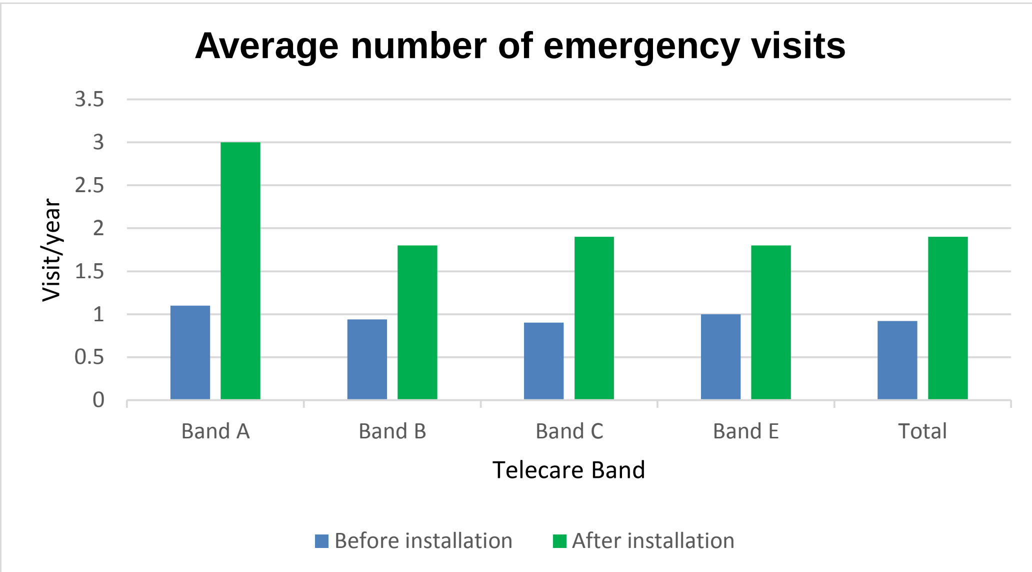

Figure 19 Average number of emergency visits, pre and post installation of telecare bands

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.13 Outpatient visits (by telecare equipment type)

Data for outpatient visits per year, pre and post the implementation of telecare services for the nine target services are presented in Figure 20. The average number of outpatient visits increased from 6.4 (SD: 8.4) visits/year per patient to 7.4 (8.7) visits/year after installation (P<0.05).

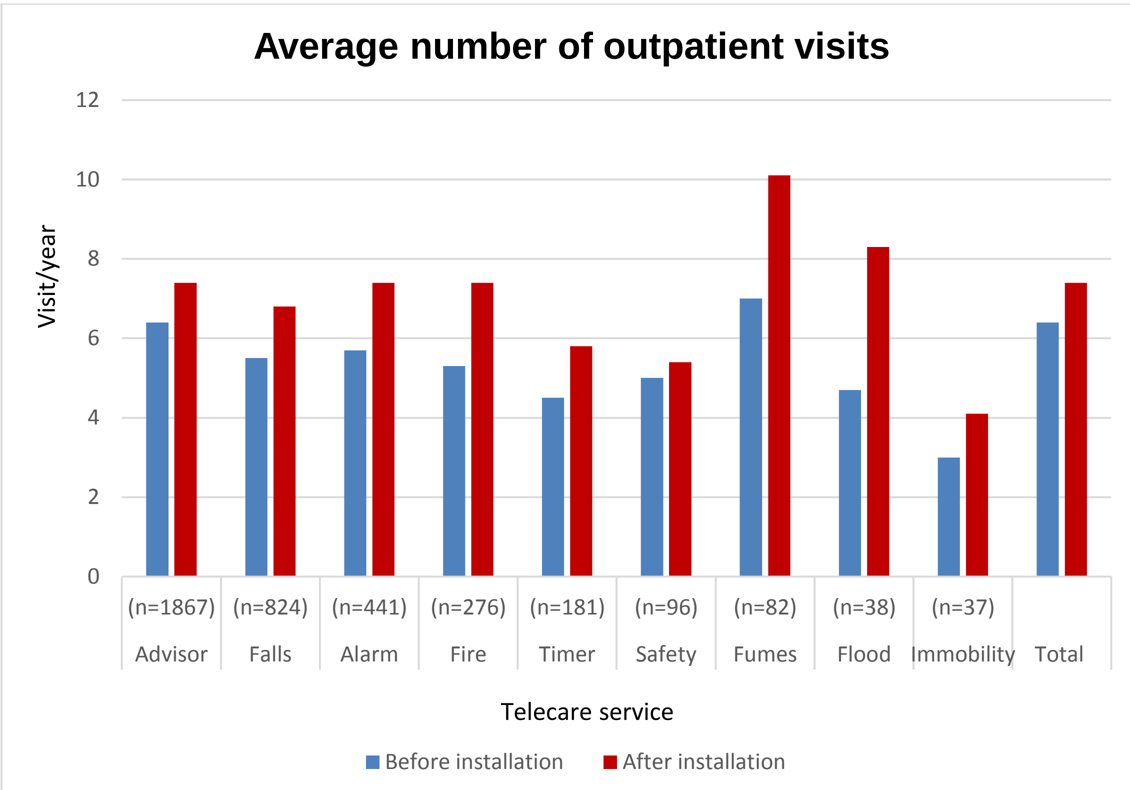

Figure 20 Comparison of average number of outpatient visits, pre and post installation of the different telecare equipment types

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

5.2.14 Outpatient visits for different telecare bands

Data for outpatient visits per year, pre and post the installation of the four telecare bands are presented in Figure 21. For patients with data on band, the average number of outpatient visits increased from 5.2 (SD: 6.2) visits/year per patient to 6.7 (8.5) visits/year after installation (P<0.05).

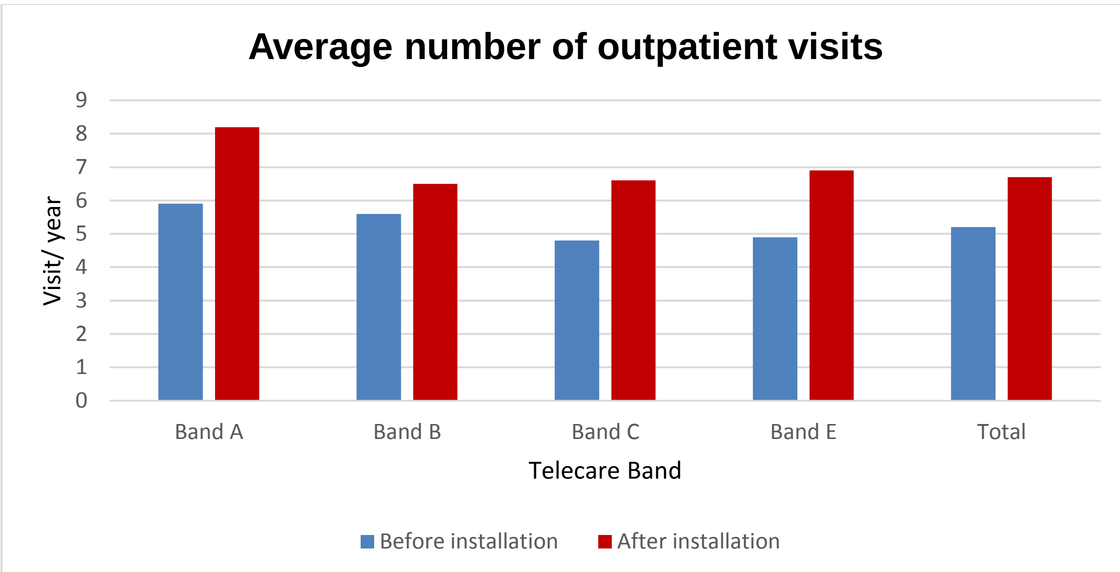

Figure 21 Comparison of average number of outpatient visits, pre and post installation of the different telecare bands

Since no control data were available, these data are simply descriptive of the changing frequency of events for the time periods before and after installation. It is not possible to determine if the increase is due to the telecare service or other factors.

6. General discussion

The data that we were provided with and able to analyse provide information on the uptake of the telecare service, and the linked data on healthcare utilisation describes the changes in this pre and post installation of the different telecare services. As noted, the lack of control data means that it is not possible to assess the impact of the service as distinct from any other factors that might have had an effect, including the increasing age of each patient. Comparative data for cohorts of patients, with similar care requirements who did not have telecare services put in place, would have allowed us to investigate these confounding factors. For example, it is to be expected that as patients get older, they are more likely to use hospital based services, e.g. emergency room visits, outpatient visits, hospitalisations and have increased lengths of hospital stay. The high number of ‘calls’ related to patients who had the telecare equipment installed indicate that the patients for whom the services were installed were high dependence patients and it seems likely that appropriate actions by the telecare team led to the prevention of negative health outcomes for them, perhaps through recourse to the healthcare services that we were able to investigate.

Ideally, a controlled, randomised trial is needed to determine and quantify the impact of telecare services. This would help determine the effects and cost-effectiveness of this service which intuitively should make an important difference to patients who need assistance with their independent living in the community. We strongly recommended that such a study is carried out to inform the future development of the service. This might be done as part of any expansion of the service, for example by randomising patients for whom the benefits of the service are uncertain to either receive or not receive it, or randomly allocating such patients to receive it immediately or after a period of 12 or more months, during which time they would act as control patients.

Appendix 1 Summary of telecare band (bundle) descriptions

Telecare Band		Band Content
Band A	Basic Package	1. Home Unit & 2 x Pendant
Band B	Home / Community Safety	1. Home Unit, Pendant, Chair Occupancy Sensor, Property Exit Alert & Flood Sensor. 2. Home Unit, Pendant, Chair Occupancy Sensor, Property Exit Alert & Heat Extreme Sensor. 3. Home Unit, Pendant & Fall Detector.
Band C	Health & Social Care	1. Home Unit, Pendant Plus Bed Occupancy Sensor 2. Home Unit, Pendant Plus Chair Occupancy Sensor 3. Home Unit, Pendant Plus Epilepsy Seizure Detector 4. Home Unit, Pendant Plus Property Exit Alert 5. Home Unit, Pendant, Bed Occupancy Sensor & Fall Detector 6. Home Unit, Pendant, Chair Occupancy Sensor & Fall Detector 7. Home Unit, Pendant, Epilepsy Seizure Detector & Fall Detector 8. Home Unit, Pendant, Bed Occupancy Sensor & Property Exit Alert 9. Home Unit, Pendant, Chair Occupancy Sensor & Property Exit Alert
Band E	Exceptional	1. Home Unit, Pendant, Bed Occupancy Sensor, Property Exit Alert & Flood Sensor. 2. Home Unit, Pendant, Bed Occupancy Sensor, Property Exit Alert & Heat Extreme Sensor. 3. Home Unit, Pendant, Chair Occupancy Sensor, Property Exit Alert & Flood Sensor. 4. Home Unit, Pendant, Chair Occupancy Sensor, Property Exit Alert & Heat Extreme Sensor.