



York Health Economics Consortium

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AIREDALE AND PARTNERS TELEMEDICINE VANGUARD

Economic Analysis of Care Homes New Models of Care Vanguard

Final Report

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Executive Summary

1. INTRODUCTION

Airedale and Partners was selected by NHS England in 2015 to become a Vanguard site under the New Care Models programme for 'enhanced health in care homes'. Building on an already established model, the Vanguard rolled out a telemedicine service model covering 248 care homes across four CCG areas in the north of England. The service provides remote consultation and support care for care home residents through video link or telephone to the Digital Care Hub at Airedale Foundation NHS Trust. The service includes a standard model and a GP Triage model.

The aim of this review was to quantify the economic benefits generated by the telemedicine programme by conducting a 'before and after' review of the use of health care resources by the care homes to derive a return on investment estimate. There are limitations to this approach which is constrained by the availability and quality of the data collected.

The report needs to be considered alongside the report by the Yorkshire and Humber Academic Health Science Network's report on the qualitative aspects of the Vanguard, which summarises the findings in relation to the developmental evaluation of the programme.

2. METHODS

A large data set of more than 290,000 data points was collated for Airedale and Partners by a business intelligence organisation during 2017, covering every contact made by care home residents with some NHS services and any telemedicine calls made to the Hub. Although this data set was large it only covered a limited period and there was no single intervention date, with telemedicine being rolled out over time. Only around 10% of care homes did not have telemedicine installed, providing a limited control group.

Data cleaning was intensive and a number of anomalies and issues with the data were discovered and rectified. Application of cut-off periods was necessary to avoid a situation where a care home had a full year of data after installation but only a partial year of data before. As a result of cleaning, the data set was reduced to around 48,000 items covering 141 care homes with telemedicine and 25 care homes without telemedicine.

The main limitations in the data set were duplicate care home names and lines of data, inclusion of non-relevant data for people under the age of 65 or with learning difficulties, and data with no identifier. These issues were rectified and the data set used was more robust following this process but interpretation of the results need to bear these limitations in mind.

3. RESULTS

The constraints of the available data, and the way in which the project was rolled out, mean that our findings are inconclusive and caution needs to be applied in interpreting the results. At face value the data analysis indicated that care homes with telemedicine had reduced use of other health care resources in the period following installation. The overview of all of the 141 care homes, in the year following installation of telemedicine, showed a reduction in emergency hospital admissions of 4%; a marginal reduction in A&E attendances; a small increase in the use of out-of-hours services (2%); and a reduction in the use of 111 calls (4%). The 25 care homes without telemedicine showed increases in emergency admissions of 7% and A&E attendances of 30%. National data collected by NHS England showed an increase in emergency admissions in areas not covered by New Care Models of 4.9%.

Analysis by type of care home showed a decrease in inpatient emergency admissions of 13% in nursing homes compared to an increase of 6% in residential homes. There were also reductions in nursing homes compared to increases in residential homes for A&E attendances (-8% versus 7%); use of out-of-hours services (-9% versus 17%) and 111 calls (-16% versus 12%).

Care homes using the standard service model, with limited numbers of calls to the Airedale telemedicine Hub, demonstrated a 2% reduction in A&E attendances compared to a 13% increase for care homes using the GP triage service model with unlimited calls. Both types of homes showed a reduction in emergency admissions. Care needs to be taken in interpreting these results as less than 10% of the care homes analysed used the GP triage service model.

Analysis of the usage of telemedicine by care homes showed wide variation in the numbers of calls made to the Hub. The data showed low usage care homes showing a 17% reduction in emergency admissions while there was a 10% increase in emergency admissions in high use care homes. High use care homes also had a 14% increase in A&E attendances in the year after installation of telemedicine compared to a reduction of 16% in low use care homes. There was a similar reduction in 111 call usage in both high and low use care homes. High use care homes showed a 3% increase in out-of-hours usage following installation of telemedicine, while low use care homes showed a 5% reduction. Scatter plots showed a very minor trend towards reduced use of 111 services but a trend towards increased use of services for A&E, emergency inpatients and out-of-hours.

4. DISCUSSION

At face value these results showed that care homes reduced some forms of health care resource use after the installation of telemedicine, and that there was a greater impact in specific settings and for particular service models. However, these results do not have statistical significance and, therefore, do not demonstrate a causal effect.

The literature on telehealth and telecare in general has very mixed findings so, given that we were unable to control for the extent of frailty in individual homes, the analyses carried out for the Airedale Vanguard can only be seen as indicative at best. The AHSN report highlighted a number of inconsistencies in the implementation of telemedicine across the three areas. While some of this is to be expected as telemedicine has been rolled out over a number of years, there are different service models and local issues which affect the way in which telemedicine is used. These factors include the influence of local GPs, different configurations of local services providing support to care homes alongside telemedicine and different knowledge and skills of care home staff in using telemedicine.

This inconsistency in usage is borne out in the patterns of usage of telemedicine described in this report. Interestingly, there appears to be no correlation between high usage of telemedicine, in terms of rate of calls made to the Hub, and reduction in the use of health care resources. In fact the opposite is apparent but this may simply be a case of higher levels of frailty in certain homes leading to higher use of telemedicine and higher use of health care resources.

The results demonstrated in this limited economic evaluation show interesting results with potential for further research and analysis:

- Airedale and Partners may want to consider exploring the possibility of carrying out more in depth analysis using statistical methods such as time-series analysis to observe some sub-sets of the data considered in this evaluation;
- Further investigation could focus more specifically on the key metrics and outcomes of interest. For example, the GP triage model could be seen as essentially an enhanced primary care offer, so more in-depth work could focus on the impact of care homes potentially using fewer GP resources, thus potentially improving GP access for the wider population which may impact on the use of acute care;
- Return on investment analysis relied on assumptions of the cost of avoided emergency admissions. A more detailed patient-level analysis could attempt to record exactly what types of admissions were avoided through use of telemedicine.

Acknowledgements

We would like to thank Rose Dunlop (Airedale Evaluation Lead) and Mark Hawker (Information Analyst) from Airedale NHS Foundation Trust for providing the data and advising on data fields. We would also like to thank Eileen McDonach and Steve Stericker for their advice and input to the analysis.

Section 1: Introduction

1.1 BACKGROUND TO THE VANGUARD

In March 2015, Airedale and Partners was one of six 'enhanced health in care homes' Vanguards selected by NHS England as part of their New Care Models (NCM) programme. The Vanguard aimed to scale up the delivery of Telemedicine in care homes to:

"improve the quality of life and end of life experience of thousands of nursing and care home residents living in Bradford, Airedale, Wharfedale, Craven and East Lancashire – and ultimately for the model to be adopted throughout the country."

This involved a wider implementation footprint than the other five Enhanced Health in Care Homes (EHCH) Vanguards as the Telemedicine service model(s) were to be delivered at scale to 248 care homes across four CCG areas with a diverse range of partners including: three acute trusts, three local authorities, two community and mental health providers, more than 130 GP practices, a number of third-sector organisations, universities and colleges and more.

The Digital Care Hub at Airedale NHS Foundation Trust was established in 2011, and predates the Vanguard and this local evaluation. It delivers 'telemedicine' to care homes as part of a partnership with a company called 'Involve' under the joint venture company 'Immedicare'. Its remit is broader than the Vanguard care homes programme, with services being delivered to care homes and prisons around the country.

The Airedale and Partners Telemedicine service involves "remote consultation and support care" for care home residents either by video link or telephone. There is a standard Telemedicine Service model, with options to add enhanced service models which may include GP Triage or Goldline services individually, or in combination.

1.2 EVALUATION OF VANGUARD

Vanguard sites are required to appoint evaluators to report on the implementation and impact of the innovations. Airedale and Partners appointed the Yorkshire and Humber Academic Health Science Network (AHSN) to conduct the evaluation.

The AHSN's report on the developmental evaluation was prepared in August 2017 and focused on the qualitative aspects of the Vanguard programme, along with insights on the way in which the programme was implemented. This report should be read in conjunction with the AHSN's report to get a holistic view of the Vanguard impact.

The economic evaluation of the Vanguard has been carried out by York Health Economics Consortium (YHEC). The objectives of the economic evaluation were to:

1. Clean and analyse the available data and assess the feasibility of analysis at an overall programme level and at sub levels;
2. Develop summary analysis of the impact of telemedicine on care homes using a before and after analysis of usage. This will be done at a programme level and a sub-levels including by different CCG, by type of home (residential v nursing), by usage of the telemedicine Hub, by environment (urban v rural), and any other sub-levels identified as being feasible for comparison;
3. Understand the costs of the telemedicine service to care homes;
4. Develop return on investment analyses for the overall programme and the sub-levels identified.

This report describes YHEC's findings in relation to these objectives. The gaps in the data mean our findings should be interpreted with caution. The weaknesses in the data are outlined in Section 2.

Section 2: Methodology

2.1 OVERVIEW

During summer 2017 a data dashboard was developed by a business intelligence organisation to support economic analysis of the Vanguard. The contract with the organisation expired in August 2017, meaning that no further data were added and the only output was a large spreadsheet with over 290,000 data points recorded. The data points consist of every contact made by care home residents in Bradford, Airedale, Wharfedale, Craven and East Lancashire with NHS statutory services and any telemedicine calls made to the Airedale Telemedicine Hub.

The data time periods covered April 2013 to March 2017 for Airedale, Wharfedale and Craven and Bradford and May 2014 to December 2016 for East Lancashire. Telemedicine was installed in most of the care homes in these areas at different points in time during these periods. This makes analysis problematic because there is no single intervention date and in effect means that a separate analysis needed to be carried out for each individual care home.

There was only a very small number (25) of care homes in the three areas that did not have telemedicine installed. This provides a very limited control group. Given this limitation, and the fact that telemedicine was installed at different times across the care homes meant that the only practical approach was to conduct a before and after analysis for each care home, based on an observation of the use of health care resources in the year before and the year after installation.

Following cleaning, the data were sorted and a 'live' period was generated for each care home based on the period one year before and one year after the installation date. However, due to the limitations of the data periods not all care homes with telemedicine had a full year of data available before and after the installation date. For example, if a care home had telemedicine installed in June 2013 in Bradford, there would only be two months of data in the 'before' period, with a full year available in the 'after' period. It was agreed, with Airedale and Partners and the AHSN that any care home that did not have at least six months of data available before and after installation of telemedicine would be excluded. Care homes with more than six months but less than a year's worth of data would be included but only for an equivalent period either side of the installation data, e.g. eight months before and eight months after.

The only practical way to gather the data was by the postcode of the care home. Data for individual patients were obtained and pseudonymised using a number which allowed for data on health care resource usage to be linked for specific patients. This provides the potential to understand what happened to care home residents following a call to the Hub.

2.2 DATA ANALYSIS

The data set obtained from the business intelligence organisation, included over 290,000 individual contacts with the NHS for residents of care homes. This included telemedicine contacts with the Hub; hospital inpatient contacts (elective, emergency and other); A&E attendances; hospital outpatient attendances; out of hospital care (out of hours, 111). Although available, hospital elective inpatient admissions and hospital outpatient appointments were not analysed as primary outcomes. This was agreed in the original scope of the Vanguard evaluation and is based on the argument that these types of health care resource are unlikely to be influenced by telemedicine.

The data were gathered and compiled from a variety of sources and included a considerable number of data fields. Our initial work involved a considerable data cleaning exercise.

Nineteen variables that were not required for any of the analysis were deleted from the dataset. The dataset included a considerable number of episodes of care for people who were under 65 years of age (99,676 episodes). This analysis concerns only those of 65 years of age or older and so those episodes were removed from the dataset. Similarly, all episodes in the dataset for a care home that was a learning disability care home were removed from the dataset as they were not included within the scope of this project. Where it was not known from the dataset if a care home included residents with learning difficulties, the Care Quality Commission website was used to inform this missing data.

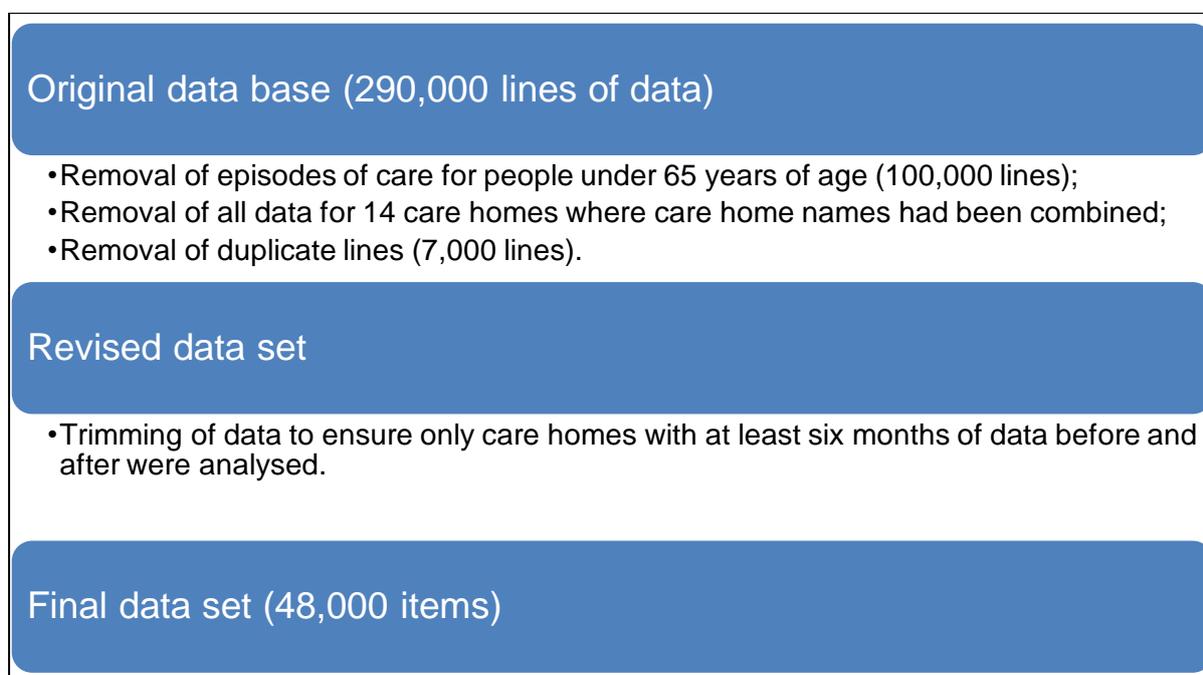
Thirteen care homes were identified in the dataset to have entries (episode data) under different care home names due to spelling error or the care home name being entered differently into the dataset. These were confirmed to be the same care home by comparing longitude and latitude data for these entries. Relevant data for each care home were combined under a single care home name. There were two examples in the dataset, Oakmount Care Home and Mill Lodge Care Home, where the care home name was the same in two locations. The care home name was updated to reflect the location for these care homes to allow for them to be identified separately.

A further issue associated with the care home name was that there were 14 examples of care home names that actually comprised two care home names. It is understood that this occurred due to some data only being available by postcode. Therefore, if more than one care home was within the postcode, the data could not be mapped to a specific home. Given that the care home live data were required for the analysis, and that this was not available for these care homes specifically, all episodes entered under a care home with two names joined together or either of the care homes within the joint name care home were removed from the dataset.

Where data were missing for the following variables, data made available from the Airedale Vanguard were used to complete the missing values: care home live date, care home type, district, care home area, care home classification, if the home was a learning disability home, size, care home triage, care home cohort. Episodes where the activity was telemedicine and this occurred prior to the care home live date were removed given that this activity would be implausible. Two-hundred and eighty-five episodes had no identifier (care home name, live date, longitude or latitude data etc.) and so were removed from the analysis.

In addition to this, once the data set had been trimmed to include only care homes for which we believed the data to be reasonably robust, and to ensure that there was at least six months' worth of data before and after installation of telemedicine, it was discovered that there were more than 7,000 duplicate lines of data in the data set. These were removed leaving a truncated set of data including 45,000 lines. The data cleaning process is outlined at Figure 2.1.

Figure 2.1: Flow chart showing data cleaning process



A proxy installation date for the control care homes was inputted to allow for the analysis window to span 12 months before and 12 months after the installation date. The proxy installation date was the median telemedicine installation date for the telemedicine care homes included in the analysis (those with residents of 65 years of age or older and not learning disability care homes). The median telemedicine installation date was the 07 December 2014.

2.3 DATA LIMITATIONS

The data were received in the form of a large Excel spreadsheet. The business intelligence organisation had previously used this dataset when developing a dashboard platform to demonstrate data in different formats. As has already been described, we needed to carry out a considerable amount of cleaning on the data set with many fields missing and a large number of problems. We have cleaned this data and imputed any missing data where possible using data available from the Airedale Vanguard.

The key concerns with the data relate to the number of lines that had to be removed or discounted for the following reasons:

- Duplicate care home names;
- People under 65 years of age (unlikely to be in a care home);
- Exclusion of data on people in care homes for learning disabilities;
- Duplicate lines of data;
- Data with no identifier, e.g. care home name.

The data were cleaned as much as possible but necessarily many lines of data had to be excluded. Given concerns over the data analysis was limited to the descriptive analysis described in objective 2, with the exception of the analysis between rural and urban care homes as this data field was not considered reliable even after cleaning.

There are also some concerns about the quality of the raw data from which these data were obtained. For example, we found five episodes recorded as maternity inpatient admissions but which were for people more than 80 years old. Any obviously erroneous data such as these were also excluded from the analysis.

Section 3: Results

3.1 OVERVIEW OF RESULTS

For the 141 care homes with telemedicine across the whole Vanguard area included in the analysis there was some face value reduction in the use of health care resources in the period after installation of telemedicine compared to an equivalent period before installation. This was the case for A&E and emergency inpatient activity, but there was no corresponding increase in the use of 111 and a small increase in the use of out-of-hours services by care homes. Emergency inpatient data were calculated on spells in hospital rather than individual finished consultant episodes. Table 3.1 demonstrates the summary data.

Table 3.1: Summary of the use of health care resources in all care homes with telemedicine (n=141)

	111	A&E	I/P emergency	OOH
Before	2,395	3,831	2,703	1,750
After	2,303	3,821	2,624	1,792
Difference	-92	-10	-79	42
% change	-4	-0.3%	-3%	2%

These high level figures hide a range of differences between care homes and sub-analyses have been carried out which are described later in this section. Tables 3.2 to 3.4 break down the results into the three CCG areas.

Table 3.2: Summary of the use of health care resources in AWC care homes with telemedicine (n=22)

	111	A&E	I/P emergency	OOH
Before	560	460	348	425
After	536	449	325	470
Difference	-24	-11	-23	45
% change	-4%	-2%	-7%	11%

Table 3.3: Summary of the use of health care resources in Bradford care homes with telemedicine (n=53)

	111	A&E	I/P emergency	OOH
Before	1,853	1,279	925	1,325
After	1,766	1,401	949	1,321
Difference	-69	122	24	-4
% change	-4%	10%	3%	-0.3%

Table 3.4: Summary of the use of health care resources in East Lancashire care homes with telemedicine (n=66)

	111	A&E	I/P emergency	OOH
Before	1	2,092	1,430	1
After	1	1,971	1,350	1
Difference	0	-121	-80	0
% change	-	-6%	-6%	-

In terms of A&E usage, Airedale, Wharfedale and Craven showed a 2% decrease in activity post-implementation of telemedicine and East Lancashire's decrease was 6%. Emergency admissions decreased by 7% in Airedale, Wharfedale and Craven and 6% in East Lancashire. In Bradford, there was an increase in A&E activity of 10% and an increase in emergency admissions of 3%.

There was a small control group of 25 care homes that did not have telemedicine installed. The comparative health care resource use figures are provided in Table 3.5.

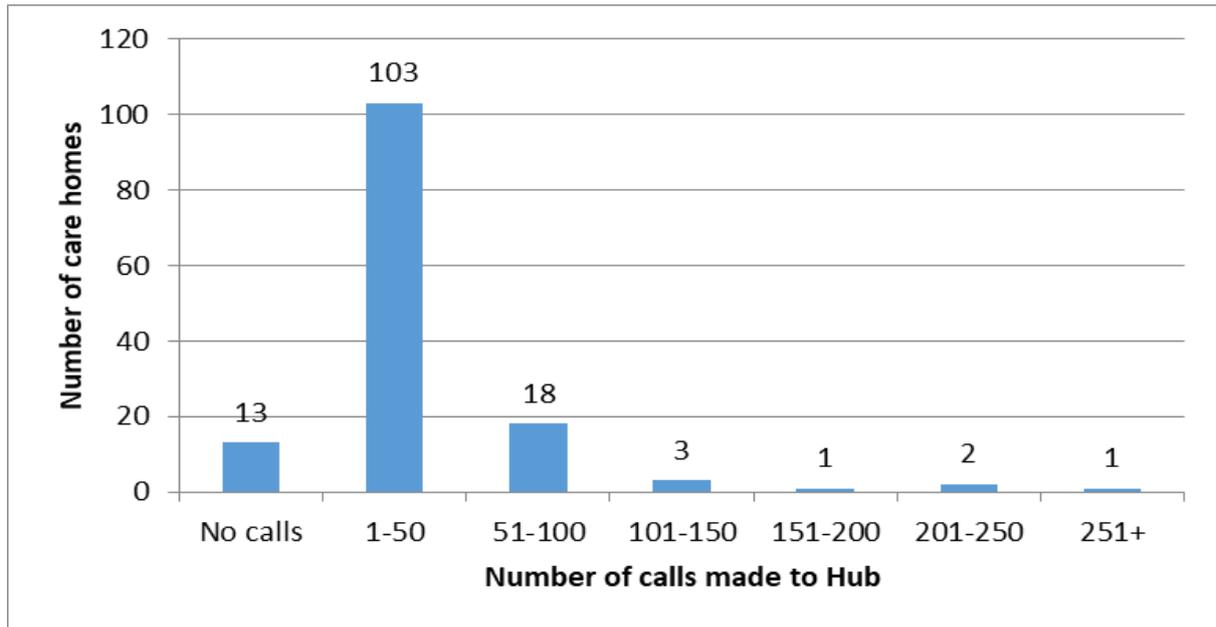
Table 3.5: Summary of the use of health care resources in care homes without telemedicine (n=25)

	111	A&E	I/P emergency	OOH
Before	101	160	124	87
After	137	208	150	136
Difference	36	48	26	49
% change	36%	30%	21%	56%

3.2 TELEMEDICINE USAGE

The data show that 128 of the 141 care homes with telemedicine (91%) made a call to the Hub during the relevant period following installation. There were 4,391 calls in total. The range of use was enormous from one call to 503 calls during the one-year period. This is demonstrated in Figure 3.1. The median number of calls was 17.

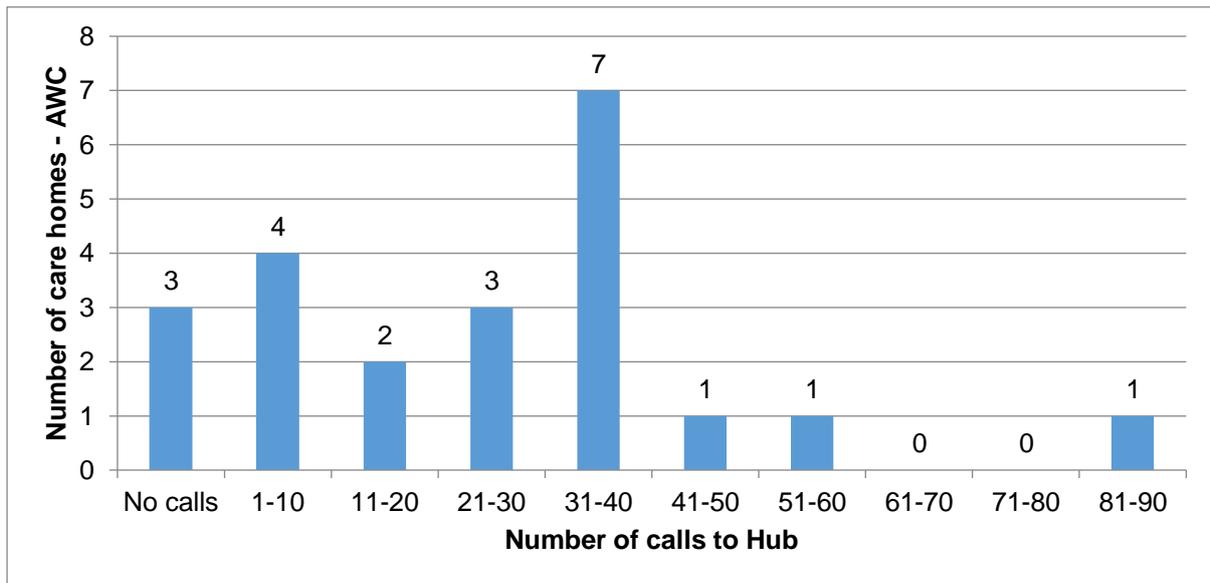
Figure 3.1: Range of calls to Hub by all care homes in the year following installation



The potential number of calls made to the Hub was, in most cases, artificially constrained by the type of contract each care home had with Airedale Hospital. Most care homes (135) had a standard telemedicine service model which consisted of a single point of contact at all times with Hub but, significantly, a restriction on the number of calls to the Hub of an average of four per month, or 48 in total per year. Further calls made would be charged for and it appears that a number of care homes with standard contracts made additional calls to the Hub. A smaller number of care homes (6) had a GP triage service model which allowed for unlimited calls to the Hub.

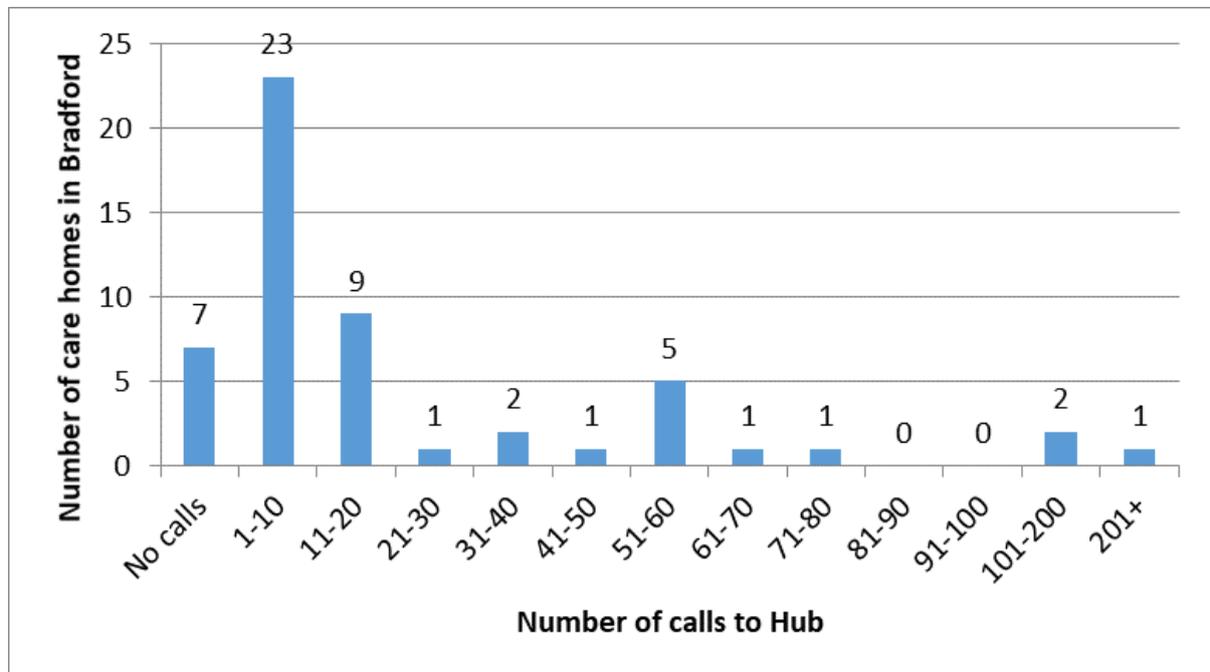
Breaking down the numbers of calls into the individual areas does not provide any particular insight into patterns of telemedicine calls, as demonstrated in Figures 3.2 to 3.4.

Figure 3.2: Range of calls to Hub by AWC care homes (n=19) in the year following installation



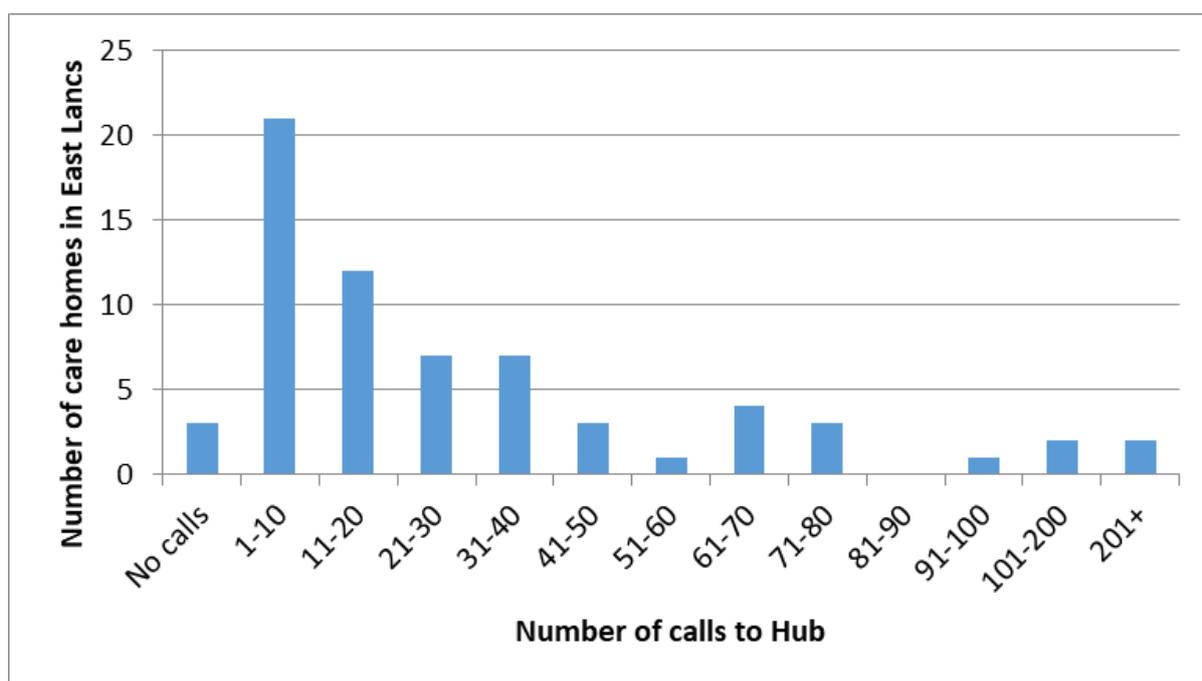
The median number of calls in Airedale, Wharfedale and Craven was 34 and the total number made was 576.

Figure 3.3: Range of calls to Hub by Bradford care homes (n=46) in the year following installation



The median number of calls in Bradford was 10 and the total number made was 1,299.

Figure 3.4: Range of calls to Hub by East Lancashire care homes (n=63) in the year following installation



The median number of calls in East Lancashire was 20 and the total number made was 2,516.

Data were stratified to identify the highest and lowest users of telemedicine in terms of calls made, ignoring those care homes in which no calls were apparently made (Tables 3.6 and 3.7). Rates of usage were calculated by dividing the numbers of calls per home by the number of beds (adjusted for the relevant time period) to generate a call rate per bed year.

This analysis showed some unexpected findings, with low usage care homes showing a 15% reduction in emergency admissions while there was a 10% increase in emergency admissions in high use care homes. High use care homes also had a 14% increase in A&E attendances in the year after installation of telemedicine compared to a reduction of 16% in low use care homes. There was a similar reduction in 111 call usage in both high and low use care homes. High use care homes showed a 3% increase in out-of-hours usage following installation of telemedicine, while low use care homes showed a 5% reduction.

Figures 3.5 to 3.8 provide scatter plots to show the inter-relation of the two variables. They show a very minor trend towards reduced use of 111 services but a trend towards increased use of services for A&E, emergency inpatients and out-of-hours.

Given the limitations of the data described in Section 2, it is important that these results are considered with caution, as there is no certainty about causal links between the use of telemedicine and changes in the use of health care resources. It may well be that care homes with higher numbers of calls to the Hub simply have a larger number of residents with a higher degree of frailty. It should be noted that the data for inpatient emergency admissions relate to finished care episodes rather than spells for this part of the analysis.

Table 3.6: Summary of the use of health care resources in care homes with high use of telemedicine (>1.5 calls per bed per year) (n=31)

	111	A&E	I/P emergency	OOH
Before	664	1,032	556	470
After	612	1,180	614	482
Difference	-52	148	58	12
% change	-8%	14%	10%	3%

Table 3.7: Summary of the use of health care resources in care homes with low use of telemedicine (<0.3 calls per bed per year) (n=45)

	111	A&E	I/P emergency	OOH
Before	628	1,226	775	478
After	585	1,034	655	452
Difference	-43	-192	-120	-26
% change	-7%	-16%	-15%	-5%

Figure 3.5: Scatterplot of usage rates versus change in use of 111 services

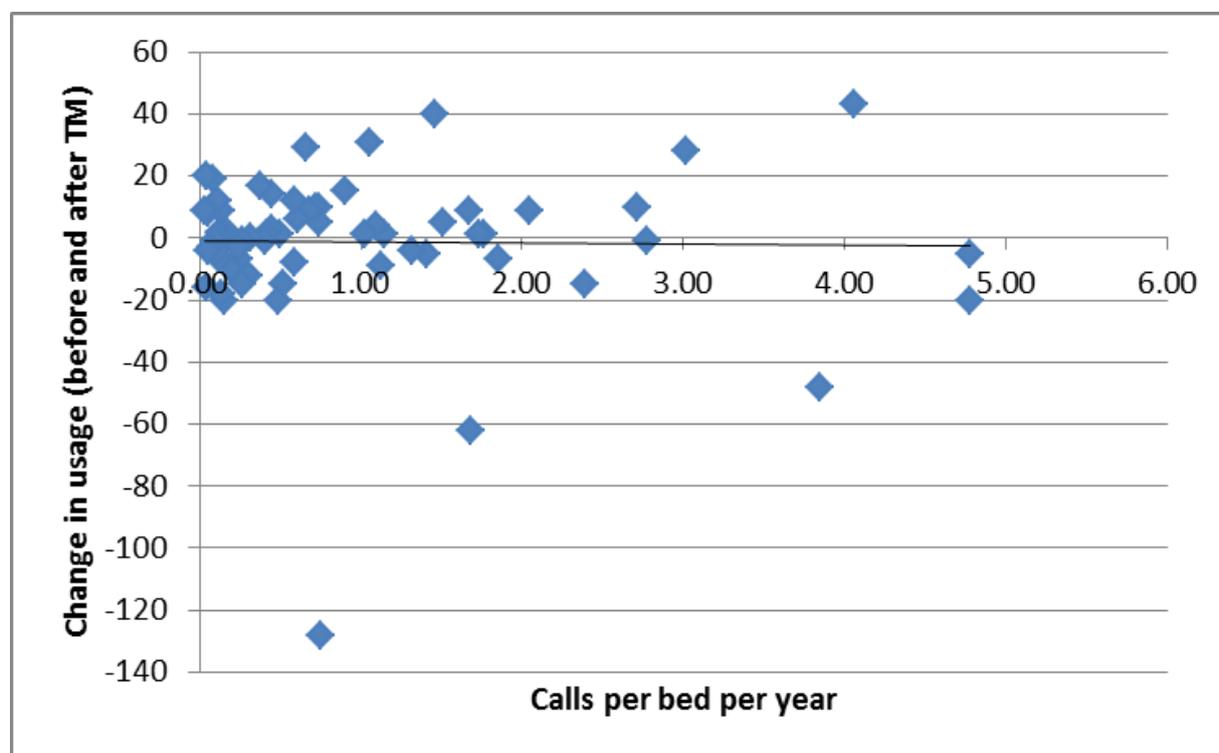


Figure 3.6: Scatterplot of usage rates versus change in use of A&E services

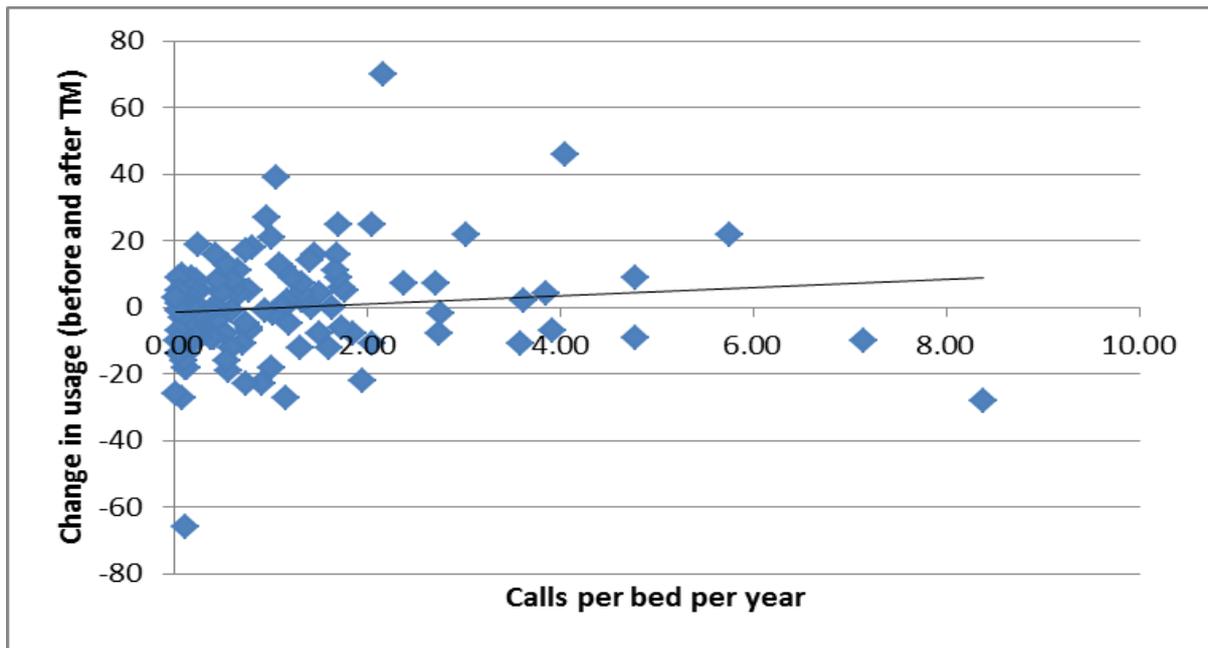


Figure 3.7: Scatterplot of usage rates versus change in use of emergency inpatient services (FCEs)

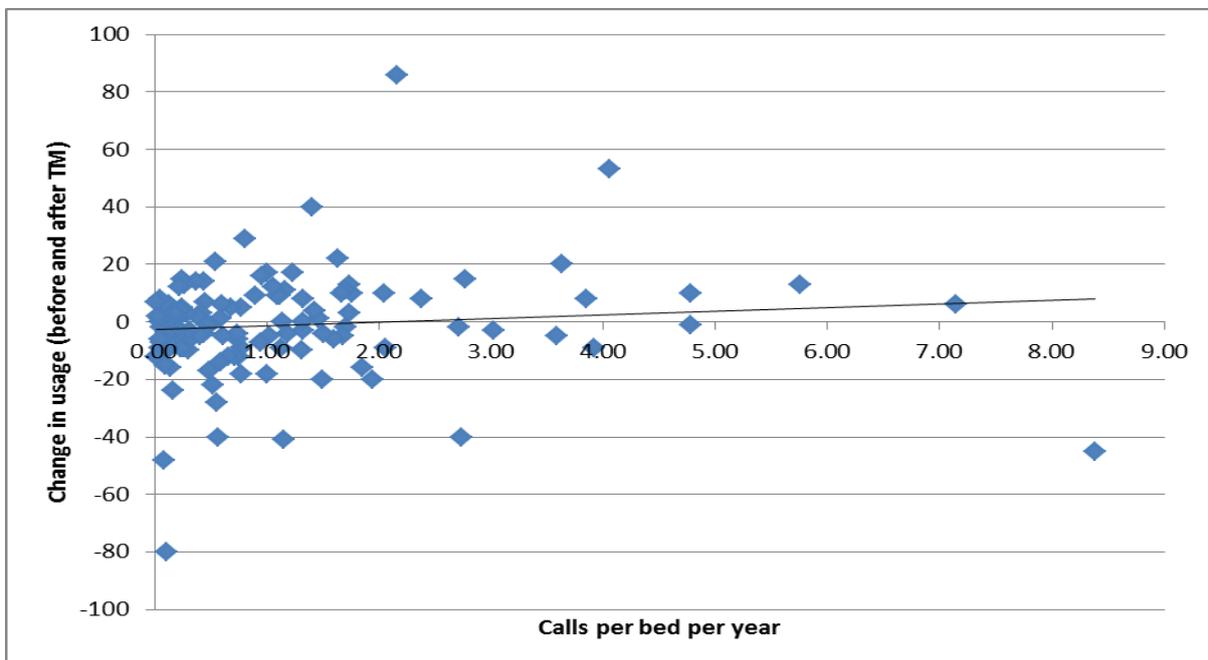
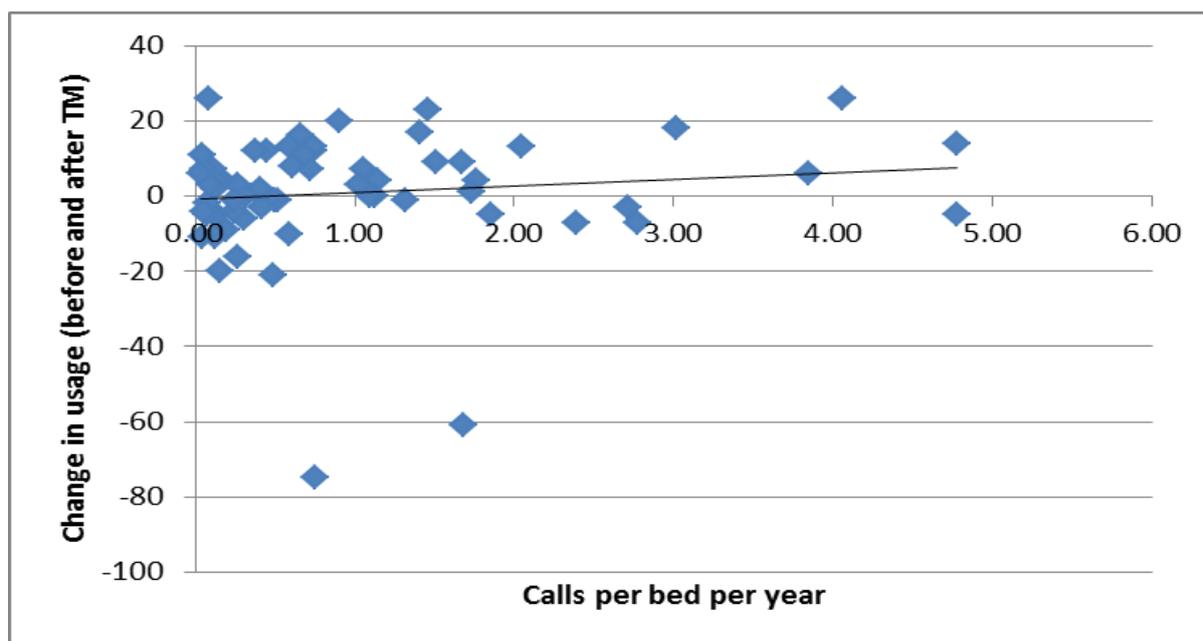


Figure 3.8: Scatterplot of usage rates versus change in use of out-of-hours services



3.3 NURSING HOMES COMPARED TO RESIDENTIAL HOMES

The care homes were divided into nursing and residential homes and analysis was conducted into any differences. Tables 3.8 and 3.9 demonstrate some apparent differences between the two types of home. Nursing homes showed a decrease in emergency inpatient admissions of 11%, compared to an increase of 5% for residential care homes. Nursing homes also recorded a decrease in the numbers of A&E attendances, 111 calls and out-of-hours episodes, with residential care homes showing increases in their use of those health care resources in the period following implementation of telemedicine.

This may not be conclusive but there may be scope to investigate these apparent differences in more depth. Some suggestions are made to this effect in Section 4.

Table 3.8: Summary of the use of health care resources in nursing care homes (n=54)

	111	A&E	I/P emergency	OOH
Before	1,327	1,876	1,346	975
After	1,109	1,726	1,202	887
Difference	-218	-150	-144	-88
% change	-16%	-8%	-11%	-9%

Table 3.9: Summary of the use of health care resources in residential care homes (n=87)

	111	A&E	I/P emergency	OOH
Before	1,068	1,955	1,357	775
After	1,194	2,095	1,422	905
Difference	126	140	65	130
% change	12%	7%	5%	17%

3.4 STANDARD SERVICE MODEL COMPARED TO GP TRIAGE SERVICE MODEL

As described in Section 2, the standard service model in theory restricted the number of calls made to the Hub, while there were unlimited numbers of calls available to care homes using the GP triage service model. Around 96% of care homes analysed used the standard service model.

Tables 3.10 and 3.11 show some interesting results, albeit the small numbers of care homes using the GP triage model mean these results must be interpreted cautiously. The standard model care homes showed a 3% reduction in hospital emergency admissions while the homes using the GP triage model showed a 3% reduction in admissions in the year following installation of telemedicine. However, while the standard homes showed a 2% reduction in A&E attendances following installation of telemedicine, the GP triage care homes showed a 13% increase in the equivalent period.

This shows some consistency with the findings demonstrated in Tables 3.6 and 3.7 relating to high and low users of telemedicine. The average number of calls made by care homes with standard service models during the year post-installation was 27, with a median of 17. For care homes with a GP triage service model, the average number of calls made during the year post-installation was 178, with a median of 128.

Table 3.10: Summary of the use of health care resources in care homes using the standard service model (n=135)

	111	A&E	I/P emergency	OOH
Before	2,395	3,493	2,476	1,750
After	2,303	3,440	2,393	1,792
Difference	-92	-53	-83	42
% change	-4%	-2%	-3%	2%

Table 3.11: Summary of the use of health care resources in care homes using the GP triage service model (n=6)

	111	A&E	I/P emergency	OOH
Before	0	338	227	0
After	0	381	231	0
Difference	0	43	4	0
% change	-	13%	2%	-

3.5 INPATIENT ELECTIVE AND OUTPATIENT ACTIVITY

Data were obtained and included in the data set on the changes in inpatient elective and outpatient activity before and after the installation of telemedicine. These data were not considered to be primary outcomes of the evaluation and so have not been included in the results reported.

The data were analysed but do not show anything of particular interest. Overall, elective hospital admissions reduced by 3% and the number of outpatient appointments did not change for care homes in the period following installation of telemedicine. These results are not significantly different for the analysis of care homes without telemedicine, although there was an increase in outpatient activity of 10% in the 'post installation' period.

3.6 POTENTIAL RETURN ON INVESTMENT

The results presented in the foregoing subsections need to be treated with caution as the control group is small and there are limitations in the analysis due to the nature of the data collected. If the results are taken at face value there is an indication that use of telemedicine reduces the use of healthcare resources in the period up to one year following installation. This assumption can be at least partially validated by comparing the results of the telemedicine group of care homes with those for care homes without telemedicine, and also by comparison with national data collected by the NHS England Vanguard New Models of Care team.

Table 3.12 shows some significant differences in the results of the two groups of care homes, with decreases in activity in the care homes with telemedicine in the period following installation and the opposite for care homes without telemedicine.

Table 3.12: Comparison of changes in outcomes for care homes with (n=141) and without telemedicine (n=25)

	111	A&E	I/P emergency	OOH
With TM	-4%	-0.3%	-3%	+2%
Without TM	+36%	+30%	+7%	+56%

National data only provides indications for emergency admissions but this shows that compared to the baseline year (2014/15), there has been an increase in emergency admissions of 4.9% in areas that are not Vanguard New Care Model sites.

These comparisons, particularly the comparison with national data, provide some validity to the assertion that the installation of telemedicine in care homes may help to reduce the use of healthcare resources.

3.6.1 Return on Investment Principles and Assumptions

Return on investment is a way of demonstrating the extent to which an intervention or innovation is cost-effective or cost saving. For this evaluation we have used the National Institute for Health and Care Excellence (NICE) formula:

$$\text{Return on investment: } \frac{\sum \text{discounted Benefits} - \sum \text{discounted costs}}{\sum \text{discounted costs}}$$

Where \sum = sum of

In order to carry out a return on investment analysis it is necessary to understand the incremental costs of the innovation and monetised values of the estimated benefits. YHEC obtained the basic costs of the telemedicine service from Airedale Hospital. The costs are £400 per month per care home for a standard service and £600 per month for the GP Triage service. This extrapolates to £4,800 per year for the standard service and £7,200 per year for the GP Triage service. As there were only six GP Triage homes included in the analysis, we have used the standard cost as the cost denominator for simplicity.

Some assumptions need to be made in relation to the benefits of the telemedicine service. The first assumption is that the benefits relate to the value of the potential reduction in the use of health care resources as a result of using telemedicine. We also need to make an assumption about the extent to which telemedicine has reduced the use of health care resources by care homes and a value needs to be ascribed to the unit costs of each form of health care resource.

A conservative estimate of the extent of the reduction in the use of health care resources can be calculated by simply examining the reduction in use in the period after the installation of telemedicine. It may also be valid to estimate the extent to which activity might have risen in the post-installation period. To do this, we used the value of 4.9% that the Vanguard New Models of Care team have for non-Vanguard areas. Although this increase refers to emergency hospital admissions, it has also been applied to activity in relation to NHS 111, A&E and GP out-of-hours. Table 3.13 shows the actual difference in the post installation period and the estimated difference if activity had grown by 4.9%.

Table 3.13: Difference in health care resource use for all care homes (n=140) following installation of telemedicine

	111	A&E	I/P emergency	OOH
Actual difference	-92	-10	-79	+42
Assuming 4.9% growth	-209	-198	-211	-44

The values of health care resources were imputed from a number of sources:

- NHS 111 services are assumed to cost £12.26 per call based on research carried out by the University of Sheffield.¹ There is some uncertainty in this value;
- A&E costs were derived from national prices and tariffs for 2016/17.² The median value of £132 was used based on a range of prices between £57 and £236 for emergency medicine;
- Weighted average costs for emergency inpatient admissions were derived from NHS Reference Costs 2015-16, using the number of finished care episodes and national average unit costs.³ The values were £3,058 for emergency inpatient admissions or £616 for 'non-elective short stay'. Although in general, avoidable admissions are more likely to be reflected by a short stay, in the case of older people even a relatively minor cause for admission can result in a longer stay in hospital. On that basis, both the short and longer stay values have been used;
- It has been assumed that an out-of-hours call out will be a visit to a care home by a GP which would take one hour including travelling time. The cost of this has been assumed to be £236 per visit based on PSSRU values.⁴

3.6.2 Return on Investment Results

The estimated changes in health care resource outlined in Table 3.13 show that that telemedicine has potential to generate a return on investment. The NICE ROI formula was applied and the costs reported by Airedale Hospital and the values imputed for health care resources were used. Using a cost per spell of £616, this forecasts a negative ROI of -£0.92 for every £1 spent based on the actual reduction in health care resource use, improving to -£0.75 for every £1 spent if 4.9% growth is assumed in the baseline activity. This indicates that while some benefits are generated (£51,112 based on the actual difference or £169,058 assuming baseline growth), they are not enough to cover the costs of telemedicine (£676,800).

If a cost per spell of £3,058 is used then the ROI forecast using the actual reduction in health care resource use improves to -£0.64 per £1 spent, based on estimated benefits of £244,029. Using assumed growth of 4.9% in the baseline, the forecast ROI would improve to £0.01 per £1 spent, based on estimated benefits of £684,320.

There is obviously wide variation in the results for individual care homes and for some groups of homes, the results may demonstrate cost-effectiveness. For example, the potential reduction in health care resources for nursing care homes is set out in Table 3.14.

¹ Pope C, Turnbull J, Jones J, et al. Has the NHS 111 urgent care telephone service been a success? Case study and secondary data analysis in England. *BMJ Open* 2017;7:e014815. doi:10.1136/bmjopen-2016-014815

² Monitor and NHS England. 2016/17 National Prices and National Tariff Workbook.

³ Department of Health. NHS Reference Costs 2015-16.

⁴ Curtis, L. & Burns, A. (2016) Unit Costs of Health and Social Care 2016, Personal Social Services Research Unit, University of Kent, Canterbury.

Table 3.14: Difference in health care resource use for nursing care homes (n=54) following installation of telemedicine

	111	A&E	I/P emergency	OOH
Actual difference	-218	-150	-144	-88
Assuming 4.9% growth	-283	-242	-210	-136

On the basis of assumed benefits and a spell value of £616, a negative ROI is forecast of -£0.81 for every £1 spent based on the actual reduction in health care resource use, improving to a negative ROI of -£0.71 for every £1 spent if 4.9% growth is assumed in the baseline activity. If the higher spell value of £3,058 is used then the ROI for the actual reduction in health care resource use is estimated as -£0.29, improving to a positive ROI or £0.05 if 4.9% growth is assumed.

It is important to remember that the benefits estimated in the ROI are only those which can be quantified with the available data. We are not able to measure or quantify any changes in quality of life among residents as a result of using telemedicine or by avoiding visits to hospital.

It is also important to consider the extent to which the potential reductions in health care use can represent cashable savings. Reductions in NHS 111 activity and out-of-hours visits will not reduce costs because there will not necessarily be a reduction in the numbers of staff providing the services, although if out-of-hours services are provided by a third party agency there may be savings. This may also be the case for A&E visits and inpatient admissions. Even if the reductions in health care use are not cashable, they still represent opportunity cost savings in that they create capacity in the system to carry out more work which may be important in meeting demand.

The attribution of costs and benefits is also an important consideration. The costs of telemedicine are borne by CCGs while the benefits may be accrued by hospital providers or CCGs.

Section 4: Conclusions

4.1 CONCLUSIONS

The AHSN report on the qualitative evaluation of the Vanguard reported that there had been considerable challenges in establishing a linked quantitative dataset for the evaluation. Having reviewed the dataset in some detail, it is clear that the data set has some significant limitations which limit the extent to which conclusions can be drawn. The data set received included problems such as the duplication of care home names in some cases, and more than 7,000 duplicate lines which had to be excluded from the analysis.

We were able to rectify some weaknesses in the dataset such as imputing missing data but significant amounts of data had to be excluded. This reduced the numbers of care homes that we could analyse from over 200 to 141. The analysis reported here needs to be interpreted with these limitations in mind.

The data that we were able to analyse should be treated with caution due to the constraints of the data and the challenges of the project rollout. Statistical testing of the data was not possible during the time available for the analysis but our opinion is that our findings are unlikely to have any statistical significance due to small numbers in the control group, the potential for bias and the variation in the observed results.

At face value the data for all of the 141 care homes, in the year following installation of telemedicine, showed a reduction in emergency hospital admissions of 3%; a marginal reduction in A&E attendances; a small increase in the use of out-of-hours services (2%); and a reduction in the use of 111 calls (4%). When these data were analysed in more detail there are some differences between types of care home and the types of telemedicine service provided.

Analysis by type of care home showed a decrease in inpatient emergency admissions of 11% in nursing homes compared to an increase of 5% in residential homes. There were also reductions in nursing homes compared to increases in residential homes for A&E attendances (-8% versus 7%); use of out-of-hours services (-9% versus 17%) and 111 calls (-16% versus 12%).

Care homes using the standard service model, with limited numbers of calls to the Airedale telemedicine Hub, demonstrated a 2% reduction in A&E attendances compared to a 13% increase for care homes using the GP triage service model with unlimited calls. Standard service model homes showed a reduction in emergency admissions of 3%, with GP triage homes showing a small increase in activity. Care needs to be taken in interpreting these results as less than 10% of the care homes analysed used the GP triage service model.

It should be noted that not all of the potential health care resource use benefits from the use of telemedicine could be quantified in this study. For example, there were no available data on the impact on primary care, so the observed benefits may be understated.

The literature on telehealth and telecare in general has very mixed findings so, given that we were unable to control for the extent of frailty in individual homes, the analyses carried out for the Airedale Vanguard can only be seen as indicative at best. The AHSN report highlighted a number of inconsistencies in the implementation of telemedicine across the three areas. While some of this is to be expected as telemedicine has been rolled out over a number of years, there are different service models and local issues which affect the way in which telemedicine is used. These factors include the influence of local GPs, different configurations of local services providing support to care homes alongside telemedicine and different knowledge and skills of care home staff in using telemedicine.

This inconsistency in usage is borne out in the patterns of usage of telemedicine described in this report. Interestingly, there appears to be no correlation between high usage of telemedicine, in terms of rate of calls made to the Hub, and reduction in the use of health care resources. In fact the opposite is apparent but this may simply be a case of higher levels of frailty in certain homes leading to higher use of telemedicine and higher use of health care resources.

4.2 RECOMMENDATIONS

The results demonstrated in this limited economic evaluation show interesting results with potential for further research and analysis:

- Airedale and Partners may want to consider exploring the possibility of carrying out more in depth analysis using statistical methods such as time-series analysis to observe some sub-sets of the data considered in this evaluation;
- Further investigation could focus more specifically on the key metrics and outcomes of interest. For example, the GP triage model could be seen as essentially an enhanced primary care offer, so more in-depth work could focus on the impact of care homes potentially using fewer GP resources, thus potentially improving GP access for the wider population which may impact on the use of acute care;
- Return on investment analysis relied on assumptions of the cost of avoided emergency admissions. A more detailed patient-level analysis could attempt to record exactly what types of admissions were avoided through use of telemedicine.