Promoting and Sustaining Independence in a Community Setting

Kent TeleHealth Evaluative Development Pilot
A study into the management of people with long term conditions
www.kent.gov.uk/telehealth
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A Study into the Management of People with Long Term Conditions

Working in partnership with:
- Participants and their Carers
- NHS Eastern and Coastal Kent
- NHS West Kent
- VA Puget Sound Healthcare System
- Viterion Telehealthcare, a Business of Bayer Healthcare

In association with:
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Acknowledgements

All the community based services, in particular the community matron teams in both East and West Kent, for their support of the pilot. Also the many people who have contributed to our understanding of this intervention, its application and potential, in Kent County Council and both NHS Eastern and Coastal Kent, and NHS West Kent Primary Care Trusts.

In particular, but not in any order;

Peter Gilroy, Chief Executive Kent County Council, (former Strategic Director Kent Social Services) for his vision

Oliver Mills, Managing Director Kent Adult Social Services, Kent County Council

Steve Leidecker, Director of Operations Kent Adult Social Services, Kent County Council

Hazel Price, Project Manager and the Telehealth team, Kent County Council

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Anne Tidmarsh, Director of Commissioning and Provision East, Kent Adult Social Services

Sue Williams, Research Manager, Kent Adult Social Services, Kent County Council

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The Service User Support Network

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Dr Neil Banik, GP, NHS Eastern and Coastal Kent

Dr Robert Stewart, Medical Director, NHS Eastern and Coastal Kent (previously Shepway PCT)

Dr David Lawrence, GP, formerly Dartford and Gravesham PCT, now NHS West Kent
And most importantly - all the people and their carers who have used the equipment and shared their data with us.

Thank you
I am delighted to be writing the foreword to this report on Telehealth. This kind of project is crucial for both social care and health economies to better understand, to be prepared for and to rise to future challenges such as an ageing population. This will mean people living longer with multiple and complex long term conditions in an increasingly difficult financial landscape.

In 2004 the former Chief Executive of Kent County Council, Peter Gilroy, had the ambition and foresight to start an innovative pilot programme that went beyond the traditional boundaries of social care. What Peter created was the Telehealth Pilot, which was about improving ‘quality of life’, supporting independence and giving people the chance to take better control of managing their long term conditions. Funded by Kent County Council and delivered in a unique partnership with health service colleagues from Kent’s GPs and Primary Care Trusts, the Pilot was the largest of its kind in Europe with 250 service users.

It was a huge success and helped health and social care work more closely together. It is fair to say that the benefits are first seen by the patient and the NHS. Kent Adult Social Services do, however, also expect financial benefits through reducing avoidable admissions to residential and nursing care and improved quality of life for carers as the technology supports them. Carers are provided with a silent and reliable source of reassurance thus reducing stress and anxiety in the longer term. Telehealth technology allows us to support more people for longer at home. In some cases, it has given users a way of staying at home in their final days, which is better for the individual and their carers as well as being better for the sector.

I have been massively encouraged to read some of the feedback from patients and professionals who have been involved in this work. Patients have told us that Telehealth has improved their lives and because of this they are now helping other people. This unique peer group continues to support and spread the word about how Telehealth is changing lives.

The Telehealth pilot has improved the quality of life of the people using it and their carers; it is simply not possible to attach a value to that. It has also achieved long term savings to the cost of care through service and system efficiencies. In the future these efficiencies could give us the chance to help more Kent residents.

Another significant outcome is the partnership between Local Government and the Health Service. Together, we have been taking advantage of the latest technology and digital changes in clinical practice and community care services.
I want to make sure services are based around people and give individuals the chance to take increased responsibility for managing their own life. I am immensely pleased that this pilot has achieved so much and look forward to seeing how it can be used even more in the every day life of people needing help and support.

Graham Gibbens  
Kent County Council Member for Adult Social Services  
September 2010
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1. Executive Summary

This innovative and ground breaking pilot commenced in March 2005, following a visit to the USA in June 2004. It was based on an agreement reached between KCC, the PCTs in Kent, general practitioners (GPs) and the VA Puget Sound Healthcare System in the USA. The decision to invest in this area to test the effectiveness of the telehealth technology was in many ways ahead of the government’s policy agenda. The full project rolled out to a total of 250 people between 2005-07, developing different clinical models of care and different frequencies of monitoring. The original intention was that the technology would be available to people with long term conditions (LTCs) aged 65 years and above, although in practice it took in a broader age range.

This highly significant telehealth pilot sought to improve the ‘Quality of Life’; to both empower and improve choice whilst supporting independence. At that time telehealth complemented our existing work with a government initiative on innovation focusing on reducing hospital admissions. This Innovation Forum together with telecare contributed to our 10 year plan – ‘Active Lives,’ of which the underlying theme is to help the people of Kent to live safely and independently in their local communities.

What happened?

At the time of the pilot, people with LTCs were primarily managed by their GP. Community matrons were only just coming into post although the findings and recommendations of the Evercare project had been around for a while.

Originally rollout was planned through a GP practice based model where the GP had overall clinical responsibility, with the day to day monitoring being undertaken by practice nurses or administration staff.

Engagement of the GP community was challenging and participation poor. However, the community matron model was more successful with the matrons engaging with differing levels of enthusiasm which in turn impacted on the GP engagement. Rollout was slow, although GPs clearly saw the potential of the technology. The old argument of having a substantial evidence base before being able to commit was particularly difficult to overcome and therefore the ‘hearts and minds’ part of engagement was one of the most difficult aspects of rollout. This all changed when, in East Kent, two specialist community matrons were employed. Given the nature of their caseload and their focus on the management of complex, multiple LTCs, telehealth was significant in the development of their role. Using this model, rollout in their locality rapidly took off and developed to embrace GPs, consultants and patients and their carers sharing information and reducing time lag for clinical communications and responses. The model later developed its own momentum and was extended across East Kent.

A major risk for the programme was acceptance and usability of the technology by participants and their carers, especially as the target age group was 65+. This risk never materialised, participants embraced the technology enthusiastically, reveling in their new found independence, empowerment and peace of mind with a level of enthusiasm we could never have anticipated. So much so that a group of 21 participants felt so strongly about what telehealth had given them that they wanted to ‘give something back’ and that took the form of a support network who actively support telehealth users by answering...
questions, troubleshooting with the equipment and helping others to establish a telehealth routine. It is a role they all embrace with passion and pride that defies the fact they have long term, multiple and complex conditions!

**Aims of the pilot**

The original target of the pilot was to replicate the results of the US study in the UK clinical setting and to:

- understand the effectiveness of the support, via telehealth technology, available to participants in enabling them to remain in their own home and to alleviate the burden on carers
- understand if people who use telehealth have reduced hospital admissions and shorter stays when they do, fewer GP and surgery contacts and fewer visits from community nursing teams
- understand if the success of telehealth in the USA could be replicated in the UK and if the technology could be used effectively
- to look at three conditions, Chronic Obstructive Pulmonary Disease (COPD); Coronary Heart Disease (CHD) and Diabetes Mellitus and especially those people who entered hospital frequently.

But in practice we looked at a broader range of outcomes.

The pilot study clearly indicates that:

- telehealth brings peace of mind to patients and carers. Some patients and carers have experienced life changing positive experiences
- telehealth supports independence and empowers people to take better control of their life and manage their conditions
- patients and carers like and embrace the technology, value it highly and want to use it!
- people who use telehealth have fewer hospital admissions and shorter stays when they do, reduced GP contacts and in some cases fewer visits from community nursing teams
- clinicians have more, regular and reliable information about a patient and can take the appropriate action based on that information. Early action (or intervention) has prevented hospital admissions and exacerbations
- telehealth promotes better medicine management by clinicians and patients
- clinicians, through the use of telehealth, are able to manage patients more efficiently and effectively
- monetary savings may be made through reduced unplanned hospital admissions, Accident and Emergency (A&E) visits, nurse/GP home visits and better use of clinician’s time. It is estimated that per patient over a six month period the telehealth intervention saved on average £1,878 per patient in 2006/07. The confidence interval ranged from a saving of £2,718 to a saving of £1,038. This figure is statistically significant at the 0.01 level which means we are 99% confident that the savings fall between these two figures
- a rough extrapolation of the savings to Kent across the three LTCs of COPD; CHD and Diabetes was undertaken using the 2006/07 Hospital Episodes Statistics (HES) data, and with caveats, the annual cost saving in 2006/07 would be of the order of £7,560,000. The range is a cost saving of £10,942,000 to a cost saving of £4,180,000. This figure is statistically significant at the 0.05 level which means we are 95% confident that the savings fall between these two figures
- if the projected cost saving to Kent of £7.5million for these LTCs could be replicated across the UK it is clear that there are potentially very significant cost savings for both the UK health and social care economies. There are also savings to the general economy when carers can return to work
the use of telehealth technology in conjunction with regular monitoring, in this case by community matrons with specialist training, produced a reduction both in the number of visits to A&E and in the number of bed days of care (BDOC) resulting in substantial savings. As a result the quality of life of those involved showed a considerable improvement, with increased confidence for the individuals and, equally important, for their carers. This represents a transformational change in quality of life for the patient or user of the service, and for carers, with consequent savings to the public purse.

The pilot was a huge success and rose to the challenges brought about by significant change in the way both health and social care worked together. It’s fair to say that the benefits initially accrue to the patient and the NHS but we also expect financial benefits to be seen in social care through avoidable admission to residential / nursing care and improved quality of life for carers as the technology supports them, providing a silent and reliable source of reassurance reducing stress and anxiety and their longer term impact. Telehealth technology allows us to support more people for longer at home and in some cases has facilitated users dying at home and that’s better for the individual, better for their carers and better for the sector.

**Participant experiences and outcomes (direct quotes).....**

Participant: Female, 59 years old, Emphysema, Chronic Obstructive Pulmonary Disease (COPD), and Polymyalgia Rheumatica (PMR).

“Before telehealth (2 years ago) I would visit the doctor’s surgery every 4 to 6 weeks. I was being admitted into hospital via emergency ambulance 5 or 6 times a year with lung infections, spending 10 to 14 days in hospital, this had a big impact on my family, a very worrying time for us all. Those times are truly terrifying. Those times are hard for me to even look back on because I really did believe that I was going to die. It must have been hard for my family as well, seeing their mum, wife fighting for breath. Since being on telehealth I have been into hospital twice a year but that has been because of a really nasty infection that wouldn’t respond to my antibiotics and I have needed intravenous drugs, and 24 hour oxygen. My last admittance into hospital was only for 36 hours, before that 5 days. I rarely go to the doctors now I have telehealth. Telehealth means to me - peace of mind, free of anxiety. There are a number of things that affect my breathing; weather, humidity, flowers, perfume, fresh air, atmosphere in a room, differences in temperatures in different rooms, so my telehealth machine would let me know that my problem is not necessarily an infection. My family and friends are grateful for the telehealth machine as they know they don’t have to worry if I feel off key, we all know what the stats say and if they are down they know my clinician Jeanette would become involved and deal with the problem, or it’s one of the above or I’ve over done it the day before.”

Participant: Male, 51 years old, Ischemic heart disease, Parkinson’s, Stroke disease, peripheral vascular disease, Hypertension.

“Before telehealth I used to spend at least eight to ten months per year as an inpatient in hospitals. My GP used to visit me at home on a regular basis and district nurses used to come to my home every other day to take my blood pressure. I was not able to plan my life on my good days, due to having to stay at home for the medical support team to come and take my blood pressure. At the time of referral, I had doubts as to how telehealth would help me with my long term conditions.
Since being on telehealth my blood pressure is monitored twice a day, morning and evenings lying down and sitting in my wheelchair. Telehealth gives me peace of mind as I can be assured that when my readings are transferred via telecommunication to the nursing centre, if there were any concerns regarding my blood pressures or blood sugar levels it can be addressed instantly. If my medication needs changing then the Matron can get in contact with my GP or the consultant and the correct medications can be prescribed.

Home visits from GP and district nurses are not so frequent as they used to be prior to being on Telehealth. Most importantly my hospital admissions as an inpatient has reduced, in the last 31 months I have spent ten days as an inpatient compared to eight to ten months per year.

Being on Telehealth has given me full control of my life and my independence. I can plan my day as I wish (go shopping with my carer, do some gardening as and when I am well enough to do so), I can visit my friends locally to where I live. And, above all, telehealth has opened so many doors for me; I am involved with public involvement group with KCC; I am part of Kent Telehealth support network volunteer group. It gives me a chance to help new Telehealth clients with any problems they may have with Telehealth equipment and to communicate and support one another.

And finally I have managed to achieve confidence and self esteem which prior to being on Telehealth I had totally lost it.”

Conclusion

This is not simply about doing things better. Telehealth is about transforming the way we work. It is about a shift of power from professionals to the citizen, enabling individuals to understand and manage their known conditions, to become in effect the expert. The technology will undoubtedly change but has the potential to promote an individual’s long term well-being and independence as well as improving individuals and their carers’ quality of life.

Used in a targeted way it can also improve the working lives of staff, is more cost effective and can be seen as another way of supporting effective clinical management in its broadest sense. The data shows that the use of telehealth technology is associated with fewer hospital admissions (A&E visits and bed days of care) along with high patient and carer satisfaction. Most importantly the figures show that the general and physical health of patients increased during the trial period.

Kent has a clear commitment to Advanced Assistive Technologies to improve the quality of life for the citizens of Kent. There are still 179 people from the Kent TeleHealth Evaluative Development Pilot who are currently using this equipment. KCC also undertook the Kent Telecare Pilot which resulted in the implementation of telecare devices in approximately 1000 homes, of which 750 continue to receive telecare support. In addition Kent recruited 2103 participants to the Whole Systems Demonstrator randomised control trial which commenced in 2007 and will complete in September 2010 bringing a total of 3,383 people recruited to use assistive technology through the three pilots.

A GP commented “It is a real example of that much talked of but rarely seen animal ‘Partnership Working’. It has been a pleasure to work with social care and other health partners. The pilot sets a good introduction to the Whole System Demonstrator Programme and I feel lights the way forward.”
An ageing population will have considerable implications for local health and social care service providers. The use of telehealth technology has the potential to produce a key and irreversible shift in how healthcare is delivered and the capacity to assist in delivering a person-centred service to patients and their carers. Clearly future investment decisions will be influenced by findings from this and other studies that point the way to different management of LTCs against the backdrop of challenging economic circumstances.
2. Key Findings

2.1 Background

The better management of people with long term conditions (LTCs) is one of the key strands of the modernisation of health and social care. Different models are being investigated as current models are high cost, high dependency and have poor outcomes. LTCs such as Chronic Obstructive Pulmonary Disease (COPD), Coronary Heart Disease (CHD) and Diabetes Mellitus are chronic illnesses that can limit a person’s lifestyle and quality of life (DH 2004b). Such conditions affect large numbers of people and their carers, whose quality of life can be improved if they are helped to manage their conditions effectively and appropriately.

People with LTCs use a disproportionate amount of health and social care services and are frequent users of unplanned acute care visits and unscheduled bed days of care. It has been recognised that there needs to be a change from a reactive to proactive model of care to support these patients and carers.

More than 17 million adults in the UK were estimated to report a chronic condition (DH 2005a). Carrier (2009) suggests that figures from the Quality Outcomes Framework (QOF) 2006-07 indicated that there are 15.4 million people in England with a LTC. This figure was supported by the General Household Survey, 2005. Numbers are expected to rise due to an ageing population and unhealthy lifestyle choices (DH 2009). The number of people with LTCs who have social and health care needs is increasing in Kent, nationally and internationally. In 2009 the Department of Health estimated that by 2025 there would be 42% more people in England aged 65 or over. They calculated that based on current figures that this “will mean that the number of people with at least one LTC will rise by 3 million to 18 million” (DH 2008a).

The need to support this group of people better has stimulated a range of innovative models of care, specifically in the United States, delivered via telehealth technology (Meyer 2002, Noel 2004, Chumbler 2004, 2005, Fetzer 2004, Darkins 2008).

Telehealth is the remote exchange of physiological data between a patient’s home and their clinician to assist in monitoring and diagnosis. This includes a home hub, with peripherals to measure vital signs, from which the data is transported down the telephone system. It can also include responses to questions given by patients about their health via the hub.

Telehealth is one of the key services available to support people with LTCs and their carers, but in the UK in 2004 - 2005 there was a systematic lack of evidence of the potential costs, benefits, quality, suitability and effectiveness of telehealth. Clark (2008) suggested that responses to information regarding telehealth projects “generally relate to small pilots (between 5 and 50 users) at the time of data collection apart from Kent (over 200).” He added that, “there are case study and local evaluation reports of positive benefits for individual users (increased re-assurance and improved quality of life) and some indications from professional judgment that hospital admissions may have been prevented.”

In 2005 an agreement was reached between Kent County Council (KCC), the Primary Care Trusts (PCTs) in Kent, General Practitioners (GPs) and the VA Puget Sound Healthcare System in the USA. The decision to invest in this area to test the effectiveness of the telehealth technology was in many ways ahead of the government’s policy agenda which concentrated on Telecare i.e personal and environmental...
sensors (DH 2005g). A pre-pilot involving 20 people was set up to test the infrastructure, the equipment and its ease of use. This model was then rolled out to a total of 250 people from 2005 - 2007, with different clinical models of care.

Initially GP led, following the creation of the new role of community matron, different models of delivery of the telehealth technology were employed. However, as little was known about the effectiveness of these different models of care, the data collected provided the opportunity to investigate the similarities and differences between the models and their impact on the implementation of the Kent TeleHealth Pilot. Although the aims of individual services vary, the essential focus for all services is to provide care that is person-centred (i.e. focuses on the needs of the person with LTC) and carer-centred (i.e. focuses on the needs of the carer). Developing new ways of working utilising the technology offers a new approach to care moving from a reactive model to a proactive one.

This telehealth technology offers participants and their carers the opportunity to gain the knowledge, skills and capabilities they require to look after themselves and those they care for, in a safe, effective and efficient manner, and to access the information and support they need. The telehealth technology was available to people with LTCs aged 65 years and above living in Kent. If the implementation was successful then it had the potential to increase all participants’ wellbeing, choice and independence.

2.2 What was the purpose of the research?

The overall aim of this pilot was to monitor and manage the health of participants, increasing participants stability thus decreasing hospital bed days of care; decreasing presentation to accident and emergency and to increase the participant’s awareness and management of their own condition; exploiting the emerging technology of telehealth and to look at whether there were any benefits for patients, carers and the health and social care sector.

The pilot also aimed to understand the relationship between the telehealth technology and its impact on the participant and different clinical models and monitoring; in particular their attitudes to, and satisfaction with the outcomes that have come about as a result of the implementation. As this study was a pilot it was set up to generate hypotheses from the findings. Specific objectives of the research were:

- to identify and review previous research on telehealth and its relationship between the results of the pilot such as changes in acute unplanned visits/episodes of care, different clinical models, clinical contacts, cost effectiveness and quality of life for the participant and their carer
- during the delivery of the pilot new models of care were introduced and this gave us the opportunity to consider the effectiveness of the different clinical models and monitoring models available to participants in enabling them to remain in their own home and reduce the impact on carers
- to understand whether telehealth can decrease acute unplanned visits/episodes of care, outpatient visits and surgery visits and to understand if there is a correlation between clinical models and monitoring
- to explore the effectiveness of the technology for people of different age groups and with different LTCs
- to consider the effectiveness of the support, via telehealth technology, available to participants in enabling them to remain in their own home and to alleviate the burden on carers
- to understand if the use of the technology had any impact on the participant and increased the stability of their disease
to understand if the technology increases the participants and carers awareness of their condition to enable them to become an Expert Patient.

The findings would allow us to ascertain what can be done to help clinicians assess the impact of telehealth on unplanned acute care visits/episodes of care and to enable participants and carers to monitor their own condition effectively and to improve their quality of life.

2.3 How was the research conducted?

This pilot is a pre-post quasi experimental observational study incorporating elements of quantitative and qualitative research.

There were several elements to the study:

- Literature review: a review of recent UK and international literature on telehealth and its deployment as well as an overview of policy at the time
- Primary research: quantitative research in thirteen different localities based in east and west Kent. In each area, participants were monitored, via telehealth, by different clinical models and with differing frequency
- Unplanned acute care visits/episodes were measured as Accident and Emergency (A&E) visits and bed days of care (BDOC). Data was collected at baseline and at six months after the commencement date to ascertain any change
- Self reported outcomes (Short Form or SF 12v2 - we used the UK version of SF12v2 which is anglicised and checked for reliability and validity. In the scoring we used UK population norms to make it representative)
- Outpatient visits were measured. Data was collected at baseline and at six months after the commencement date to ascertain any change
- Contacts with the different clinical models were counted. These contacts for all clinical models included home visits, phone contacts, nurse contact (in surgery), and surgery contacts. Contacts were correlated to any change in the A&E visits or BDOC
- Changes in unplanned acute care visits/episodes were measured as A&E visits and BDOC for different age groups and males and females
- Following a written invitation to participate, telephone interviews were conducted over a three week period in order to measure the level of client satisfaction with regards to the service they received and to identify potential participants for involvement in a TeleHealth Service Users Support Network
- Case studies and general comments from clinicians and people using telehealth, including their carers
- Unplanned acute care visits/episodes were measured for the different LTCs to ascertain any change. Data was collected at baseline and at six months after the commencement date to ascertain any change
- Baseline data collection for all measures (except SF12v2) was collected for a period of six months prior to installation for each patient.

2.4 Method of delivery of services

- Clinicians set individual parameters for the clinical readings that each patient took in their home. The telehealth hub was connected to the phone line and the peripherals (e.g. blood pressure monitor) were attached which took such readings as blood pressure and weight. The equipment was tailored to each person’s clinical requirements.
The readings were taken once a day and transmitted down the line to a secure server where the clinician could look at the readings.

The three different clinical models were: GP and district nurse (GP/DN), specialist community matrons who had been specialist nurses (e.g. cardiac, diabetes, respiratory) and community matrons from a general background. These groups monitored patients regularly (daily) or sporadically (three times a week or less).

Clinicians were able to ask the patient to repeat readings and could contact the patient if there were abnormal readings to change medication or make any other necessary intervention.

A consultant, a GP or community matron could access these readings if they provided care for this patient.

Eligibility was established if the person had been diagnosed with at least one of the following: COPD, CHD or Diabetes Mellitus. Some patients also had secondary conditions and co-morbidities.

Over 250 patients (n=250) were recruited to the study from March 2005 to the end of July 2007. 202 people (n=202) contributed to the evaluation. 86 people (n=86) took part in the telephone interviews. Information regarding clinical contacts is available for 148 people (n=148).

The study received ethical approval from the Local Research Ethics Committee and Research Governance along with Research & Development approval from the PCTs.

### 2.5 Findings

It should be noted that this is a pragmatic study and therefore it is difficult to state if the caseloads of different clinical models are the same.

- The data analysed shows that regular monitoring is associated with substantial increased savings. In one site, where community matrons had specialist training, the majority of patients who had complex conditions received telehealth, therefore bringing about a change in working practices. Thus focused targeting of patients brings more positive results. In other sites where there were fewer people on telehealth the clinical workload could have been greater and varied.

- Regular monitoring shows -77 A&E visits and -849 bed days of care for people contributing to the data.

- Sporadic monitoring shows -11 A&E visits and +313 bed days of care for people contributing to the data.

- Overall reduction is -88 A&E visits and -536 bed days of care in Kent. However, there was an increase in hospital bed days of care in some sporadically monitored sites which may be due to a few individual patients (see Tables 1, 2, and 3 p26).

- Overall contact with GPs and district nurses by phone, home visit, surgery visit and nurse visits decreased and the unplanned acute visits also decreased although bed days of care for some groups increased (Tables 1, 2, and 3 p26). It is unknown if these were referrals straight to hospital and not via the unscheduled A&E route.

- Statistically significant increases in mean contacts for community matrons were observed for phone and home contacts and the unplanned acute visits and bed days of care decreased for this group depending on frequency of monitoring (see Overall baseline, six month and mean differences for all outcomes).

- Among those who had a baseline, six weekly and 6-month follow-up SF-12v2 questionnaire (n=97), there was a statistically significant improvement in the physical component summary scores. The improvement was most pronounced in the patients from east Kent. There was a decline in mental component scores of less than one point which was not statistically significant.
It could be argued that given the understanding of the different models in which the overall movement of both physical and mental component scores occurs, this suggests the importance of the clinician in offering care and therefore providing reassurance, information and help to self manage. Telehealth can be seen as an effective tool that provides extra support for clinicians, contributing to a reduction in unplanned admissions following increased clinician telephone contacts or targeted visits. The decrease in bed days is most noticeable among those regularly monitored, indicating that support and early intervention may be higher for this group, changing practice from reactive to proactive.

Qualitative findings from the telephone survey show 91% of people believe that telehealth has helped them manage their condition(s) more effectively with 98% stating they would recommend telehealth to other people.

Monetary savings may be made through reduced unplanned hospital admissions, A&E visits, nurse/GP home visits and better use of clinician’s time. It is estimated that over a six month period the telehealth intervention saved on average £1,878 per patient in 2006/07. The confidence interval ranged from a saving of £2,718 to a saving of £1,038. This figure is statistically significant at the 0.01 level.

A rough extrapolation of the savings to Kent across the three LTCs of COPD; CHD and Diabetes was undertaken using the Health Episodes Statistics Emergency Admission Data for 2006/07, the Quality Outcomes Framework register for 2006/07 for the above and the result of the six month cost saving, and with caveats, the annual cost saving in 2006/07 would be of the order of £7,560,000. The range is a cost saving of £10,942,000 to a cost saving of £4,180,000. This figure is statistically significant at the 0.05 level.

If the projected cost saving to Kent of £7.5 million for these LTCs could be replicated across the UK it is clear that there are potentially very significant cost savings for both the UK health and social care economies. There are also savings to the general economy when carers can return to work.

A summary of activity levels for 6 months before and after installation is shown in Overall baseline, six month and mean differences for all outcomes.

Further detailed analysis is in Section 8.

People were successfully managed at home at end of life and an increase was seen in people being kept out of acute care at this time.

2.6 Conclusion

The telehealth technology has the potential to promote an individual’s long term well-being and independence as well as improving individuals and their carer’s quality of life. Used in a targeted way it can also improve the working lives of staff, is more cost effective and can be seen as another way of supporting effective clinical management in its broadest sense. The data shows that the use of telehealth technology is associated with fewer hospital admissions (A&E visits and bed days of care) along with high patient and carer satisfaction. Cost transference was also looked at in the economic analysis. The patient and their family or carer is one of the most important ‘variables’ in LTCs (and health and social care costs). Most importantly the tables show that the general and physical health of patients increased during the trial period.

The use of telehealth technology has the potential to produce a key and irreversible shift in how healthcare is delivered. The development of the pilot scheme in each site reflected the local context in terms of clinical models and monitoring. Monitoring of complex caseloads can be challenging and whilst this study is limited in reaching consensus on the best methods of monitoring, it appears that regular monitoring is more successful. In the most successful site a new way of working was developed which integrated telehealth into the care pathway. An ageing population will have considerable implications for.
local health and social care service providers and this technology has the capacity to assist in delivering a person-centred service to patients and their carers.

Clearly future investment decisions will be influenced by findings from this and other studies that point the way to different management of LTCs against the backdrop of challenging economic circumstances.
## Overall baseline, six month and mean differences for all outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline mean/median (CI) [n]</th>
<th>Month 6 mean/median (CI) [n]</th>
<th>Mean difference (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>1.0 (1.0; 3.0) [70]</td>
<td>1.0 (1.0; 2.3) [70]</td>
<td>-0.5 (0; 1.0)</td>
</tr>
<tr>
<td>Home visits</td>
<td>2.0 (1.0; 2.0) [70]</td>
<td>0.9 (0; 1.0) [70]</td>
<td>-0.5 (-0.5; 0)*</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>2.0 (1.0; 6.0) [70]</td>
<td>2.0 (1.0; 4.0) [70]</td>
<td>-0.5 (-0.5; -1.5)*</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>1.0 (1.0; 3.0) [70]</td>
<td>0.5 (0.4; 1.0) [70]</td>
<td>-0.5 (-1.0; 0)*</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>0.4 (0.1; 0.6) [77]</td>
<td>0.0 (0; 2.0) [77]</td>
<td>0.5 (0; 1.0)**</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 3.0) [78]</td>
<td>0.0 (0; 2.0) [78]</td>
<td>0.5 (0; 1.0)*</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>1.0 (0; 3.0) [79]</td>
<td>1.0 (0; 2.0) [79]</td>
<td>-0.5 (-0.5; 0)</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>1.0 (0; 2.0) [200]</td>
<td>0.0 (0; 1.0) [200]</td>
<td>-0.5 (-0.5; 0)**</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>0.7 (0; 12.4) [200]</td>
<td>0.4 (0; 4.2) [200]</td>
<td>-1.5 (-1.5; -4.0)**</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>25.4 (24.1; 26.7) [183]</td>
<td>28.1 (26.6; 29.6) [154]</td>
<td>2.2 (0.1; 5.4)**</td>
</tr>
<tr>
<td>Physical health</td>
<td>23.4 (22.2; 24.6) [172]</td>
<td>26.1 (24.6; 27.6) [142]</td>
<td>2.8 (0.6; 5.1)*</td>
</tr>
<tr>
<td>Mental health</td>
<td>39.6 (37.8; 41.4) [172]</td>
<td>40.0 (38.0; 41.9) [142]</td>
<td>0.43 (-2.4; 3.4)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
Table 1. Summary of A&E and Bed days of Care change†

<table>
<thead>
<tr>
<th>Type of monitoring</th>
<th>A&amp;E - change</th>
<th>Bed days of care - change</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP/District Nurse (DN)</td>
<td>-5</td>
<td>+198</td>
</tr>
<tr>
<td>Community Matron sporadic</td>
<td>-6</td>
<td>+115</td>
</tr>
<tr>
<td>Community Matron regular</td>
<td>-44</td>
<td>-429</td>
</tr>
<tr>
<td>Specialist Matron</td>
<td>-33</td>
<td>-420</td>
</tr>
<tr>
<td>Total</td>
<td>-88</td>
<td>-536</td>
</tr>
</tbody>
</table>

† Please see detailed figures in Tables 2-5 below

Table 2. Sporadic Monitoring by GP/District Nurse and site

<table>
<thead>
<tr>
<th>GP/DN</th>
<th>Total number of participants</th>
<th>A&amp;E - change</th>
<th>Bed days of care - change</th>
<th>Patients with large increase in bed days (BDOC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-3</td>
<td>+58</td>
<td>1 person 41 BDOC 1 person 42 BDOC</td>
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<tr>
<td></td>
<td></td>
<td>-1</td>
<td>+187</td>
<td>1 person 145 BDOC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+3</td>
<td>-51</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-4</td>
<td>+4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>-5</td>
<td>+198</td>
<td></td>
</tr>
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</table>

Table 3. Sporadic Monitoring by Community Matron and site

<table>
<thead>
<tr>
<th>Community Matron</th>
<th>Total number of participants</th>
<th>A&amp;E - change</th>
<th>Bed days of care change</th>
<th>Patients with large increase in bed days (BDOC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>+108</td>
<td>1 person 57 BDOC 1 person 59 BDOC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-6</td>
<td>+7</td>
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<tr>
<td>Total</td>
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<td>-6</td>
<td>+115</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Regular Monitoring by Community Matron and site

<table>
<thead>
<tr>
<th>Community Matron</th>
<th>Total number of participants</th>
<th>A&amp;E - change</th>
<th>Bed days of care - change</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-10</td>
<td>-125</td>
</tr>
<tr>
<td></td>
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<td>-10</td>
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<td></td>
<td></td>
<td>-5</td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>+2</td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>-44</td>
<td>-429</td>
</tr>
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</table>

Table 5. Regular Monitoring by Specialist Matron and site

<table>
<thead>
<tr>
<th>Specialist Matron</th>
<th>Total numbers of participants</th>
<th>A&amp;E - change</th>
<th>Bed days of care - change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>53</td>
<td>-33</td>
<td>-420</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>-33</td>
<td>-420</td>
</tr>
</tbody>
</table>
3. Introduction

3.1 Predicted demographic change and long term conditions

Predictions of a rapid demographic change with falling birth rates and increasing life expectancy will result in an increase in the ageing population, bringing with it many challenges in the future. The health of people in the UK has improved and is continuing to improve; people now live longer than ever before. Extra years of life whilst beneficial, mean that more people now, and in the future, will live with an illness that can be controlled but not cured. These illnesses are known as long term conditions (LTCs), some examples are heart disease, stroke, COPD, cancer, CHD, arthritis, diabetes, mental illness, and asthma, amongst others. The NHS now sees in the UK population, more people with a LTC than those with sudden or acute illness.

The size and scale of LTCs is well documented. 60% of adults in England report a chronic health problem (DH 2004b). 17.5 million people (UK) may be living with a chronic disease (NHS Confederation Conference). Up to three-quarters of those over 75 years of age are suffering from a LTC, and this figure continues to rise. By 2030, the estimate is that the incidence of LTCs in the over 65s will more than double. But many people suffer from more than one condition. Approximately a quarter of people in the UK have three or more LTCs, making care far more complex. Three quarters have one or two problems.

People with LTCs will place a demand on health and social care systems in many areas such as staffing and acute emergency services, as well as a burden on family carers. This increased demand for health and social care services also coincides with public health strategies and spending to educate people regarding lifestyle choices, thus preventing disease and enabling people to live longer and stay healthy at the same time.

Thus both the management of LTCs and healthy ageing, and specifically actively promoting the health of older people, are becoming increasingly important in Kent, the UK and internationally.

The need to provide alternative and better models of care for this group of people has stimulated a range of innovative models of care, specifically in the United States, delivered via telehealth technology.

Telehealth is just one of a range of terms such as Telecare, Telemonitoring or Telehealth at home and the distinctions between these are often blurred. There is little consistency in the terminology used but telehealth means providing health care at a distance, in this case in the participant’s home. Curry (2003) in a report for the Department of Health on Telecare, stated that ‘Telehealth monitoring is the remote exchange of physiological data between a patient at home and medical staff at hospital to assist in diagnosis and monitoring (this could include support for people with lung function problems, diabetes etc). It includes (amongst other things) a home unit to measure and monitor temperature, blood pressure and other vital signs for clinical review at a remote location (for example, a hospital site) using phone lines or wireless technology.’

While various individual projects and programmes existed that aimed to promote public health for all people, there were very few innovative strategies in the UK in 2004 that sought to harness technology, apart from telecare, and use it as a tool to provide daily personalised care to people with LTCs and help them manage their conditions effectively.
3.2 International Telehealth and its applicability to Kent

On a visit to the United States, the then Strategic Director of Kent Social Services had the opportunity to meet with people from the VA Puget Sound Healthcare System and see a demonstration of telehealth in use. The Department of Veterans Affairs, Office of Care Coordination Services, had been using telehealth to take some basic clinical readings to check on symptoms and measure vital signs (blood pressure, blood glucose, pulse, weight, etc) in the homes of ex-serviceman or veterans. One of the main drivers for their use of telehealth was the distance between the veterans’ homes and their health care providers. For veterans who had a health problem like chronic obstructive pulmonary disease (COPD), chronic heart failure, coronary heart disease, diabetes and depression getting treatment could be complex and inconvenient with journeys to health services taking over a day.

The Veterans Health Administration (VHA) is a large integrated health care service that in 2008 served 5.6 million patients annually, with a total of 7.6 million veterans enrolled to receive health care (Darkins 2008). The Care Coordination/Home Telehealth (CCHT) is the name of the national programme operated by the VHA in the United States. The CCHT model of care is built upon the Community Care Coordination Service (CCCS), a previous programme piloted by VHA between 2000 and 2003, and combines elements from other VA home telehealth pilots. Darkins (2008) discusses that in 2004 a group of care and case managers met within the VHA to arrive at a definition of CCHT. Darkins states that this was;

‘The use of health informatics, disease management, and home telehealth technologies to enhance and extend care and case management to facilitate access to care and improve the health of designated individuals and populations with the specific intent of providing the right care in the right place at the right time’.

Specifically the programme was set up to manage the care of veterans with chronic conditions and avoid their unnecessary admission to long-term institutional care and to provide non-institutionalised care (NIC). There are now more than 30,000 (mostly elderly) patients being currently served by CCHT. Therefore this is probably the largest and more integrated model of home telehealth in the US and internationally.

For some, especially older veterans, conditions like these made it difficult for them to remain living independently in their own home but telehealth enabled professionals to monitor them and therefore reduced the need for institutionalised care.

It was clear that in the VA this telehealth technology offered participants and their carers the opportunity to gain the knowledge, skills and capabilities they required to look after themselves, and those they cared for, in a safe, effective and efficient manner, and to access the information and support they needed.

The VA was a natural partner as they had piloted this technology across many people with successful results and some of these are discussed in the literature review; Noel (2004), Chumbler (2005, 2009) and Darkins (2008).

Darkins (2008) stated that the VHA had seen a 25% reduction in bed days, 20% reduction in admissions and an 86% patient satisfaction rating. For each year from 2003 - 2007, Darkins undertook an end of year census (point prevalence) for the number of patients receiving telehealth. This showed that the numbers of veterans supported increased from 2,000 in 2003 to 31,570 in 2007 (1,500% growth). Due to
an ageing population, the number of veterans aged 85+ is set to increase substantially and will peak in 2012 at 1.4 million, an increase of 167% over the year 2000 figure. These demographic changes mean that the CCHT is set to increase the numbers using telehealth above the 2007 level recorded and it is anticipated that the CCHT will provide care for 110,000 patients by 2011 (Darkins 2008).

The CCHT uses the framework of the Chronic Care Model (Wagner 1999, 2001) to support the implementation of telehealth by making the patient’s home the focus of care, where applicable, along with an emphasis on patient self management and shared responsibility.

The Strategic Director was able to see the transferability of this innovative and emerging technology and the potential for personalisation and delivery of both health and social care in a more integrated way. This led to a visit by a group of health and social care professionals, including two GPs, nurses, a matron, a care manager and a policy manager, to explore the possibility of integrating and using this technology as a tool to assist clinicians in personalising care for people with LTCs in Kent. Following a successful visit, this interest led to KCC Members involvement, taking a lead on trialing this technology across Kent in partnership with health colleagues. This was a natural extension of Kent’s existing interests in exploring the potential of other assistive technologies such as Telecare.

An agreement was reached between KCC, five PCTs in Kent, GPs and the VA Puget Sound Healthcare System in the USA. The decision to invest in this area to test the effectiveness of the telehealth technology was in many ways ahead of the government’s policy agenda. A pre-pilot involving 20 people was set up to test the infrastructure, the equipment and its ease of use. This model was then rolled out to a total of 250 people between 2005-07, developing different clinical models of care and different frequencies of monitoring.

The telehealth technology was available to people with LTCs aged 65 years and above living in Kent. If the implementation was successful then it had the potential to increase all participants’ well-being, choice and independence.

### 3.3 Overview of aims of the pilot

The Kent TeleHealth Pilot was quantitative and qualitative, seeking to generate hypotheses from the results. It was the largest study of its kind in the UK. One of the main questions we wished to answer was whether similar findings from telehealth programmes in the USA involving veterans could be replicated in the UK, providing alternative models of care for of people with LTCs. The US and UK health and social care sectors face growing pressure from the increasing number of people with LTCs. The need to reduce the cost of such care by avoiding unnecessary unscheduled admissions and interventions from both the primary and the secondary sector is therefore essential but it is also important not to shunt costs to elsewhere in the system. It was also important to learn the lessons from the US and explore if they could be applied in the UK. There is also a need to delay the cost of long term care for people by better managing their conditions. By helping people with LTCs to better manage their condition and remain at home, the US studies suggest that this brings benefits for patients and the health and social care economy.

The overall aim of this pilot was to monitor and manage the health of participants, increasing participants’ disease stability thus decreasing hospital bed days of care and decreasing presentation to accident and emergency (A&E). Most importantly the pilot wished to investigate if there was an increase in a participant’s awareness and management of their own condition. By exploiting the emerging technology of telehealth we wished to look at whether there were any benefits for patients and carers.
such as empowerment, supporting independence as well as the benefits to the health and social care sector. We also needed to understand if the technology would work in the UK and the interlinked responsibility of partner agencies.

The pilot also aimed to understand the relationship between the telehealth technology and its impact on the participant and different clinical models and monitoring; in particular their attitudes to, and satisfaction with the outcomes that have come about as a result of the implementation.

The programme started in March 2005 and ran until July 2007. The partners were five PCTs, namely Dartford and Gravesham (D&G); Maidstone & Weald; Shepway; SW Kent and Ashford; VA Puget Sound Healthcare System and Viterion Telehealthcare, a Business of Bayer Healthcare.

### 3.4 Kent projected need

Kent has an ageing population which will put pressures on health and social care in the future unless other models of care can be found. Of the current Kent population, each individual has an average of 1.6 of the 3 target conditions. Of these conditions, 37% have Chronic Obstructive Pulmonary Disease (COPD), 41% have Coronary Heart Disease (CHD) and 22% have Diabetes Mellitus (Type 2 diabetes). All the Type 2 diabetes sufferers have at least 1 co-morbidity.

### 2001 Kent populations and predicted change 2006 - 2016

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<th>2016</th>
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<td>1,376,800</td>
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### Kent populations and predicted change 2006 – 2016 Ages 65+

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<td>KCC Area</td>
<td>239,500</td>
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### Estimated numbers (2006 population) with type 2 diabetes, CHF, COPD

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<th>CHF</th>
<th>COPD</th>
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<tr>
<td>KCC Area</td>
<td>34,007</td>
<td>15,833</td>
<td>13,768</td>
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Census data
3.5 Structure of the report

This report seeks to evaluate through the Kent TeleHealth Pilot, the introduction of specific innovative telehealth technologies. This telehealth technology was part of Kent’s wider Active Lives (2010) strategy, to improve the life outcomes of older people with chronic diseases in their own homes or other community settings, and provide efficiencies across the health and social care economy. This pilot project was achieved with international and local health partners who are experts in the field of chronic disease management.

This report outlines the research aims and objectives that we have sought to answer in the pilot as well as the methods used. There are also sections on the policy background at the time, a search of the literature and an outline of the method of delivery of the service.

Analysis of all available data has been undertaken including an economic evaluation. There are limitations in the data and these are described in Section 8. A very simple extrapolation of the costs to Kent are included in Appendix 5, but a number of caveats need to be considered in the interpretation of this data as not all the data required to undertake the extrapolation was available to us.

Clinical and patient acceptance and satisfaction were key to the smooth running of the pilot including any plans for future implementation. Case studies and examples of clinical comments as well as a patient satisfaction survey are included in the qualitative analysis.
4. **NHS and social care policy background at the time**

The White Paper *Saving Lives: Our healthier nation* (DH 1999), set out the Government’s action plan for tackling poor health by improving the health of everyone, but most importantly those most at risk. ‘*Saving Lives*’ specifically highlighted the specific issues of cancer, coronary heart disease and stroke, accidents, and mental health.

*The NHS Plan* (DH 2000) set out a plan for investment and reform of the NHS. The Plan proposed changes across the NHS, outlining a new delivery system for the NHS as well as changes between health and social services, and changes for NHS doctors, for nurses, midwives, therapists and other NHS staff. The plan also ‘outlines changes for patients and in the relationship between the NHS and the private sector.’ It proposes ‘more and better paid staff, using new ways of working, reduced waiting times and high quality care’ centred on patients as well as ‘improvements in local hospitals and surgeries.’

More money was put into the system to bring about this change. *The NHS Plan* set targets for waiting times and put the patient at the centre of the NHS. One of the key goals was to enable and support people in improving their own health. Another goal was to meet the challenge of making a real difference to inequalities in health detailed in *Saving Lives*, as well as supporting those with conditions that they will live with all their lives.

As well as treating people with curable problems so that they become better quickly and live their lives to the full, the NHS plan also stated the need to support those people with chronic conditions, such as Congestive Heart Failure (CHF), CHD, renal failure and COPD, enabling them to manage their condition better and becoming an expert on their own condition. It was acknowledged that poor management of people with chronic conditions would lead to increased hospital bed days, accident and emergency department visits and the risk of a hospital acquired infection.

*The expert patient: a new approach to chronic disease management for the 21st century* (DH 2001) was a report from the Chief Medical Officer which showed how patients with chronic diseases were able to benefit from becoming involved in the decision making process regarding their own treatment. The report drew on examples from both the US and the UK including research papers. *The Expert Patients Programme*, designed to empower patients to manage their own healthcare. It was to be piloted and then rolled out nationally, with the aim of enabling more people to take greater control of their own care and to listen to themselves and their own symptoms, supported by their clinical team. Patients were to receive education to become experts in their own condition.

Several patient groups and organisations representing patients, health and social care came together forming a partnership on managing LTCs. They identified the three actions that taken together would have an impact on people with LTCs. They were: diagnosis and assessment; individual support; and providing individual care plans.

In the 2001 budget it was announced that Sir Derek Wanless would undertake a review of the technological, demographic and medical trends over the next two decades that would affect the UK. This review was to identify the key factors that would determine the financial and other resources required to ensure that the NHS could provide a publicly funded, comprehensive, high quality service available on the basis of clinical need and not ability to pay.
Securing Our Future Health was published in 2002 by the Department of Health for the Treasury, to enable the Chancellor to consider the possible implications of this analysis for the Government’s wider fiscal and economic strategies in the medium term; and to inform decisions in the next public spending review in 2002. It concluded that the UK would need to spend substantially more on health care and that fundamental reform would be needed to enable those resources to be used effectively. The review also looked at patient and public expectations, changes in health needs and different patterns of disease, workforce roles, pay, and the overall productivity of the health service. As there was uncertainty around how these drivers might change or influence costs, the review listed three scenarios:

**Solid progress** is made – ‘people become more engaged in relation to their health: life expectancy rises considerably, health status improves and people have confidence in the primary care system and use it more appropriately. The health service is responsive with high rates of technology uptake and a more efficient use of resources’

**Low uptake** – ‘there is no change in the level of public engagement: life expectancy rises by the lowest amount in all three scenarios and the health status of the population is constant or deteriorates. The health service is relatively unresponsive with low rates of technology uptake and low productivity’

**Fully engaged** – ‘levels of public engagement in relation to their health are high: life expectancy increases go beyond current forecasts, health status improves dramatically and people are confident in the health system and demand high quality care. The health service is responsive with high rates of technology uptake, particularly in relation to disease prevention. Use of resources is more efficient.’

(DH 2002 Chapter 3 p35).

### Total UK NHS spending

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<thead>
<tr>
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<th>Average annual real growth, per cent</th>
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<td>Projections</td>
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<td>Solid progress</td>
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<td>Fully engaged</td>
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1 Net spending on a resource basis, converted to real terms using the GDP deflator at market prices.

Excerpts from Table 5.1: Source DH (2002 Chapter 5 - p79)

### Personal social services (PSS) spending in England

<table>
<thead>
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<th>Average annual real growth, per cent</th>
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<td>Fully engaged</td>
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1 Net spending on a resource basis, converted to real terms using the GDP deflator at market prices. Excludes children’s and family services.

Excerpts from Table 5.4: Source DH (2002 Chapter 5 - p94)
What is significant in both these tables is the suggestion that patient perception and engagement will have a substantial influence on both NHS and social care expenditure.

Wanless stated that ‘Improving the use of ICT in the health service is a key issue in improving quality and productivity.’ Importantly the report noted that ‘The effect of ageing will be larger for social care as care needs rise sharply with age.’ One of the recommendations of this report into future health care trends and spending was that a similar review of social care was needed. Improving Chronic Disease Management (DH 2004a) was a note that set out the current position at the time and was aimed at PCT, NHS Trust and Strategic Health Authority (SHA) management teams. The document stated that it was estimated that in the UK ‘17.5 million adults may be living with a chronic disease’ or long term condition. It noted that around ‘6 in 10 adults in the household population report some form of chronic health problem.’ It went on to suggest that it was likely that ‘up to three-quarters of those over 75yrs are suffering from chronic disease’, and this figure was continuing to rise.

It concluded that if the current trend continued ‘By 2030, the estimate was that ‘the incidence of chronic disease in the over 65s will more than double.’ The document also stated that it was estimated that ‘45% of those with chronic disease suffer from more than one condition.’

This document stated that chronic diseases are those diseases that can only be controlled and not, at present, cured. They include diabetes, asthma, arthritis, heart failure, chronic obstructive pulmonary disease, dementia and a range of disabling neurological conditions. These chronic diseases have a significant impact not only on a person’s quality of life and but also on their family, with the incidence of chronic disease increasing with age. As people live longer, more people are living with more than one chronic condition and this means that they face particular challenges, for both their medical and social care. This document also states, like Wanless (DH 2002), that the care of people with chronic conditions uses a large proportion of health and social care resources. Significantly it states that ‘people with chronic conditions are significantly more likely to see their GP (accounting for about 80% of GP consultations), to be admitted as inpatients, and to use more inpatient days than those without such conditions.’

But the UK is not alone in this figure and the World Health Organisation (WHO) data indicates that this incidence is reflected globally, with 75% of the total population having one chronic condition and 50% having two or more conditions. The WHO has identified that such conditions will be the leading cause of disability by 2020 and that, if not successfully managed by governments all around the world, will become the most expensive problem for health care systems.

Chronic Disease Management A compendium of information (DH 2004b) quoted statistics that gave an insight to the problems to be faced by the health and social care economy in the future. It stated that of the total population of the UK (59million) over 60% of people had a chronic condition with 8.8million people in England having a long term illness that severely limits their day to day ability to cope. It highlighted US data which states that 45% of those with chronic disease are likely to have more than one chronic condition and for those over 65 this rises to nearly 70%. In the UK about 26% of people with a long standing problem have 3 or more problems (British Household Panel Survey 2001).

It also suggested that the old model of care based around acute care was out of date and quoted Kane (2002) who stated that ‘The predominant acute disease paradigm is an anachronism. It is shaped on a 19th century notion of illness as a disruption of the normal state produced by a foreign presence or external trauma, e.g. infection or injury. …Under this model acute care is that which directly addresses the threat. …In fact, modern epidemiology shows that the prevalent health problems of today (defined both in terms of cost and health impact) revolve around chronic illness.’
The document asserted that the people who fell into this category may be known to both health and social care. Their medication may be complex and if there is a problem with one condition this impacts on the others. They often have social need and may be isolated from family. If younger they may not be able to work. They may also have co-morbidities that may be missed such as depression.

This document highlights that the poor management of chronic diseases leads to wasteful use of resources. It documents that ‘80% of bed days in hospitals are currently used by emergency beds with many admissions being preventable.’ It suggests, that based on examples from the US (Kaiser Permanente, California, VHA, Chronic Care Model, Evercare) and Canada, of the eleven leading causes of hospital bed use in the UK, ‘eight were due to conditions which if care in the community and general practice were strengthened lead to a fall in admissions.’

This is backed up by data that shows that 25% of admissions are accounted for by 0.67% of all diseases which include mental illness (like schizophrenia and depression), heart disease, dementia, asthma and COPD and 50% of bed day use is accounted for by only 2.7% of all medical conditions, most of which are chronic diseases. (Source: HES data 2002). People with chronic conditions are more likely to be admitted to hospital and usage rises with the number of chronic conditions, with longer stay in hospital. The document shows that this group of people is only a small proportion of the total population. Further analysis of the data shows that just ‘5% of inpatients account for 42% of overall inpatient days. 10% of inpatients account for 55% of overall inpatient days with a further 50% of inpatients account for 10% of overall inpatient days.’ Source: Analysis of British Household Panel Survey).

The document suggested that primary care should work in partnership with patients ‘making use of the three R’s:

✓ Registration of a population of patients for whom primary care teams identify problems, co-ordinate care and help support their condition
✓ Recall of people to ensure they get the care they need by using prompts and reminders
✓ Review patients to ensure they receive the best evidence based care and are supported to manage their condition.’

This was to be supported by the new GP and Pharmacy contracts and especially the Quality and Outcomes Framework (QOF).

The document suggests that for this minority of patients with more severe or unstable forms of chronic diseases there was strong evidence from the US, that disease specific case management or specialist care can make a difference – especially for those 15% who use hospital bed days or the 2.7% who have frequent admissions to hospital. Therefore good case management is necessary to find these patients and identify them to stop repeated hospital admissions. This document provides strong evidence for a case in investing in case management. It also importantly shows the benefits to the patient of self care, with increased control over their life.

The term ‘chronic condition’ was replaced with ‘long term condition’ or long standing condition to reflect the fact that people cannot be cured.

The NHS Improvement Plan: Putting People at the Heart of Public Services (DH 2004c) set the government’s priorities for 2004-08 and supported the ten year reform set out in The NHS Plan. The NHS Improvement Plan set a new strategic model for management of LTCs through self care, disease management and case management. It stated, that with waiting times reduced, the NHS must concentrate on providing better
support to those people who have medical conditions that they will have for the rest of their lives. It acknowledged that it was now time for a ‘radical, far-reaching and ambitious approach to making a real difference to the quality of life of people who live with illnesses every day.’

By being proactive and preventative, the strategy was to make a difference to people’s lives and to improve the quality of their life. It highlighted that often the NHS is regarded as being dominated by treating and curing disease, but large numbers of people are living with conditions that cannot be cured. It promised higher-quality care for people with LTCs. Personalised care was seen as the way to support people by improving people’s care close to home, through specialist nurses and GPs with a special expertise in their condition. It was envisaged that this would lead to fewer admissions to hospital, which can cause anxiety for both patients and their carers/families as well as being a poor use of hospital resources.

The NHS Improvement Plan (DH 2004c) described a new clinical role known as community matrons. These community matrons were to ‘use case management techniques with patients who meet a criteria denoting very high intensity use of health care.’ Importantly the role specified that ‘with special intensive help, these patients are able to remain at home longer and to have more choice about their health care.’

The case management work of community matrons was and remains central to the government’s policy for the management of people with LTCs. Specifically this model of case management meant that there was one person who acted as both provider and procurer of care, taking responsibility for ‘ensuring all health and social care needs are met, so that the patient’s condition stays as stable as possible and wellbeing is increased’.

There was a new GP contract, which would reward doctors for delivering higher standards of care while the new post of community matrons would support patients with complex LTCs. NICE (National Institute for Health and Clinical Excellence) was continuing its work to develop guidelines on cost-effective drugs and clinical guidelines on treatment.

The effective management of LTCs increasingly became a focus for both health and social care and became a priority for government policy. It was against this background that KCC began investigating the use of telehealth.

This new model fitted well with the Kent TeleHealth Pilot aims, as the community matrons were tasked with:

- helping to prevent unnecessary admissions to hospital
- reducing length of stay of necessary hospital admissions
- improving outcomes for patients
- integrating all elements of care
- improving patients’ ability to function and their quality of life
- helping patients and their families plan for the future
- increasing choice for patients
- enabling patients to remain in their homes and communities
- improving end of life care.

Whilst the Public Health White Paper Choosing Health Making healthy choices easier (DH 2004d) underpinned this approach to LTCs, it was seen as building ‘on the public’s growing desire for a healthier future by ensuring that the self care support is in place for people - particularly those in disadvantaged groups and areas - to make healthier choices about diet, physical activity and lifestyle.’
Promoting and Sustaining Independence in a Community Setting

Supporting People with Long Term Conditions – An NHS and Social Care Model to support local innovation and integration (DH 2005a) introduced new management arrangements for transforming service delivery for people living with LTCs. The aim of the document was to reduce the unscheduled use of secondary care services by increasing the ‘provision of care in a primary, community or home environment’. Its goal was that patients with LTCs would receive ‘high-quality care personalised to meet their individual requirements.’ But most importantly to underpin this it wanted to put into place within the ‘health and social care communities an effective, systematic approach to the care and management of patients’ with a LTC. It highlighted what it saw as the current problems:

- ‘17.5 million people in the UK report a long term condition (such as diabetes, asthma or arthritis). Note as opposed to 15.4 million in England.
- For some people, especially older people and those with more than one condition, discomfort and stress is an everyday reality.
- The impact on the NHS and social care for supporting people with long term conditions is significant.
- Care for many people with long term conditions has traditionally been reactive, unplanned and episodic. This has resulted in heavy use of secondary care services.
- Just 5% of inpatients, many with a long term condition, account for 42% of all acute bed days.
- Only about 50% of medicines are taken as prescribed.’

Public Service Agreements (PSA) were brought in as part of the government’s Comprehensive Spending Review and required health and social care to work together. This document set a PSA target to reduce inpatient emergency bed days by 5% by March 2008 using 2003/04 as the baseline. The PSA required health and social care communities to provide an effective, systematic approach to the care and management of patients with a LTC. ‘Health communities were expected to make progress towards the PSA target from 2005 onwards by offering a personalised care plan for vulnerable people most at risk.’ (DH 2005a)

But most importantly it asked professionals to identify all LTC patients in the health community. It set out a stratification of disease levels to match the care needed for each group of patients. These were:

- ‘Level 3: Case management - Identify the most vulnerable people, those with highly complex multiple LTCs, and use a case management approach, to anticipate, co-ordinate and join up health and social care.
- Level 2: Disease-specific care management - This involves providing people who have a complex single need or multiple conditions with responsive, specialist services using multi-disciplinary teams and disease-specific protocols and pathways, such as the National Service Frameworks and Quality and Outcomes Framework.
- Level 1: Supported self care - collaboratively help individuals and their carers to develop the knowledge, skills and confidence to care for themselves and their condition effectively.’

The initial focus was on the very high intensive users of secondary care services and this was to be through a case management approach. Community matrons were to be a key in this approach using any tools and techniques available to them to make an impact and were to be at the forefront of case management. There were to be 3000 community matrons in post by March 2007. One of a number of tools that was available to community matrons in Kent was telehealth. When the specialist community matrons came into post their remit included using telehealth from the commencement of their service. One of the main aims was to treat patients sooner, nearer to home and earlier in the course of disease.
But in order to do this the clinician requires a combination of:

- earlier detection
- good control to minimise effects of disease and reduce complications
- more effective medicines management
- reduction in the number of crises
- promoting independence, empowering patients and allowing them to take control of their lives
- prolonging and extending the quality of life.'

As will be seen from the literature review, emerging research from the USA showed that telehealth could assist in all these areas.

To support the implementation of Supporting People (DH 2005a), a complementary document was published. Supporting people with long term conditions: Liberating the talents of nurses who care for people with long term conditions (DH 2005b) stated that nurses should perform a key role in caring for people with LTCs. This document described some of these roles and paid considerable attention to the new clinical functions of the community matron. It described how people could benefit from the service and who would be eligible. A supplementary document How a Community Matron can help you with your long term condition (DH 2005c) was published for public information and this leaflet explained how people with a LTC could be offered support from a community matron.

National Service Frameworks (NSFs) are long term strategies which cover different areas of care for improving specific areas of care. The NSFs are designed to improve care by setting national standards and identifying the key interventions that need to be put into place. The National Service Framework (NSF) for Long term Conditions (DH 2005d) was a strategy to be a sign of a real change in the way health and social care bodies and their local partners worked with people with LTCs to both plan and deliver the services.

The NSF document built on Supporting People with Long Term Conditions (DH 2005a) and aimed to improve the lives of people with LTCs by:

- giving people choice, through services planned and delivered around their individual needs;
- supporting people to live independently and play their full part in society;
- co-ordinating partnership working between health and social services and other local agencies.

The NSF did focus on neurological conditions and requirements were based on evidence from services for people with neurological conditions, but the NSF stated that these issues were also relevant to people living with other LTCs. This framework acknowledged that people with LTCs are intensive users of services. Kings Fund research (2009) states that although people with LTCs make up 31% of the population they account for 52% of GP appointments and 65% of outpatient appointments. (Note this is in contrast to the figures stated in DH 2004 and DH 2002).

Long-term Conditions Information Strategy-Supporting the National Service Framework for Long-term Conditions (DH 2005e ) was published to coincide with the NSF and provide information for a wide group of stakeholders.

Both ministers and academics had visited the USA and Europe to see if there were different models of care that could bring down the costs associated with LTCs. One of the conclusions they reached was the need to integrate primary and secondary care, focusing on prevention as well as treatment. To do this
they would align financial rewards for doctors with integrated care, and underpin medical practice with a strong evidence base. Specifically they aimed to put in place a system to reduce the reliance on secondary care services and increase the provision of care in a primary, community or home environment. The Kent TeleHealth Pilot sought to build on this by the use of telehealth in the home. Whilst the USA had shown a reduction in secondary care, one of the objectives of the pilot was to see if this could be replicated in Kent.

As will be seen from the literature review, emerging research from the USA showed that telehealth could assist in all these areas.

The King's Fund commissioned Sir Derek Wanless to conduct a review of social care in 2005. The outcome was a report, *Securing Good Care for Older People* (2005), which looked at the challenges facing social care over the next 20 years, the resources that will be needed to meet them (both staffing and monetary), and the options for finding those resources. *Securing Good Care for Older People* concluded by suggesting a 'partnership' model of funding as the best, fairest and most cost-effective way of delivering a minimum level of care to people that they could top-up from their own resources.

In 2005, the Department of Health launched a consultation on the future of community services. *The Green Paper: Independence, Wellbeing and Choice* (DH 2005) set out the government's vision for the future of adult social care in England. The Green Paper addressed the challenges for social care of a changing and ageing population, higher expectations and the objective of enabling people to have as much control over their lives, in as much as possible, for as long as possible. The paper examined a range of prevention, enablement and early intervention services which included Telecare and preventative electronic technology. It described the need, like previous documents, for collaborative partnerships, joint commissioning with other authorities, the NHS, the voluntary sector and people using services to design and deliver seamless services.

From the early work on demographic and health predictions, including the cost of long term care Malley et al (2006), Wittenberg (2006) it had been clear that another approach to managing these conditions was needed.

Many of the preceding policy documents aligned well with the aims and objectives of the Kent TeleHealth Pilot.

*Building Telecare in England* (DH 2005g) had set the scene for extending Telecare, Telehealth and advanced remote monitoring to a wider population to support individuals, carers and people with LTCs such as COPD and Diabetes. £80m of additional funding was made available from the Preventative Technology Grant (PTG) and Kent was awarded £1.988k. The grant was intended to enable organisations to have financial flexibility to improve care pathways and Kent used the PTG to implement Telecare. The accompanying *Telecare Implementation Guide* (DH 2005h) was published at the same time.

The Green Paper, *Independence, Wellbeing and Choice* fed into the 2006 White Paper *Our Health Our Care Our Say* (DH 2006). This policy document went further by recognising and attempting to focus on the key issues for people with LTCs. It looked at the range of services that could be delivered in the community or at home and that could be integrated and tailored to peoples’ needs. It described the need to improve joint PCT and local authority commissioning arrangements, to ensure better integration across services, make the best use of resources and prevent duplication. The report particularly mentioned the new possibilities opened up by the use of assistive technology, both telecare and telehealth, to support people in their own homes. However the report called both of these technologies Telecare and did not
distinguish between them. As both telecare and telehealth had been implemented in Kent the distinction is clear in relation to Kent but in much of the literature the terms are used interchangeably.

By 2005 telecare was in use in many parts of the UK and was becoming more mainstream. In the White paper, Our Health Our Care Our Say (DH 2006), the government pledged to set up a National Demonstrator Project (Whole System Demonstrator Programme) to evidence the benefits of assistive technologies.

**Other relevant policy documents are:**

*Diabetes in the UK* (2004) gave a report on the number of people with diabetes in the UK but also highlighted that Type 2 diabetes can bring risks of heart disease, stroke, kidney disease and eye disease to name a few. Type 1 diabetes can increase the risk of eye damage, kidney damage and nerve damage.

*Self-Management for Long-Term Conditions- Patients’ perspectives on the way ahead* (Kings Fund 2005).

*Caring for people with long term conditions: an education framework for community matrons and case managers* (DH 2006c) explained how commissioners and providers can use the competencies framework set out in *Case management competences framework for the care of people with long term conditions* (DH 2005i) to develop appropriate education and training.


*Clearing the air; A National study of chronic pulmonary disease* (Healthcare Commission 2006).

*Supporting self care - a practical option: Diagnostic, monitoring and assistive tools, devices, technologies and equipment to support self care* (DH 2006b).

**The following are a few of the later documents on long term conditions:**

*Putting People First a shared vision and commitment to the transformation of adult social care* (2007) was specifically aimed at social care and the personalisation of services for people. The government vision was that people would be able to live their own lives as they wish; confident that services are of high quality, are safe, and promote their own individual needs for independence, well-being, and dignity. The government wished to introduce individual budgets which would be designed to give individuals a full understanding of the finance that is available to them, in order to empower them to take control and make decisions about the care that they receive. An independent report which evaluated the initial Individual Budgets pilot programme (*IBSEN*) was published in 2008.

*The Coronary Heart Disease National Service Framework* (DH 2008b) was a report on progress and stated that, whist there was good news in falling mortality figures, there was still much to do.

*Raising the Profile of Long Term Conditions Care - A Compendium of Information* was published in 2008. This document highlighted the latest evidence which continued to support the previous messages about LTCs. It reiterated the intensive use of services, the fact that numbers are predicted to increase as a result of lifestyle choices. It stated that ill-health, specifically among those of working age, placed a burden on health and social care. Importantly, it highlighted the huge savings and benefits to the population if health and social care communities invested in effective LTC management (2008a).
It updated *Chronic Disease Management A compendium of information* (DH 2004b) and illustrated that the PSA target to reduce hospital admissions by 5% had been achieved and a reduction of 10% had been realised.

It emphasised that this was not an NHS issue but a joint issue with social care. This document has been updated with *Improving the health and wellbeing of people with long term conditions - World class services for people with long term conditions – information tool for commissioners* (2010a). There have been consistent messages about what is important for people with LTCs.

*Supporting People with Long Term Conditions – Commissioned Personalised Care Planning - A guide for commissioners* (2009) was a guide to help commissioners fulfill their obligation to embed personalised care planning.

In 2007 when Lord Ara Darzi carried out the *Our NHS, Our Future; NHS Next Stage Review*, LTCs were one of his eight priorities. The final report calls for an NHS that empowers patients with greater choice, better information and more control and influence, is as relevant to people with LTCs as any other patient.

The NHS and Social Care agenda today is informed by this, with numerous projects built around these concepts. The Department of Health requires that all people with LTCs receive a personalised care plan and, with others, are developing programmes on self-care; research projects to test the use of telecare and telehealth in supporting independent living; new specialist nursing roles and sophisticated computer tools that allow health care professionals to identify and support people at risk.

A recent DH document *Ten things you need to know about Long Term Conditions* has updated the information in previous documents. The following is the estimated need for England given in April 2008 (DH website):

1. 15.4 million people, or almost one in three of the population, in England suffer from a long-term condition
2. Three out of every five people aged over 60 in England suffer from a long-term condition
3. Due to the aging population the number of people in England with a long-term condition is set to rise by 23% over the next 25 years
4. 5% of the patients, the majority of whom have one or more long-term condition account for 49% of all in-patient hospital bed days
5. Patients with long-term conditions are very intensive users of health care services. Those with long-term conditions account for 31% of the population, but use 52% of all GP appointments and 65% of all outpatient appointments
6. It is estimated that the treatment and care of those with those with long-term conditions accounts for 69% of the primary and acute care budget in England
7. 6.4 million people have clinically identified hypertension. It is estimated that the same number again have unidentified hypertension, meaning that an estimated one in five of the population suffers from the condition
8. Common mental health problems affect about one in seven of the adult population with severe mental health problems affecting one in a hundred
9. The UK economy stands to lose £16 billion over the next 10 years through premature deaths due to heart disease, stroke and diabetes
10. It is estimated that 85% of deaths in the UK are from chronic diseases. Within this, 36% of all deaths will be from cardiovascular disease and 7% from chronic respiratory disease.
5. Review of current literature

This literature review has employed an inclusive approach to encompass evidence to support implementation of home-based interventions for the improvement of chronic disease management. This section reviews both the academic and provider evidence base for telehealth. In some instances the review has also looked at other interventions which differ slightly from the Kent TeleHealth Pilot design but where general lessons are transferable to the home telehealth intervention.

The literature review aims to identify and review previous research on variable models of telehealth and its impact upon acute unplanned visits/episodes of care, clinical contacts, cost effectiveness and quality of life for the participant and their carer.

The review looks at the usability of the technology, any reliability issues, benefits to patients and carers and providers, cost benefits to healthcare systems (both acute and primary care), and the impact of the intervention on the functional and cognitive status of patients. It also considers evidence on the empowerment of patients to become an ‘Expert Patient’.

Articles have been included irrespective of the study design. This is not a systematic review as many systematic reviews tend to concentrate on randomised controlled trials. As long as articles have some relationship or possibly transferability of outcomes which relate to home-based telehealth interventions they are included. The articles reviewed refer to national and international work.

The review is also different from some reviews in that it tends to be date ordered. This is to give the reader some idea of the literature that was available to staff up to 2004/5 when the technology was being investigated and purchased and from 2005/7 during the pilot period.

Much early literature was positive about the potential benefits of telehealth. Ruggiero (1999) points to cost savings for provider and patient, improving the quality of measurements, obtaining a new type of follow up and improving patient’s quality of life. However trials were small and there was little hard evidence of any cost benefit.

Kinsella’s systematic review (1999) also included telemedicine. The studies reviewed showed that many visits, either to patients in their homes or by patients with chronic diseases to a clinic or surgery, which are aimed at capturing vital signs and assessing the patient, could be performed by telehealth and with more detailed data. As early as 1996, Warner suggested that the new technological advances in telecommunications and computer design would provide tools for community nurses to improve patient care and nurse efficiency. He stated that nurses could be proactive, capturing vital signs data without visiting the home, scheduling daily events, teaching and empowering patients, and remotely managing the care plan by using telehealth in home care.

Riva (2000) suggests that telehealth has been used successfully in optimising health services to isolated patients, although much of the review is also concerned with more medical software. However he does raise an important point noted in Section 6.3 regarding the security of the system and suggests that there are three fundamental types of relationship where ‘a duty is owed by one party to another.’ These are the relationship between the clinician and the patient; the relationship between clinicians and the relationship between the provider of the telemedicine system and the user.
Wooton and Hebert (2001) suggests an evaluation framework for telehealth and this theme is reiterated in further studies which all tend to agree that there is no one validated way of evaluating telehealth, thus making it difficult to compare results from studies. Interestingly they ask not only if the technology works and at what cost, but whether it is a replacement for current practice.

However there appears to be no study which compares the effectiveness of daily vital signs monitoring of people with complex co-morbidities in a community setting, in a GP practice, in outpatients and in an acute inpatient setting. Neither does there appear to be a study which compares the economic costing of these different methods as well as implications for clinical staffing. There does not appear to be a study that looks at patient satisfaction with the different models, as well as costs associated with extra travel and convenience.

One of the early studies to show positive outcomes for telehealth was that by Meyer (2002). This study shows the result of eight projects within the Veterans Health Administration (VHA) which tested disease management principles, the role of the Community Care Co-ordinator and the use of technology to maintain veterans in their own home. Results showed a 40% reduction in emergency department visits, 63% reduction in hospital admissions, 60% reduction in hospital bed days, 63% reduction in VHA nursing homes admissions and an 88% reduction in nursing home bed days of care. The functional assessment of patients was measured using SF36 which also showed significant improvements in several domains. One of the most illustrative notes from this article is that two out of three Americans, at least 150 million people, have one or more chronic conditions that have the capacity to reduce the quality of their lives, and in addition these conditions may account for two-thirds of the annual $1 trillion in health care costs.

An early systematic review by Whitten et al (2002) sought to look at cost-effectiveness studies of telemedicine interventions (primarily using videoconferencing-based technology). They concluded that there was little good evidence that telehealth was a cost-effective means of delivering health care, however they acknowledged that many early studies did not include this cost-effectiveness information. Whitten found that further examination of the studies found them to be diverse and across different types of organisational contexts so that the data used in these studies to support claims of cost-effectiveness were difficult to compare.

They reported that the studies were small, methodologically flawed and like this pilot were pragmatic evaluations rather than randomised controlled trials. Out of 612 articles they found only 24 which showed any cost-effectiveness and only 3 had a formal hypothesis. The benefits were shown as cost savings with no analysis of any changes in benefit to patients. They dismissed much evidence by stating that many claims were not founded on strong evidence, but their systematic review revealed a disagreement with other colleagues who questioned their methods and terminology such as Paul Scuffham et al. (2002), McCrone (2002) and other respondents.

Whitten had stated that few papers were published that were not successful, but Hailey (2003) stated that presentations at conferences had been good as people were willing to share success and failure. Whilst they acknowledged limitations to studies, they saw success in telehealth as the contribution it made to the operation of health services and the maintenance and improvement of health status.

A review of the socio-economic impact of telehealth by Jennet (2003) concluded that indicators were not used consistently; however they did state that telehealth had significant socio-economic benefit to patients and their families, health care providers and the health care system. The main benefits identified were increased access to health services, cost effectiveness, improved health outcomes, better quality of care, better quality of life, enhanced support and the opportunity for education of the patient.
Although many studies concentrate on the main chronic diseases, such as Diabetes, COPD, Chronic Heart Failure (CHF) and Coronary Heart Disease (CHD), other applications are found consistently in the literature. Hatzakis, in 2003, suggested the use of telehealth in Puget Sound VHA to deliver services to veterans with multiple sclerosis. This administration area, which was the Kent partner, is geographically large, covering veterans health needs from Washington, Portland, Seattle and Alaska. Thus the potential for telehealth to deliver real cost saving especially in travel to clinics cannot be underestimated.

Throughout much of the literature there are pointers to key drivers of success. One of the most important of these is the acceptance of staff to use the equipment in an integrated care pathway and to see its benefits. In 2004, Fetzer, a nurse by profession, wrote about the implementation of telehealth in New Hampshire. Fetzer describes that although the nurse is not ‘hands on’; there is a utilisation of knowledge, skills and judgement in analysing the vital signs data from patients. Hence telehealth has reduced emergency department visits and additional hospitalisation by assessing clients on a daily basis. A pilot using just eight patients reduced hospitalisation by 82%. But more importantly Fetzer points to the benefits to staff, enabling targeted visits to patients and giving patients a sense of control by participating in the data collection and any symptoms that may require action. Fetzer talks about clinical impact and it is worth underlining the importance that clinical decision making has around using the data generated by telehealth. The pilot reinforced these findings.

This is further illustrated by Benner (1984) who states that the problem solving of a proficient or expert nurse differs from that of the beginner. He suggests that the knowledge embedded in clinical expertise is central to the advancement of nursing practice and describes the different stages of nursing competence from beginner to expert and how decisions can differ between the two. In other words there is an argument that the specialist matron’s clinical decisions are more likely to have an impact if they are more experienced than a generalist matron or other staff. This is key to many of the findings.

One study often referred to, which shows the success of telehealth, is Noel et al. (2004). This study examines the use of telehealth on a high-resource veteran population in Connecticut. This study also used a control group (a lack of which drew criticism of other studies). The telehealth patients showed a statistically significant decrease at 6 months for hospital bed days of care (p<0.0001), emergency department visits (p=0.023) and patient satisfaction (p<0.001). Although they found that functional levels of patients did not change, they did notice an improvement in cognitive status, treatment compliance and stability of chronic diseases.

One of the positive results is that due to a belief or feeling of being supported by the provider; the technology has the ability to enhance patient’s perceptions. This is key to achieving improved and ongoing motivation, self awareness, self management of chronic diseases and an enhanced sense of well-being.

Noel et al. (2004) also point to the obvious fact that telehealth transports data. It is an additional tool to use in helping to monitor adults and increasingly an elderly population with chronic complex co-morbidities who may have difficulty with movement and transportation to the health care provider. Using this tool as an integrated part of the professional’s day enables clinicians to triage and treat early signs and symptoms of instability, thus preventing exacerbations before they occur or become urgent. Chumbler suggests that while it is possible for anyone to look at the data, it is the knowledge and skill that expert clinicians have that impact on how they use the data - thus impacting on a person’s health.
Critically telehealth is a tool and what the clinician gets out of it is dependent on what they put in to it. Telehealth has the ability to change the relationship between professionals and patients and put them on a more equal footing as they become more expert in their own condition and their readings. A confident practitioner is able to use telehealth effectively to its full potential.

Although many US studies such as this show the bed days of care (BDOC) and Emergency department (ED) visits as a change, what they do not show is the number and type of interventions as a result of the clinician’s decision making using the telehealth data and how many extra BDOC and ED visits might have been saved as a result of using telehealth. (Please note ED = Accident and Emergency.)

The NHS Plan (2000) stated that care should be delivered effectively and efficiently to patients and carers with an emphasis of quality and care built around the needs of the user. In the national COPD audit (2004) Taylor states that there were 8013 emergency admissions of patients with acute exacerbations. The cost of care was rising and it was clear that a new pathway was needed. Carlisle Housing Association Careline Service approached the local PCT to develop a care plan to support patients who were discharged early and to deliver the personalised care set out in the NHS plan.

Telemedicine units were used and parameters set for each individual patient which would inform the 24 hour team if an intervention was required. From 2004 there was a 50% reduction in hospitalisation. Although an economic saving to the NHS, the real benefit was that patients and carers felt less anxious about their condition and discharge thus reducing the number of acute exacerbations. Not only did patients feel empowered but they were also compliant with their medication and therapies. This led to increased self esteem, reduced hospital stays and the risk of acquiring a hospital based infection.

The Trust also benefited as this produced savings and stopped bed blocking. Taylor (2005) states that early diagnosis and intervention prevent deterioration in a patient’s condition. Telemedicine offers an accurate and quick way of monitoring patients who are chronically ill. All targets set for savings in the study have been exceeded.

Chumbler et al (2005) assessed the use of health-care services and clinical outcomes in veterans with diabetes who were enrolled in two care coordination/home telehealth programmes (CCHT) to understand if monitoring rates made any difference to outcomes. To date this study by Chumbler is the only study found, apart from the Kent TeleHealth Pilot, which looks at different monitoring rates and the results give similar conclusions to the Kent pilot. Chumbler monitored one group of patients weekly (n=197), with more intensive evaluations, while the other was monitored daily (n=100), but less intensively. Patients in the two groups were similar in demographic and clinical characteristics at baseline, although their pattern of service use was different in the preceding 12 months.

During the 12 months of the study, patients who were monitored daily showed a significant reduction in all hospital admission rates for all causes as well as diabetes and in addition their clinic visits reduced. This was in sharp contrast to the weekly monitored patients whose change in service use almost doubled. Chumbler suggests that this may be because their readings were available daily and the care coordinator was able to quickly respond to changes in blood glucose values, whereas conversely medication adjustments in the weekly group may not have been as timely. Hospital admissions and number of bed days of care decreased significantly in the daily monitoring group, and increased significantly in the weekly monitoring group. Unscheduled primary care clinic visits were lower in the daily monitored group than in the weekly monitored group. The differences between the two groups were significant (P<0.01). There were no significant differences between the groups in the clinical outcomes.
Chumbler suggested that further work should be undertaken using randomized controlled trial designs to determine if frequencies and intensity of home monitoring leads to differences in service utilization and health outcomes.

This finding regarding the frequency of monitoring is of interest as Whitten (2007), in a study of COPD/CHF patients, states that subjects assigned to telehealth were required to have a minimum of one telemedicine visit per week with a registered nurse (real time video visits) as well as face to face contact. Her findings were that overall the addition of telehealth to COPD/CHF patient care did not have a significant effect. It is possible to surmise, given the findings of Chumbler (2005), that daily monitoring may have proved more beneficial to patients. However despite her early previous systematic reviews which were not positive, she states that critics of telehealth often suggest that studies in this field must demonstrate that telehealth provides ‘better outcomes’ than traditional forms of care. But Whitten concludes telehealth may be valuable if ‘outcomes are similar and costs reduced.’

However findings from two UK studies reported in 2006. The first study by Procter (2006) was based in North East London and had data from 25 participants. Patients were a group of 65+ elderly people with multiple complex conditions who experienced repeated hospital admissions. This pilot was undertaken in a deprived area of London. The pilot evolved over two years and consisted of monitoring of vital signs (pulse, blood pressure, body weight, peak flow readings, blood oxygen via pulse oximeter and blood sugar levels entered by the patient). Readings were taken daily at a set time and downloaded to a secure server. The equipment was used to ask the patients questions about their health such as fluid intake. The equipment could also be used to send a reminder to the patient. The nurse who received the referral, assessed the patient, installed the equipment and undertook daily monitoring via a laptop. By monitoring observations daily the nurse was able to respond immediately to queries, investigate a problem and if necessary visit the patient. She was also able to liaise with other clinicians or providers.

Data from the study showed a 38% decrease in hospital admissions, with a 62% reduction in hospital bed days over four months. The nurse also noted that in 14 cases there was early detection of problems perhaps leading to further hospital savings. Conclusions were that the system provided reassurance for relatives located at a distance as well as improving patient confidence and communication.

Brownsell et al. (2006) reported interim findings from a pilot study where telecare systems were installed in 42 homes to patients with chronic heart failure. The pilot sought to understand the impact of telemonitoring system. The system had a hand held device which asked a range of health questions. Other data such as blood pressure and weight were recorded and like the previous study any areas of concern raised an alert. SF12 questionnaire for general health was recorded prior to entry to the pilot and repeated at 6 months. The questions raised a higher number of alerts than was anticipated and these were modified. Of the 6,703 alerts generated 180 were considered to be associated with medical interventions. Compliance was high and dropped only slightly. Despite initial problems with the technology, Brownsell reports that the system allowed ‘medical staff to act in a preventative way rather than a reactive way.’ There are no reports of savings in unscheduled emergency care.

Systematic reviews are useful for looking at results of trials. Hersh et al (2006) describe several studies, (reported between 2000-2004). The following are studies they reviewed in the field of CHF. One study was by Benatar (2003), where nurse telemangement of 108 patients using vital signs monitoring by an advanced practice nurse improved outcomes for patients with chronic heart failure, showing lower rates of readmission and depression/anxiety. This study also shows the importance of the knowledge, skills and capabilities of the clinician and reinforcing the findings of Fetzer (2004) and the work by Benner (1984). Another study by Jerant (2001) found a similar result for the same patient group using home videoconferencing and electronic auscultation.
LaFramboise (2003) and Roth (2004) found improvements in quality of life with CHF patients and Roth in his study of home monitoring of vital signs showed a reduction in hospital days by two thirds. Kobb (2003) monitored chronic disease in the elderly using vital signs data and showed a reduction in hospital admissions, nursing home admissions, emergency department and clinic visits.

However of six studies Hersh et al. reviewed in the field of Diabetes Mellitus only one had a statistically significant result. This study by Montori (2004) included feedback to the patient to improve outcomes and gives important messages that the technology is just a tool and needs this extra clinical interaction to be effective. The feedback is a reassurance that someone is monitoring their data and is reinforced by the comments from participants in the Kent TeleHealth Pilot.

Another systematic review by Martinez (2006) on home monitoring for heart failure concluded that home monitoring is easy to use, widely accepted, economically viable and has a positive effect upon the patient’s health and quality of life. Its use can lead to a reduction in readmissions, reduction of bed days and decreases in mortality by better monitoring. This has been confirmed by a more recent study by Antonicelli (2008) with 57 elderly CHF patients who suggested the results may be due to better compliance by patients.

Since 2006 there have been many articles on telehealth and evaluation methods. As early as 2000, May et al. gave an example of an evaluation framework that can be considered when commencing a study design, along with examples of variables. This is a really useful guide for those new to the field and it could be assumed that there would have been some agreement on methods, but several years later, Botsis et al (2008) suggest there is no scientific holistic model for evaluation from different perspectives.

All of the above studies written between or prior to 2004-06, and many others too, would have been available to the telehealth team. They show reductions in unscheduled care, empowerment of patients and clinicians, compliance with medication, improved quality of life, reduction in anxiety and the notion that telehealth as a tool for the expert clinician can bring about a change from being reactive to proactive delivering personalised care for the patient. The economic costs were yet to be fully researched but it is clear from the early literature that telehealth brings benefits.

Later systematic reviews, by Pare, G (2007), Delligraie (2008) and Rosser (2009), all suggest that technology is beneficial if used as a correct tool as it can empower patients and carers and influence behaviour change, such as medication compliance thus improving their condition. The empowerment of patients is important as it places them in a different relationship to clinicians and research has shown they do not feel so dependent.

Pare points to the fact that the challenge of looking after the increasing number of people with chronic diseases is not just the increase in hospital beds but the increase needed in clinicians and care staff. In some countries chronic shortages of nurses exist, with fewer entering the nursing profession, therefore in the face of these shortages a fundamental shift in the process of care is needed.

Delligraie and Dansky (2008) conducted a systematic review to ‘identify studies on the effect of home telehealth on clinical care outcomes.’ All publications were peer reviewed, written between 2001-2007 and were regarding studies conducted in home or residential settings. Of the 154 articles and dissertations, a total of 29 articles met the inclusion criteria. They found that the three predominant conditions in these studies were heart disease, psychiatric conditions and diabetes. Results showed that ‘The weighted mean effect size for the overall meta-analysis was 0.50, and the z-statistic was 3.0, indicating that telehealth had a moderate, positive and significant effect (P<0.01) on clinical outcomes.’
sub analysis was undertaken which indicated positive significant effects of telehealth for some disease categories (heart disease and psychiatric conditions), but not others (diabetes). Overall, they concluded that the meta-analysis indicated that telehealth positively affects clinical outcomes of care, even in different patient populations. However the results of this review did not give positive findings for the relationship between telehealth and diabetes.

Wakefield et al (2009) evaluated two telehealth applications, delivered by telephone and videophone, for improving outcomes of patients at discharge who had had an acute exacerbation of heart failure. The outcomes measured were patient self-efficacy, with care and knowledge of and compliance with prescribed medications. Patients were randomly assigned to either control (usual satisfaction care), telephone or videophone groups. Study nurses contacted the intervention patients once each week for 90 days after discharge.

There were no significant differences although the intervention patients were more likely to have had their medications adjusted. Knowledge scores improved in the intervention group patients; although these scores were lower at enrolment compared to the control group. It is possible that routine monitoring of symptoms by the study nurses led to medication adjustments and accounted for the intervention patients significantly delayed time to readmission relative to the control patients. However it is difficult to judge if daily vital signs monitoring would have brought about a different result rather than the weekly illustrated here.

Many authors suggest that telehealth would be useful but many point to a lack of large randomised controlled trials. Barlow et al (2007) undertook a systematic review of home telecare for frail elderly patients with chronic conditions. This included vital signs monitoring or home telehealth. They found most articles had been published in the three previous years and 64% of studies were from the US. Based on the evidence they reviewed, they found that the most effective type of monitoring was the automated vital signs monitoring which reduced health service use. In conjunction with telephone follow up by nurses, they found that this improved clinical indicators and reduced health costs. They did conclude that whilst the cost-effectiveness may be less certain, there is no reason to say that this technology does not work. It is hoped that the Department of Health Whole Systems Demonstrator Programme in the UK will add to the weight of new evidence.

More recently in the field of diabetes there have been two positive studies which have shown that telehealth reduces hospitalisations and clinic visits. Barnett (2006) studied veterans enrolled with the VA Care Coordination Home Telehealth (CCHT) program during 24 months and compared this to a cohort of patients with diabetes not enrolled onto the programme. As diabetes is associated with high rates of mortality and costs (30% of all VA pharmacy prescriptions), the VA has sought to monitor patients’ vital signs remotely.

The study was carried out in Florida, Puerto Rico and South Georgia with 391 patients in each group. The treatment group had a significant reduction in hospitalisation, however these patients may have had different health status. After adjusting for this there is still a reduction with better home management for this group.

In a follow-up to this study Chumbler et al. (2009) assessed the home care monitoring for 387 patients over four years and compared with a control group (n=387). They found significantly more deaths in the control group (n=102.26%) compared with the intervention (n=75.19%). There was a longer survival rate for those on telehealth and the telemonitoring programme was associated with reduced 4 year all-cause mortality. They conclude that daily monitoring reduces mortality.
This finding of reducing mortality or disease progression has also been suggested by Glaser (2009). In her article she suggests that the main goals of COPD treatment are to slow disease progression, alleviate symptoms and prevent complications and exacerbations that require urgent treatment. She illustrates this with the VA monitoring of COPD patients and concluded that by replacing crisis management (visits to ED departments and hospital bed days), with preventative care by using early detection of symptoms (via vital signs monitoring), deterioration in a patient’s condition is slowed.

Trappenberg et al (2008) discusses the results of a non-randomised trial for home telehealth monitoring for COPD patients. They suggest that the comparison of the telehealth group with a control group indicates that the telehealth group had a significant decrease in hospital admission rates. They state that ‘This approach provides daily symptom surveillance and enhances disease knowledge and self-management, thus improving healthcare for patients with COPD.’ They suggest that adopting telehealth can ‘substantially improve care and decrease healthcare utilization of patients with moderate to severe COPD.’

Some recent studies have discussed clinician attitudes to adoption of telehealth. Vuononvirta et al. (2009) discussed a telehealth network in Finland. They identified ten different types of adopters such as ‘enthusiastic user, positive user, critical user.’ The study showed that whilst negative attitudes are not a barrier to telehealth adoption, this required extra work from the project team. They concluded that managers need to take into account the diverse attitudes of professionals and the different actions needed to help them to adopt telehealth into their work.

Abraham (2008) concludes that the VA personnel feel that home telemonitoring is meeting the needs of patients, decreasing the hunting and gathering of data requirements by physicians and nurses, promoting more efficient use of time and leads to better diagnosis in clinical and emerging care. The lead care co-ordinator was originally assigned 125 patients but Abraham suggests that sufficient staffing needs to be put in place based on the complexity of patients’ conditions.

There are several other suggestions. Firstly, success stories of improvements or early detection need to be marketed so that physicians will realise the benefit of referring patients. Secondly, the Care co-ordinator should ensure that the selection criteria of patients are robust so that those who may most benefit are enrolled. Thirdly, the clinician should be aware that education of the patient will empower patients, making them more aware of their own control over their health and hence compliance with medication and other aspects such as exercise.

Darkins (2008) suggests that the CCHT provides ‘one solution to the complex equation of how to care for the rapidly rising numbers of patients with chronic care needs in the population.’ He states that the VA offers a ‘potential model for other healthcare systems facing comparable challenges.’ But importantly he notes that CCHT does not replace the need for nursing home care or for traditional non-institutionalised care programmes. It does however enhance patients’ ability to self manage their chronic condition as well as delaying institutionalisation. For many patients with chronic conditions home telehealth offers a way to remain independent within their own home. He argues that it is necessary to integrate this technology into the care pathway so that the clinical process does require some re-engineering but the benefit to patients and health care organisations is great.

In a further use of technology Rosser et al (2009) conducted a systematic review to investigate the use of technology in achieving behaviour change in chronic illness. As was found with compliance in laying data SF12 data in the Kent TeleHealth Pilot, Rosser et al showed that initiating and continuing successful behaviour change through technological interventions may pose difficulties and challenges. However, they
found that there were potential benefits of delivering therapy in this way. They also concluded that for people with LTCs, technological self-management systems could provide a practical method of understanding and monitoring their condition, as well as therapeutic guidance to alter maladaptive behaviour.

In 2009, Litan, an economist stated that the United States could cut $197 billion from its health care bill over the next 25 years by widespread use of remote monitoring to track the vital signs of patients. But he warned that failure to make the right policy adjustments will cut these savings by over $44 billion over the 25 year period.

Work undertaken by Malley et al. (2006), Wittenberg et al. (2006) show the long term projections on long term care expenditure for older people to 2022. Whilst the telehealth technology has immediate savings in the health sector it also brings with it savings in the social care sector. The numbers of care staff required to look after an ageing population with complex co-morbidities will need to expand as projected costs are set to rise by 110%. Care hours are projected to rise by 40%. This assumes that the rate at which people present in the future with chronic diseases does not change from the current rate. Vital signs monitoring, whilst empowering the patient, also relieves family and carer burden. Self monitoring may mean that the number of people requiring services, especially in a crisis, is decreased.

None of the studies reviewed discussed in detail whether telehealth brings extra benefits such a QUALI of extra life (health) or capture information about an individual’s social care-related quality of life (SCRQOL) (Netten 2009).
6. **Organisations involved in the Delivery of the Kent TeleHealth Evaluative Development Pilot**

6.1 **The vision for Kent County Council, the NHS and other partners**

The vision for the Kent model of telehealth was that it ‘will make a difference to the quality of peoples lives, improve their independence and empower them to health educate, self-assess and monitor their own health condition, and offers the potential for people to self manage a wider range of social care interactions.’ KCC worked collaboratively with key stakeholder NHS trust partners in acute, community and primary services to improve the life outcomes of a pilot group of people in Kent with chronic disease management requirements.

This particular telehealth technology consists of disease management tools with unique user friendly interfaces specifically focused on the needs of older people to easily access and use the technology with confidence.

The telehealth devices enable the patient to measure the following vital signs:-

- Blood pressure
- Blood sugar
- Blood oxygen
- Temperature
- Weight
- Record peak flow
- Record stethoscope sounds
- Take ECGs.

The information is automatically sent through an ordinary analogue telephone line (at no cost to the service user) to a secure server where the clinician can look at the readings.

6.2 **TeleHealth communities and the organisations involved**

Five PCTs, namely Dartford & Gravesham, Maidstone & Weald, Shepway, South West Kent and Ashford confirmed their participation in the pilot. Dartford & Gravesham and Maidstone & Weald, both had a GP who originally visited Seattle to see the programme operated by the VA Puget Sound Healthcare System, were advanced in their preparation for the pilot in relation to the other PCTs. The decision was taken to ‘roll out’ to either or both of these GPs first. This initial roll out was to ensure that the system was tested adequately before adding the main pilot participants.

The role/responsibilities for the PCTs is captured under point 6.2.4, Health Professionals: GP/Nurse/Care Managers.

As the largest Pilot in the UK, there was no ‘blueprint’ for delivery. There are other partner organisations which are part of the TeleHealth community and the following paragraphs provide a brief description of their roles and responsibilities. Subsequently, as roll out progressed, they were adapted and modified in light of lessons learnt. Changes to the NHS delivery team are discussed in section 7.5.
6.2.1. Commercial Services Department (CSD)

Commercial Services Department comprises several business units. In respect of TeleHealth the units we will be working with are the warehouse operation and technical services (TS)

**Warehouse operation**

**Function:**
- To take delivery of all Viterion equipment
- To store securely and in dry conditions
- To deliver requested stock to TS.

**Collaboration:**
- With TS as necessary.

**Technical Services**

**Function:**
- To draw down stock of V100 or V500 from the warehouse
- To store V100 and V500 and all peripherals in a secure and dry environment
- To configure V100 and V500
- To select individual service user requirements and pack into a bin
- To deliver to and install at service user homes or other selected sites throughout Kent
- To collect all equipment and peripherals from service users and return to TS
- To inspect all equipment returned to TS and identify damage and malfunctions
- To reconfigure all V100 and V500
- To clean and sterilise (as appropriate and according to operational procedures) all equipment
- To process all appropriate stock movement records
- To return any defective equipment to Viterion.

**Collaboration:**
- With project administration
- With Kent Home Improvement Agencies (KHIA)
- With the clinicians/nurses.

6.2.2. Installation agencies

Installation of equipment in service users’ homes or other locations will be undertaken by Technical Services and KHIA. KHIA is a collection of individual agencies, some of which are aligned to district or borough councils, who work alongside all agencies and in particular KCC, Kent and Medway Towns Fire Service (KMTFS) for the handy van initiative. It is the Handy Van scheme that will provide the infrastructure for the KHIA’s to install TeleHealth equipment. Both technical services and KHIA’s will undertake the following functions. In the case of TS this will dovetail with their other responsibilities for the Kent TeleHealth programme.

**Function:**
- To undertake the site survey, ideally with project administration, of the service user’s home
- To collect the TeleHealth equipment bin from TS
• To unpack and install (according to the agreed timetable/schedule and protocols) in the service user’s home
• To test and demonstrate equipment as functional
• To leave service user’s home safe and secure in accordance with operational protocols
• To return empty bins and paperwork to TS
• To collect all equipment and peripherals from service users and return to TS

Collaboration:
• With project administration
• With TS and other KHIAs
• With clinical/nursing staff

6.2.3. Project administration

This role is key to the interface between the service user, health professional, installation agencies and social services. It is pivotal to the whole programme.

Function:
• To maintain the service user database
• To collaborate information with health and social services professionals to process applicants on to the pilot
• To undertake home visits with health and social care professionals and introduce service user to the scheme
• To undertake same with installation agencies
• To ensure service user and their carer or representative fully understand the agreement to participate in the pilot
• To train service users and their carers
• To be a point of contact for all aspects of the day to day programme activity
• To troubleshoot
• To place the service user ‘order’ with TS
• To monitor installation agencies performance
• To oversee records and produce reports
• To compare programme outcome data the VA and evidence the outcomes of both programmes
• To ensure other agencies i.e. IF, Unscheduled Care Desk etc are engaged.

Collaboration:
• With all parties

6.2.4. Health professionals: GP/nurse/care manager

GPs and nurses

Function:
• To select service users suitable for the programme using the selection criteria
• To monitor the daily measurements of the patient cohort
• To act on the patient data and take preventative action
• To request patient participation and assignment from project administration
• To provide feedback on the programme to Project Administration.
• To ensure other agencies i.e. IF, Unscheduled Care Desk etc are engaged
To interpret the programme data and outcomes
Data evaluation.

Collaboration:
- With project administration
- With the PCTs
- With the care manager

Care managers

Function:
- With health professionals select service users suitable for the programme
- To work with project administration to ensure the service user and their carer or representative(s) fully understand the agreement to participate in the pilot
- To support the service user.
- To work with the Health Professionals assigned to the service user
- To ensure other agencies i.e. IF, Unscheduled Care Desk etc are engaged.

Collaboration:
- With project administration
- With the PCTs
- With the GP/nurse

6.2.5 Viterion TeleHealthcare, a business of Bayer Healthcare

Manufacturer and supplier of the equipment: telehealth devices and peripherals. An agreement existed whereby Viterion will not supply this equipment to the UK or Europe during the period of this pilot.

Function:
- To manufacture the V100, V500 and peripherals to UK Standard
- Deliver to KCC nominated storage facility
- Provide technical support KCC throughout the pilot
- To train TS and KHIA on installation of equipment in service users’ homes or other locations.
- To train the project team and clinicians on use of Viterion hardware and software. In particular reviewing data trends, and alerts for out of range parameters (question or vital sign data)
- Train the trainers for KCC and partner organisations.

6.2.6 Department of Veterans Affairs (VA), VA Puget Sound Healthcare System

The VA have been using the Viterion equipment as a Chronic Disease Management tool for the last four years and it is the outcomes of that programme that inspired the KCC TeleHealth Evaluative Development Pilot.

Function:
- To partner KCC in the evaluative pilot
- To support KCC with documentation, experience and processes in delivering the pilot.
6.3 System security

The system’s design was examined and approved to UK standards and the following brief summary is an overview of the system (details provided by Viterion 2010 and the NHS).

- The security only allows TeleHealth units with the correct user name and password to connect to the server. This restriction is not based on the phone number of the patient. There is a user authentication scheme whereby patients must log on to their home units with a unique password.

- First the telehealth hub must authenticate when it connects to the server, then the patient must log in with their unique password.

- There are three modes of authentication. The first is the device itself which is preprogrammed with a username and password for accessing the network. The second is a telehealth application that authenticates the device on an application level. The third is the patient password that is entered on the device by the patient.

- Data is stored on an isolated network segment from the main system servers. This is a secure server protected by external and internal firewalls.

- There is a software maintenance program to ensure that all system security software is fully patched and updated. Viterion installs and maintains all appropriate security software patches and updates.

- Data is transmitted directly to the KCC server via plain old telephone systems (POTS). Clinicians access the data through a secure web browser with 128-bit encryption.

- The system maintains internal log files that track when a telehealth monitor has connected to the server and what data was transmitted. This data is only available to Viterion maintenance personnel.

- The hub was specifically manufactured for the UK market to meet type approvals and receive the 'kite mark.' The peripherals already had approval by the appropriate national bodies.

In addition to the above, NHS protocols are in place for accessing data should members of staff be monitoring their patients from home and using their own machines it is essential that they do so providing the following safeguards:

- Their internet connection is wired or if wireless this must be using WPA or WPA2 encryption.
- Staff must confirm their PC has received the latest operating system security patches, are protected by an active antivirus program and it has the latest signatures applied.
- When connecting to NHS Mail they must select a specific option.
- Staff must ensure they do not save any documents, screenshots or information on their private drives.
- After closing internet explorer or other web browser, they must clear all temporary files, cookies and cache information to ensure that no information remains on the local PC.
- All normal data protection guidance must be followed, such as lock screen when not in use and don’t allow other members of the family see the clinical or PII information.
- In addition all, PCT policies and procedures will apply and be followed.
7. Design of the research

7.1 Research aims and objectives

The overall aim of this pilot was to monitor and manage the health of participants: increasing participant's stability thus decreasing hospital bed days of care; decreasing presentation to accident and emergency and to increase the participant's awareness and management of their own condition; exploiting the emerging technology of Telehealth and to look at whether there were any benefits for patients, carers and the health and social care sector.

The pilot also aimed to understand the relationship between the telehealth technology and its impact on the participant and different clinical models and monitoring; in particular their attitudes to, and satisfaction with the outcomes that have come about as a result of the implementation. As this study was a pilot it was set up to generate hypotheses from the findings.

Specific objectives of the research were:

- Identify and review previous research on telehealth and its relationship between the results of the pilot such as changes in acute unplanned visits/episodes of care, different clinical models, clinical contacts, cost effectiveness and quality of life for the participant and their carer

- Consider the effectiveness of the different clinical models and monitoring models available to participants in enabling them to remain in their own home and reduce the impact on carers, following the changes to the delivery models in the pilot

- Understand whether telehealth can decrease acute unplanned visits/episodes of care, Outpatient visits and surgery visits and to understand if there is a correlation between clinical models and monitoring

- Explore the effectiveness of the technology for people of different age groups and with different LTCs

- Consider the effectiveness of the support, via telehealth technology, available to participants in enabling them to remain in their own home and to alleviate the burden on carers

- Understand if the technology increases the participants and carers awareness of the condition to enable them to become an Expert Patient

- Understand if telehealth is an effective tool that can be used by clinicians and any problems encountered

- As Specialist Matrons targeted patients with unstable conditions we hoped that the results would help us to understand if the use of the technology had any impact on the participant and increased the stability of their disease(s)/condition

- Recommend further strategies based upon the hypotheses generated from the research.
The findings would allow us to ascertain what can be done to help clinicians assess the impact of Kent TeleHealth Pilot on unplanned acute care visits/episodes of care and to enable participants and carers to monitor their own condition effectively and to improve their quality of life.

7.2 How the research was conducted

This pilot is a pre-post quasi experimental observational study.

There were several elements to the study:

- **Primary research:** quantitative research in thirteen different localities based in east and west Kent. In each area, participants were monitored by different clinical models (GP/district nurse; community matron; specialist community matron) and with differing frequencies (regular and sporadic)

- The identification of suitable participants, obtaining informed consent of participants and carers, installation of telehealth unit, training of participant and staff all described in 7.4

- General demographic data was collected for each participant. Their LTCs and other conditions were noted

- Data was collected for a range of indicators as described in 7.3

- Unit costs associated with an economic analysis were gathered for 2007 (Table 17). The modelled changes in overall costs were analysed (Table 18). This economic costing is for a period of six months and is for the community matrons and specialist community matrons as GP data was insufficient to undertake a complete analysis

- Self reported outcomes (Short Form or SF 12 v2 - UK version - anglicised and checked for reliability and validity) was completed on installation and then every four to six weeks

- Telephone interviews were conducted over a three week period in order to measure the level of client satisfaction with regards to the service they received and to identify potential participants for involvement in a TeleHealth Client Self Help Group

- Case studies and general comments from people using telehealth and their carers.

- Literature review: a review of recent UK and international literature on telehealth and its deployment at the time of the study as well as a review of policy documentation

- A very rudimentary extrapolation of costs has been undertaken and is in Appendix 5. Many caveats are associated with this costing and are discussed in Appendix 5

- The Director of the Centre for Health Services Studies, Professor A. Alaszewski, gave support to the telehealth team as a requirement under NRES Ethics approval.
7.3 Summary of data collected for the study

Telehealth technology works by monitoring vital signs, such as blood pressure, blood glucose, oxygen saturation, weight and transmitting the data to a central hub, where the data can be securely accessed and monitored against personal parameters set by the individual's clinician. Evidence that vital signs are outside of 'normal' parameters triggers a clinical response. The peripheral devices for monitoring different vital signs can be used on their own or in combination in order to best meet the needs of the individual and get the best fit with local services, including those provided by family and friends. The daily data which was transmitted to a central secure server was accessible to the clinical contacts and was not analysed in this study.

All data which has been analysed was collected for the period six months prior to installation and six months after installation. Where data after installation is available for a shorter period, then the same pre-installation data period reflected this. Data has been used for installations that took place from January 2006 until July 2007 and as all units were not installed simultaneously there is data from across all seasons.

As well as training the user, the telehealth team also trained the clinicians in the use of the system. This cost has been added into to the economic analysis. As well as the GPs, district nurses, community matrons and specialist community matrons some consultants used the system.

The patient data collected was name, gender, NHS number, date of birth, type of chronic condition(s) and the timescale of the data. The installation date was recorded. Where a person died, the date of death was noted.

The site number was noted which corresponded to either a GP/DN; community matron or specialist matron site. Later the telehealth team added whether the site was monitored regularly 3-5 times a week or less frequently. They noted this by their visits and communication with teams. Some sites monitored daily (5 days a week) and later in the pilot increased this to seven days a week. All sites were noted as being either west or east Kent.

Unplanned acute care visits/episodes were measured as A&E visits (ED visits) and bed days of care (BDOC). BDOC were noted as a total for each participant for six months before and after installation so it was not possible to investigate the number of episodes and length of admissions.

Outpatient visits were measured per patient. However reliable data was only available from one region.

Contacts with the different clinical models were counted. These contacts were for all clinical models and included home visits, phone contacts, nurse contact (in surgery), and surgery contacts. GP records were used to track phone calls, home visits, GP surgery visits and nurse surgery visits. Details of community matron and specialist community matron phone calls and visits were also collected. Contacts were correlated to any change in the A&E visits or bed days of care to investigate transference of costs. GP contacts were also investigated to understand if a reduction in unscheduled care would also bring about a reduction in GP contacts.

Changes in unplanned acute care visits/episodes were measured as A&E visits, BDOC for different age groups and males and females.

Unplanned acute care visits/episodes were measured for the different LTCs to ascertain any change.
Data was collected at baseline and at six months after the commencement date to ascertain any change. The data was analysed where the cohort was a suitable size for analysis.

Data was collected during the trial for the six month period after installation using GP records and acute sector data from the PCTs. The PCTs provided us with acute sector data for A&E visits and hospital bed days of care from secondary uses service (SUS) data.

As stated in the analysis, we were unable to obtain data from all sites for the evaluation. On compiling the dataset ready for the analysing of the data for this study, it emerged that there were some discrepancies between the primary and acute sector data. We have therefore taken the acute sector data (SUS) as being closest to the true value.

SF12v2 is a questionnaire which gives an indication of general, physical and mental health. This questionnaire was completed by participants on installation of the equipment. It had been hoped that these questions could be added to the telehealth hub but this was not possible and they were sent to participants by post. These were completed every 4-6 weeks and entered onto the database. This was in contrast to other studies where the SF12v2 questionnaire was completed once every 6 months.

The economic model is based upon a clinician accessing the data, making appointments and undertaking paperwork. As many sites reported that it took just one minute to access the patient data, assess the risk and act accordingly, the time allowed per patient is 5 minutes.

Due to missing data, the economic analysis is only built upon the community matron and Specialist matron model.

7.4. Discussion of method of delivery of services

This research is both quantitative and qualitative. The qualitative part is in the form of a patient survey, quotes from clinicians and patients (including relatives) and case studies. This was not a randomised controlled trial but in contrast to the smaller studies and disease specific studies, the Kent TeleHealth Pilot targeted 250 service users with LTCs and aimed to evaluate these people over an extended period of time and a broader spectrum of outcomes. Not only would the study begin to grapple with the emergent technologies of telehealth, but also, in the necessary context of community based health, across a number of delivery models.

These 250 people were enrolled in the Kent TeleHealth Pilot from March 2005 until the end of July 2007, 202 of whom have contributed data to this evaluation. Over 179 people are still being monitored on the equipment (as of March, 2010). 86 people took part in the telephone interview. Information regarding clinical contacts is available for 148 people. Unfortunately some data from GPs was unavailable and this is discussed in the analysis.

Clinical eligibility was established if the person had been diagnosed with at least one of the following:

- Chronic Obstructive Pulmonary Disease (COPD)
- Coronary Heart Disease (CHD)
- Diabetes Mellitus.

Patients also had secondary conditions and co-morbidities.

Once the clinician had identified the eligible patients, they asked the patient’s permission for the KCC telehealth team to contact them.
Two members of the telehealth team visited the patient. One member of staff briefed the patient and their carer about the equipment. The other asked for their informed consent. The KCC telehealth team ensured participants understood the consent procedure. If the participant was happy they undertook a brief inspection of the home environment to ensure that the equipment could be suitably installed.

The team left the consent form, an information pack and a SF12v2 survey with the patient to complete.

This was then followed up 24-48 hours later with a telephone call. Provided the patient was still happy the team arranged for the installation of the equipment and the technical staff trained the user and asked them to lay down initial data. The installation team collected the signed consent form and the completed SF12v2 and passed this to the telehealth team.

It was important to ensure that time was allowed to support both the clinician and the patient at the beginning of the process. This allowed the patient to become familiar with their readings i.e ‘know their numbers’ and what is typical for them; to ensure that they used the equipment properly and did not become anxious about changes in their readings which may drive inappropriate contact with health professionals.

Clinicians set individual parameters for the clinical readings that each patient took in their home. The telehealth hub was connected to the phone line and the peripherals were attached which took readings such as blood pressure, weight, blood glucose levels. The peripherals were allocated to each patient and were tailored to each person’s clinical disease requirements.

The readings were taken once a day and transmitted down the telephone line to a secure server where the clinician could look at the readings and were provided with the appropriate password permissions from the telehealth team. A consultant, a GP or community matron could access these readings if they provided care for this patient and were provided with the appropriate password permission from the telehealth team. The real time nature of the telehealth equipment enabled readings outside the normal range to be quickly confirmed or dismissed. If an abnormal reading was confirmed it could be acted on as appropriate.

The three different clinical models were: GP and district nurse (GP/DN), specialist community matrons who had been specialist nurses (e.g. cardiac, diabetes, respiratory) and community matrons from a general background (matron). These groups monitored patients regularly (daily) or sporadically (less than three times a week).

Patient compliance was monitored through the interrogation of the equipment by clinical services and the system administrators, Kent Adult Social Services (KASS), the latter providing any necessary support to the participant in relation to the use of the equipment on an ad hoc basis. Compliance was encouraged by the use of the messaging aspect, typically ‘Thanks for taking your readings, keep up the good work.’ Where a patient struggled to use the equipment the administrators provided additional training and support. Any issues regarding the physical operability of the equipment was dealt with by the administrators, leaving all and any clinically related issues for the monitoring clinician. All parties were made aware of this division of responsibility from the outset and it appeared to be an important step in the engagement process for clinical staff, being one of the most asked about aspects when briefing them.

The study received ethical approval from the Local Research Ethics Committee and Research Governance along with Research & Development approval from the PCTs.
7.5 Concurrent changes to the structural and clinical teams

Clinical changes came about in 2005 before the structural changes to the PCTs in 2006, which reinforced the clinical changes and resulted in more community matrons.

The structural change was the reorganisation of all PCTs in England in October 2006. The nine PCTs in Kent were reduced in number to two, NHS West Kent and NHS Eastern and Coastal. The areas covered by the original five PCTs were distributed across the two new PCTs. This restructure did not alter the pilot in any way as partners were already signed up to the process.

Changes were made to the delivery models for telehealth during roll-out in late 2005 which resulted from clinical changes in the NHS. Clinical changes resulted in a partial shift from a General Practitioner (GP) led model to one driven mainly by the community matrons who were newly appointed in 2005. Community matrons were to ‘use case management techniques with patients who meet a criteria denoting very high intensity use of health care.’ Importantly the role specified that ‘With special intensive help, these patients are able to remain at home longer and to have more choice about their health care.’

The new role of the community matron came into being with a remit to support people with complex conditions. As the new community matron model was established, telehealth was available to support them. Some community matrons, following training in 2005, adopted telehealth in an integrated way from late 2005.

The case management work of community matrons was and remains central to the government’s policy for the management of people with LTCs. Specifically this model of case management meant that there was one person who acted as both provider and procurer of care, taking responsibility for ‘ensuring all health and social care needs are met, so that the patient’s condition stays as stable as possible and wellbeing is increased’ (DH 2004c).

This new model fitted well with the telehealth aims as the community matrons were tasked with:

- helping to prevent unnecessary admissions to hospital
- reducing length of stay of necessary hospital admissions
- improving outcomes for patients
- integrating all elements of care
- improving patients’ ability to function and their quality of life
- helping patients and their families plan for the future
- increasing choice for patients
- enabling patients to remain in their homes and communities
- improving end of life care.

The community matron role was in its infancy and the new matrons were drawn from a variety of backgrounds, working practices and skill sets which included district nurses and specialist nurses e.g. those with experience in dealing with diabetes, respiratory and cardiac disease. There was, initially, one site with specialist community matrons.

The variance in the models of health care utilising telehealth differed slightly in their adoption of the technology to support the management of their patients. This difference in delivery is useful to find the most effective model but it should also be noted that total caseloads of the specialist community matron may have been, in the infancy of the pilot, more complex and fewer in number of patients overall. The
specialist matrons initially targeted those patients who had had unscheduled admissions to hospital and had complex co-morbidities and enrolled the majority of their caseload into the Kent TeleHealth Pilot. The criteria for selection onto the specialist community matron caseload was a patient whose condition was unstable, had unscheduled care in the last six months and who had two or more co-morbidities (preferably cardio or respiratory). They also had the ability to reject cases if they felt they were inappropriate.

In the GP led model, where the monitoring was generally carried out by the district nurse working from the practice, the monitoring using telehealth was less regular but the frequency was typically once every 3 days or twice a week. In other areas, where the community matron caseload was extremely large (clinical caseload and not telehealth caseload), telehealth monitoring was less frequent and therefore the use of the technology and its functionality was not fully utilised. One of the most effective models of engagement and delivery appears to be the specialist community matron where patients took their readings on a daily basis and messages were sent to encourage compliance typically once a week. These readings were checked on a daily basis.

To complement the vital signs data there was a comprehensive question bank with disease specific questions being allocated to the patient on an individual basis. These questions asked about their physical well being and daily routine. The questions, which were rarely used in other telehealth models of engagement, were used by patients regularly although compliance varied by individual due to the repetition. Patients did tend to use the questions delivered via the telehealth device to report changes in signs or symptoms when they felt something had changed and there are reports from clinicians of exacerbations (clinical deterioration) being detected from question responses alone.

As well as clinician knowledge and skills, typical clinician responses to variances in readings depended on knowledge and experience of a particular individual and their clinical history, but may have included:

- A phone call to discuss the changes with the patient
  
  I have spoken to the patient and his wife today, they are both over the moon with the TeleHealth Machine, apparently it picked up erratic readings particularly on the blood pressure BP and the matron intervened immediately and spoke to the Dr. on his behalf with a view to changing his medication. This man is only a new client and was amazed how good it has been for him already. - Ashford

- Notification to the GP or consultant to discuss the case and changes to treatment, including faxing readings printed from the back end of the system.
  
  As of today I have requested a 24hr ECG tape because of TeleHealth readings on the patient. He was always showing signs of Bradycardia but we were keeping an eye on it after discussion with his consultant. All the while he was asymptomatic it was not a problem but now he is becoming symptomatic and may need to be paced also. Similarly I am keeping an eye on (name withheld) for the same thing!

- A visit to the patient to carry out further tests including further readings

- Initiation of a patients ‘Emergency Management Plan’, for example to start taking a predetermined programme of antibiotics, followed by an urgent house call.
It should be noted that the clinical parameters are a safe range of settings and are based upon the clinical guidelines (NICE guidelines) for the specific disease and what is normal for the patient. These parameters are revised at least every 3 months or more frequently depending on if and how readings change. It may be that due to someone’s age their weight increases and this is not part of the clinical parameter. Telehealth technology may be used as a tool to measure this parameter.

Developing new ways of working utilising the technology offers a new approach to care moving it from a reactive model to a proactive one.

Whereas the specialist matrons looked at the data first thing in the morning and used the data to triage their visits and book appointments for the day, community matrons from a district nurse background do not appear to have the same number of patients on the Kent TeleHealth Pilot and therefore their way of working was different. It can be suggested that some community matrons who may have had just 6 people enrolled onto telehealth were more likely to undertake their case management as usual and look at the data during the day or not as frequently as the specialist matrons.

In the community matron model it could be that their telehealth patients were not a large part of their caseload, it could also be suggested that they were not always the same priority as they would have needed to respond to other cases first. This is evidenced by the extra training that the telehealth team had to undertake as people were less familiar with the system. The telehealth team was able to evidence the frequency of monitoring for this study.

Taking into consideration the different clinical models of delivery and frequency of monitoring of the participant, this has enabled a comparison to be made across models. Using the collected data the effectiveness of the various models can assist in the generation of hypotheses regarding the best models of care and the frequency of monitoring. There do not appear to be studies in the UK (before 2007) that had reported on the success or otherwise of these different clinical delivery models of care using telehealth in the UK, neither were there comparable studies in the USA except for Chumbler who undertook a study which monitored patients either weekly or daily (see p48-49). In addition there is little or no information in studies on the distinct care pathways for these different clinical models of care.
8. Results of quantitative analysis

8.1 Methods of analysis-outcome analysis

A number of different approaches have been deployed in developing an appropriate analytical strategy for the data. The data has been analysed using STATA 11 IC, PASW and SAS. Two major issues have informed the analytical strategy. First the data available contains significant quantities of missing data. Second the distribution of the outcome data makes traditional parametric statistical analysis difficult to justify.

In addressing the issue of missing data a number of approaches have been explored. The first approach involves simple imputation of missing data in order to create a larger sample from which to explore outcomes. The first, and simplest, approach involves the imputation of a variety of new outcome datasets using imputation using mean values, median values, minimum values, maximum values and last outcomes carried forward. In order to explore the impact of these imputations sensitivity analysis was conducted to compare the original data to the variety of imputed forms. The aim of imputation of this sort is to increase the rigor of estimates rather than modify the observed outcome. Sensitivity analysis concluded that the impact of imputation of this sort made significant changes to the observed outcome and therefore could not be considered as a reliable means of maximising the value of the observed information.

A second approach to imputation was attempted that aims to create multivariate regression models to explore the potential prognostic factors that lead to a known outcome. Despite the generation of a variety of statistical models no convergence or fit could be established. This is probably a result of the dominance of missing versus available data for some outcomes.

The overall interpretation is that the rules for imputing missing data could not be established and as such data has not been imputed for the sample.

The second major issue with the data is the distribution. Standard analytical procedures assume that data is normally distributed in that the variance in the sample is distributed equally above and below the observed mean. On examination only three variables were normally distributed; general health, physical health components and mental health components of the SF-12. These variables were analysed using parametric statistical techniques, the paired t-test that generate both covariate adjusted mean scores and 95% confidence intervals. When considering the other variables the fact that a number of observations were missing and the non-normal distribution suggests that non-parametric exact test, suitable for small samples, were appropriate. The differences between groups were established using Wilcoxon Rank tests and the 95% confidence intervals generated using Hodges-Lehman tests.

In terms of notation in each table an indication of the measure of central tendency is presented, this is a measure of where statistically the average participant lies. In addition the confidence interval is indicated in terms of two measures. This confidence interval provides a rigorous interpretation of where the true population measure actually lies. So a mean or median of 2 means that the actual participant statistic is 2 and a confidence interval of 0; 3 indicates that the true population statistic lies between 0 and 3. Data has been presented for baseline and six month outcomes and mean differences between the groups have been presented.
The data has been analysed overall, by location (East or West Kent), by monitoring type (sporadic versus regular), by model (specialist matron versus general practitioner/ district nurse versus community matron) and by LTC (COPD versus CHD). In addition an additional outcome analysis has been conducted layering the previous outcomes by region.

Where appropriate significant changes have been identified at either the 95% or 99% level. A full interpretation of the results is presented in the results section.

The analysis of the results follows the tables.
Table 6: Overall sample demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Region n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>West Kent</td>
<td>93 (46.0)</td>
</tr>
<tr>
<td>East Kent</td>
<td>109 (54.0)</td>
</tr>
<tr>
<td><strong>Gender n (%)</strong></td>
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</tr>
<tr>
<td>Male</td>
<td>113 (55.9)</td>
</tr>
<tr>
<td>Female</td>
<td>89 (44.1)</td>
</tr>
<tr>
<td><strong>Model n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Specialist Matron</td>
<td>53 (26.2)</td>
</tr>
<tr>
<td>GP/DN</td>
<td>35 (17.3)</td>
</tr>
<tr>
<td>Community Matron</td>
<td>114 (56.4)</td>
</tr>
<tr>
<td><strong>Monitoring Type n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>143 (70.8)</td>
</tr>
<tr>
<td>Sporadic</td>
<td>59 (29.2)</td>
</tr>
<tr>
<td><strong>Mean age in years (95% CI)</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>72.7 (71.4;74.0)</td>
</tr>
<tr>
<td><strong>Co-morbidities n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Cerebral Vascular Accident</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>34 (16.8)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>75 (37.1)</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>124 (61.4)</td>
</tr>
<tr>
<td>COPD</td>
<td>124 (61.4)</td>
</tr>
<tr>
<td>Transient Ischemic Attack</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>1 (0.5)</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>4 (2.0)</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>10 (5.0)</td>
</tr>
<tr>
<td>&gt;1 Comorbidity</td>
<td>123 (60.9)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD</td>
<td>5 (2.5)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD &amp; Diabetes</td>
<td>1 (0.5)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level  
** significant at the 0.01 level
Table 7: Overall sample demographics by region

<table>
<thead>
<tr>
<th>Variable</th>
<th>West Kent</th>
<th>East Kent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>49 (52.7)</td>
<td>64 (58.7)</td>
</tr>
<tr>
<td>Female</td>
<td>44 (47.3)</td>
<td>45 (41.3)</td>
</tr>
<tr>
<td><strong>Model n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialist Matron</td>
<td>0</td>
<td>53 (48.6)**</td>
</tr>
<tr>
<td>GP/DN</td>
<td>35 (37.6)</td>
<td>0***</td>
</tr>
<tr>
<td>Community Matron</td>
<td>58 (62.4)</td>
<td>56 (51.4)</td>
</tr>
<tr>
<td><strong>Monitoring Type n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>40 (43.0)</td>
<td>103 (44.5)**</td>
</tr>
<tr>
<td>Sporadic</td>
<td>53 (57.0)</td>
<td>6 (5.5)**</td>
</tr>
<tr>
<td><strong>Mean age in years (95% CI)</strong></td>
<td>73.7 (71.7; 75.6)</td>
<td>71.8 (70.0; 73.7)</td>
</tr>
<tr>
<td><strong>Co-morbidities n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebral Vascular Accident</td>
<td>3 (3.2)</td>
<td>2 (1.8)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>20 (21.5)</td>
<td>14 (12.8)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>33 (35.5)</td>
<td>42 (38.5)</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>59 (63.4)</td>
<td>65 (59.6)</td>
</tr>
<tr>
<td>COPD</td>
<td>52 (55.9)</td>
<td>72 (66.1)</td>
</tr>
<tr>
<td>Transient Ischemic Attack</td>
<td>0</td>
<td>1 (0.9)</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>0</td>
<td>1 (0.9) 2 (1.8)</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>2 (2.2)</td>
<td>2 (1.8)</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>3 (3.7)</td>
<td>7 (6.4)</td>
</tr>
<tr>
<td>&gt;1 Comorbidity</td>
<td>52 (43.3)</td>
<td>71 (57.7)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD</td>
<td>1 (1.1)</td>
<td>4 (3.7)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD &amp; Diabetes</td>
<td>0</td>
<td>1 (0.9)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
Table 8: Overall sample demographics by monitoring type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regular</th>
<th>Sporadic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Region n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Kent</td>
<td>40 (28.0)</td>
<td>53 (89.8)**</td>
</tr>
<tr>
<td>East Kent</td>
<td>103 (72.0)</td>
<td>6 (10.2)</td>
</tr>
<tr>
<td><strong>Gender n (%)</strong></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>85 (59.4)</td>
<td>28 (47.5)</td>
</tr>
<tr>
<td>Female</td>
<td>58 (40.6)</td>
<td>31 (52.5)</td>
</tr>
<tr>
<td><strong>Model n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specialist Matron</td>
<td>53 (37.1)</td>
<td>0**</td>
</tr>
<tr>
<td>GP/DN</td>
<td>0</td>
<td>35 (59.3)**</td>
</tr>
<tr>
<td>Community Matron</td>
<td>90 (62.9)</td>
<td>24 (40.7)**</td>
</tr>
<tr>
<td><strong>Mean age in years (95% CI)</strong></td>
<td>71.9 (70.3; 73.2)</td>
<td>74.7 (72.1; 77.3)</td>
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<tr>
<td><strong>Co-morbidities n (%)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebral Vascular Accident</td>
<td>2 (1.4)</td>
<td>3 (5.1)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>16 (11.2)</td>
<td>18 (30.5)*</td>
</tr>
<tr>
<td>Diabetes</td>
<td>53 (37.1)</td>
<td>22 (37.3)</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>70 (59.2)</td>
<td>45 (76.3)*</td>
</tr>
<tr>
<td>COPD</td>
<td>101 (70.6)</td>
<td>23 (39.0)**</td>
</tr>
<tr>
<td>Transient Ischemic Attack</td>
<td>1 (0.7)</td>
<td>0</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>1 (0.7)</td>
<td>0</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>2 (1.4)</td>
<td>2 (3.4)</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>9 (6.3)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>&gt;1 Comorbidity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heart Failure &amp; COPD</td>
<td>88 (71.5)</td>
<td>35 (28.5)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD &amp; Diabetes</td>
<td>5 (3.5)</td>
<td>0</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
Table 9: Overall sample demographics by model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Specialist Matron</th>
<th>GP/ DN</th>
<th>Community Matron</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Region n (%)</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>West Kent</td>
<td>0</td>
<td>35 (100)</td>
<td>58 (50.9)**</td>
</tr>
<tr>
<td>East Kent</td>
<td>53 (100)</td>
<td>0</td>
<td>56 (49.1)**</td>
</tr>
<tr>
<td><strong>Gender n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>30 (56.6)</td>
<td>16 (45.7)</td>
<td>67 (58.8)</td>
</tr>
<tr>
<td>Female</td>
<td>23 (43.4)</td>
<td>19 (54.3)</td>
<td>47 (41.2)</td>
</tr>
<tr>
<td><strong>Monitoring Type n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular</td>
<td>53 (100)</td>
<td>0</td>
<td>90 (78.9)**</td>
</tr>
<tr>
<td>Sporadic</td>
<td>0</td>
<td>35 (100)</td>
<td>24 (21.1)**</td>
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<tr>
<td><strong>Mean age in years</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(95% CI)</td>
<td>74.1 (71.5; 75.7)</td>
<td>75.2 (71.7; 78.7)</td>
<td>72.74 (71.3; 74.0)</td>
</tr>
<tr>
<td><strong>Co-morbidities n (%)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebral Vascular</td>
<td>1 (1.9)</td>
<td>2 (5.7)</td>
<td>2 (1.8)</td>
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<tr>
<td>Accident</td>
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<tr>
<td>Hypertension</td>
<td>6 (11.3)</td>
<td>12 (34.3)</td>
<td>16 (14.0)*</td>
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<tr>
<td>Diabetes</td>
<td>18 (34.0)</td>
<td>14 (40.0)</td>
<td>43 (37.7)</td>
</tr>
<tr>
<td>Coronary Heart Disease</td>
<td>46 (86.8)</td>
<td>29 (82.9)</td>
<td>49 (43.0)**</td>
</tr>
<tr>
<td>COPD</td>
<td>33 (62.3)</td>
<td>5 (14.3)</td>
<td>86 (75.4)**</td>
</tr>
<tr>
<td>Transient Ischemic Attack</td>
<td>1 (1.9)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Peripheral Vascular</td>
<td>1 (1.9)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>1 (1.9)</td>
<td>0</td>
<td>3 (2.6)</td>
</tr>
<tr>
<td>Heart Failure</td>
<td>7 (13.2)</td>
<td>1 (2.9)</td>
<td>2 (1.8)</td>
</tr>
<tr>
<td>&gt;1 Comorbidity</td>
<td>41 (33.3)</td>
<td>19 (15.4)</td>
<td>63 (51.2)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD</td>
<td>4 (7.5)</td>
<td>0</td>
<td>1 (1.9)</td>
</tr>
<tr>
<td>Heart Failure &amp; COPD &amp; Diabetes</td>
<td>1 (1.9)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
### Table 10: Overall baseline, six month and mean differences for all outcomes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline mean/ median (CI) [n]</th>
<th>Month 6 mean/ median (CI) [n]</th>
<th>Mean difference (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>1.0 (1.0; 3.0) [70]</td>
<td>1.0 (1.0; 2.3) [70]</td>
<td>-0.5 (0; 1.0)</td>
</tr>
<tr>
<td>Home visits</td>
<td>2.0 (1.0; 2.0) [70]</td>
<td>0.9 (0; 1.0) [70]</td>
<td>-0.5 (-0.5; 0)*</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>2.0 (1.0; 6.0) [70]</td>
<td>2.0 (1.0; 4.0) [70]</td>
<td>-0.5 (-0.5; -1.5)*</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>1.0 (1.0; 3.0) [70]</td>
<td>0.5 (0.4; 1.0) [70]</td>
<td>-0.5 (-1.0; 0)*</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>0.4 (0.1; 0.6) [77]</td>
<td>0.0 (0; 2.0) [77]</td>
<td>0.5 (0; 1.0)**</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 3.0) [78]</td>
<td>0.0 (0; 2.0) [78]</td>
<td>0.5 (0; 1.0)*</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>1.0 (0; 3.0) [79]</td>
<td>1.0 (0; 2.0) [79]</td>
<td>-0.5 (-0.5; 0)</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>1.0 (0; 2.0) [200]</td>
<td>0.0 (0; 1.0) [200]</td>
<td>-0.5 (-0.5; 0)**</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>0.7 (0; 12.4) [200]</td>
<td>0.4 (0; 4.2) [200]</td>
<td>-1.5 (-1.5; -4.0)**</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>25.4 (24.1; 26.7) [183]</td>
<td>28.1 (26.6; 29.6) [154]</td>
<td>2.2 (0.1; 5.4)**</td>
</tr>
<tr>
<td>Physical health</td>
<td>23.4 (22.2; 24.6) [172]</td>
<td>26.1 (24.6; 27.6) [142]</td>
<td>2.8 (0.6; 5.1)*</td>
</tr>
<tr>
<td>Mental health</td>
<td>39.6 (37.8; 41.4) [172]</td>
<td>40.0 (38.0; 41.9) [142]</td>
<td>0.43 (-2.4; 3.4)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline mean/median (CI) [n]</th>
<th>Month 6 mean/median (CI) [n]</th>
<th>Mean difference (CI)</th>
<th>Baseline mean/median (CI) [n]</th>
<th>Month 6 mean/median (95% CI) [n]</th>
<th>Mean difference (95% CI)</th>
</tr>
</thead>
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<td><strong>General practice</strong></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>2.0 (0; 6.0) [21]</td>
<td>1.0 (0; 5.0) [21]</td>
<td>0.0 (-1.0; 2.0)</td>
<td>1.0 (0; 4.0) [49]</td>
<td>1.0 (0; 3.0) [49]</td>
<td>-0.5 (-1.0; 0)*</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 2.0) [21]</td>
<td>0.0 (0; 2.0) [21]</td>
<td>0.0 (-0.5; 1.0)</td>
<td>1.0 (0; 3.0) [49]</td>
<td>0.0 (0; 1.0) [49]</td>
<td>-0.5 (-1.0; -0.5)*</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>1.0 (0; 4.0) [21]</td>
<td>2.0 (0; 5.0) [21]</td>
<td>0.5 (-1.5; 1.5)</td>
<td>3.0 (0; 6.0) [49]</td>
<td>1.0 (0; 5.0) [49]</td>
<td>-1.0 (-2.0; 0)*</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>2.0 (0; 6.0) [21]</td>
<td>1.0 (0; 6.0) [21]</td>
<td>0.0 (0; 1.0)</td>
<td>0.0 (0; 4.0) [49]</td>
<td>0.0 (0; 1.0) [49]</td>
<td>-0.5 (-1.0; 0)**</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
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<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>0.0 [21]</td>
<td>0.0 [21]</td>
<td>0.0</td>
<td>0 (0; 1.0) [56]</td>
<td>1.0 (0; 4.0) [56]</td>
<td>1.0 (0; 1.5)**</td>
</tr>
<tr>
<td>Home visits</td>
<td>0.0 (0; 2.0) [21]</td>
<td>1.0 (0; 6.0) [21]</td>
<td>1.0 (0; 2.0)</td>
<td>0 (0; 2.0) [57]</td>
<td>1.0 (0; 4.0) [57]</td>
<td>0.5 (0; 1.0)</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>na</td>
<td>na</td>
<td>na</td>
<td>1.0 (0; 4) [79]</td>
<td>1.0 (0; 3) [79]</td>
<td>-0.5 (-0.5; 0)</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>0.0 (0; 1.0) [93]</td>
<td>0.0 (0; 1.0) [93]</td>
<td>0.0 (-0.5; 0)</td>
<td>1.0 (0; 3.0) [107]</td>
<td>0.0 (0; 1.0) [107]</td>
<td>-0.5 (-1.0; -0.5)**</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>0.0 (0; 1.0) [93]</td>
<td>0.0 (0; 5.0) [93]</td>
<td>0.0 (0; 0.5)</td>
<td>6.0 (0; 13.0) [107]</td>
<td>0.0 (0; 3.0) [107]</td>
<td>-6.0 (-8.5; -4.0)**</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>General health</td>
<td>25.1 (23.2; 26.9) [90]</td>
<td>28.1 (26.2; 30.9) [92]</td>
<td>2.2 (0; 5.4)</td>
<td>25.7 (24.0; 27.5) [93]</td>
<td>28.1 (26.2; 30.0) [62]</td>
<td>2.2 (0; 5.4)</td>
</tr>
<tr>
<td>Physical health</td>
<td>22.9 (21.2; 24.6) [85]</td>
<td>25.4 (23.4; 27.4) [89]</td>
<td>2.2 (-0.7; 5.1)</td>
<td>24.0 (22.3; 25.6) [87]</td>
<td>27.3 (25.0; 29.6) [53]</td>
<td>3.8 (0.5; 7.1)**</td>
</tr>
<tr>
<td>Mental Health</td>
<td>40.1 (37.7; 42.4) [85]</td>
<td>41.5 (39.0; 44.1) [89]</td>
<td>1.2 (-2.4; 4.9)</td>
<td>39.1 (36.4; 41.8) [87]</td>
<td>37.5 (34.5; 40.5) [53]</td>
<td>-0.8 (-5.5; 3.9)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
<table>
<thead>
<tr>
<th>Variable</th>
<th>Sporadic</th>
<th>Regular</th>
<th>Mean difference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Baseline mean/ median (CI) [n]</td>
<td>Month 6 mean/ median (CI) [n]</td>
<td>Mean difference (95% CI)</td>
</tr>
<tr>
<td><strong>General practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>2.0 (0; 4.0) [23]</td>
<td>1.0 (0; 5.0) [23]</td>
<td>0.0 (-1.0; 2.0)</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 2.0) [23]</td>
<td>1.0 (0; 3.0) [23]</td>
<td>0.0 (-0.5; 0.5)</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>2.0 (0; 4.0) [23]</td>
<td>2.0 (0; 5.0) [23]</td>
<td>1.0 (0; 1.5)</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>2.0 (0; 5.0) [23]</td>
<td>1.0 (0; 5.0) [23]</td>
<td>0.5 (-1.5; 0.5)*</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Phone calls</td>
<td>0.0 [23]</td>
<td>0.0 [23]</td>
<td>0.0</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 7.0) [23]</td>
<td>1.0 (0; 9.0) [23]</td>
<td>1.0 (0; 3.0)</td>
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<tr>
<td><strong>Acute care</strong></td>
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</tr>
<tr>
<td>Outpatients</td>
<td>10 (4.0; 12.0) [3]</td>
<td>11 (4.0; 14.0) [3]</td>
<td>1.0 (-2.0; 4.0)</td>
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<tr>
<td>A&amp;E visits</td>
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<td>0.0 (0; 1.0) [59]</td>
<td>0.0</td>
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<tr>
<td>Inpatient bed days</td>
<td>0.0 (0; 1.0) [59]</td>
<td>0.0 (0; 1.00) [59]</td>
<td>0.1 (0; 2.5)*</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>25.2 (22.7; 27.7) [50]</td>
<td>28.3 (25.8; 30.8) [52]</td>
<td>5.4 (-0.1; 5.7)</td>
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<tr>
<td>Physical health</td>
<td>23.1 (20.8; 25.4) [47]</td>
<td>25.6 (23.1; 28.2) [49]</td>
<td>3.0 (-1.0; 6.6)</td>
</tr>
<tr>
<td>Mental health</td>
<td>42.4 (39.4; 45.4) [47]</td>
<td>42.1 (38.4; 45.8) [49]</td>
<td>-0.4 (-5.8; 4.6)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level  
** significant at the 0.01 level
Table 13: Baseline and six month outcomes by model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Specialist Matron</th>
<th>GP/DN</th>
<th>Community Matron</th>
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<tbody>
<tr>
<td></td>
<td>Baseline mean/median (CI) [n]</td>
<td>Month 6 mean/median (CI) [n]</td>
<td>Baseline mean/median (CI) [n]</td>
</tr>
<tr>
<td><strong>General practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>1.0 (0; 4.0) [29]</td>
<td>1.0 (0; 4.0) [29]</td>
<td>3.0 (0; 6.0) [17]</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 3.0) [29]</td>
<td>0.0 (0; 1.0) [29]</td>
<td>1.0 (0; 4.0) [17]</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>3.0 (0; 8.0) [29]</td>
<td>1.0 (0; 6.0) [29]</td>
<td>1.0 (0; 4.0) [17]</td>
</tr>
<tr>
<td>Nurse Surgery visits</td>
<td>1.0 (0; 3.0) [29]</td>
<td>0.0 (0; 2.0) [29]</td>
<td>2.0 (0; 6.0) [17]</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>0.0 (0; 1.0) [36]</td>
<td>2.0 (0; 6.0) [37]</td>
<td>0.0 [17]</td>
</tr>
<tr>
<td>Home visits</td>
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<td>2.0 (0; 4.0) [37]</td>
<td>0.0 (0; 2.0) [17]</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>1.0 (0; 3.0) [34]</td>
<td>1.0 (0; 3.0) [34]</td>
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<tr>
<td>A&amp;E visits</td>
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<td>0.0 (0; 1.0) [52]</td>
<td>0.0 [35]</td>
</tr>
<tr>
<td>Inpatient bed days</td>
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<td>0.0 (0; 4.0) [52]</td>
<td>0.0 [35]</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>25.7 (23.3; 28.1) [49]</td>
<td>27.4 (22.7; 32.1) [18]</td>
<td>25.6 (22.2; 29.0) [32]</td>
</tr>
<tr>
<td>Physical health</td>
<td>23.3 (20.9; 25.6) [47]</td>
<td>29.1 (24.4; 33.9) [17]</td>
<td>22.9 (20.2; 25.6) [31]</td>
</tr>
<tr>
<td>Mental health</td>
<td>40.0 (35.7; 44.4) [47]</td>
<td>33.1 (26.8; 39.4) [17]</td>
<td>41.7 (37.9; 45.4) [31]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* significant at the 0.05 level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>** significant at the 0.01 level</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 14: Mean differences, 95% confidence intervals and number of subjects by model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Specialist Matron</th>
<th>GP/ DN</th>
<th>Community Matron</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean difference (CI)</td>
<td>Mean difference (CI)</td>
<td>Mean difference (CI)</td>
</tr>
<tr>
<td><strong>General practice</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>-1.0 (-2.0; 0)</td>
<td>-0.5 (-2.0; 2.0)</td>
<td>-0.5 (-1.0; 0.5)</td>
</tr>
<tr>
<td>Home visits</td>
<td>-0.5 (-1.0; 0)**</td>
<td>0.5 (-0.5; 1.0)</td>
<td>-0.5 (-1.5; 0)*</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>-0.5 (-2.5; 0)</td>
<td>1.0 (0; 1.5)</td>
<td>-2.0 (-3.0; -0.5)*</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>-0.5 (-1.0; 0)</td>
<td>0.0 (-1.0; 1.0)</td>
<td>-1.0 (-1.5; 0)*</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>1.5 (1.0; 2.5)**</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0.5; 2.0)*</td>
<td>0.5 (-0.5; 2.0)</td>
<td>0.0 (-0.5; 1.0)</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>0.0 (-1.0; 0)</td>
<td>na</td>
<td>-0.5 (-1.0; 0)</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>-0.5 (-1.0; -0.5)*</td>
<td>0.0 (-0.5; 0)</td>
<td>-0.5 (-0.5; 0)**</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>-7.5 (-10.5; -4.0)**</td>
<td>0.0 (0; 7.0)</td>
<td>-1.5 (-4.0; 0)**</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>5.4 (-0.1; 12.9)</td>
<td>0.0 (0; 5.4)</td>
<td>2.2 (0.1; 5.4)*</td>
</tr>
<tr>
<td>Physical health</td>
<td>8.7 (2.3; 15.0)**</td>
<td>2.7 (-2.0; 7.5)</td>
<td>1.7 (-0.8; 4.3)</td>
</tr>
<tr>
<td>Mental health</td>
<td>-6.5 (-18.4; 4.6)</td>
<td>0.8 (-7.1; 6.7)</td>
<td>1.6 (-1.6; 5.1)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
Table 15: Baseline, six month and mean differences for all outcomes by long term condition (COPD/CHD)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Baseline mean/median (CI) [n]</th>
<th>Month 6 mean/median (CI) [n]</th>
<th>Mean difference (CI)</th>
<th>Baseline mean/median (CI) [n]</th>
<th>Month 6 mean/median (95% CI) [n]</th>
<th>Mean difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General practice</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>1.5 (0; 4.5) [16]</td>
<td>1.0 (0; 5.0) [16]</td>
<td>-1.0 (-4.0; 0.5)</td>
<td>2.0 (0; 6.0) [29]</td>
<td>1.0 (0; 4.0) [29]</td>
<td>-0.5 (-1.5; 0)</td>
</tr>
<tr>
<td>Home visits</td>
<td>1.0 (0; 3.0) [16]</td>
<td>0.0 (0; 2.0) [16]</td>
<td>-1.0 (-1.5; 0)</td>
<td>1.0 (0; 3.0) [29]</td>
<td>0.0 (0; 1.0) [29]</td>
<td>-0.5 (-0.5; 0)</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>2.5 (0; 7.5) [16]</td>
<td>1.5 (0; 3.5) [16]</td>
<td>-1.0 (-2.5; 0.5)</td>
<td>2.0 (0; 7.0) [29]</td>
<td>3.0 (0; 6.0) [29]</td>
<td>0.0 (-1.5; 1)</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>1.0 (0; 3.0) [16]</td>
<td>0.0 (0; 2.0) [16]</td>
<td>-0.5 (-1.0; 0)</td>
<td>2.0 (0; 5.0) [29]</td>
<td>1.0 (0; 4.0) [29]</td>
<td>-0.5 (-1.5; 0)</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>0.0 [16]</td>
<td>0.0 (0; 1.0) [16]</td>
<td>0.0 (-0.5; 0.0)</td>
<td>0.0 (0; 1.0) [34]</td>
<td>0.0 (0; 1.0) [34]</td>
<td>0.1 (0; 1.0)*</td>
</tr>
<tr>
<td>Home visits</td>
<td>0.5 (0; 4.5) [16]</td>
<td>1.0 (0; 6.0) [16]</td>
<td>0.5 (-1.0; 2.0)</td>
<td>0.0 (0; 2.0) [34]</td>
<td>1.0 (0; 4.0) [34]</td>
<td>1.0 (0; 1.5)**</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>0.0 (0; 2.0) [28]</td>
<td>0.0 (0; 2.0) [28]</td>
<td>0.0 (0.5; 0.5)</td>
<td>1.0 (0; 4.0) [24]</td>
<td>1.0 (0; 3.0) [24]</td>
<td>-0.5 (-1.5; 0.5)</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>1.0 (0; 3.0) [64]</td>
<td>0.0 (0; 1.0) [64]</td>
<td>-0.5 (-0.5; 0)</td>
<td>0.0 (0; 2.0) [66]</td>
<td>0.0 (0; 1.0) [66]</td>
<td>-0.5 (-1.0; 0)*</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>2.0 (0; 15.0) [64]</td>
<td>1.0 (0; 8.0) [64]</td>
<td>1.0 (-0.5; 0)</td>
<td>0.0 (0; 12.0) [66]</td>
<td>0.0 (0; 2.0) [66]</td>
<td>-0.5 (-4.5; 0)</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>23.4 (21.5; 25.4) [58]</td>
<td>29.2 (26.5; 31.9) [53]</td>
<td>5.4 (0.1; 7.5)**</td>
<td>25.7 (23.4; 28.0) [58]</td>
<td>26.1 (23.7; 28.5) [51]</td>
<td>0.5 (-2.2; 5.4)</td>
</tr>
<tr>
<td>Physical health</td>
<td>22.5 (20.3; 24.6) [58]</td>
<td>25.9 (23.0; 28.7) [53]</td>
<td>3.5 (-0.2; 7.3)</td>
<td>23.3 (21.3; 25.4) [53]</td>
<td>25.2 (22.6; 27.8) [46]</td>
<td>2.1 (-1.8; 5.9)</td>
</tr>
<tr>
<td>Mental health</td>
<td>37.9 (34.5; 41.3) [53]</td>
<td>41.9 (38.6; 42.4) [46]</td>
<td>4.0 (-1.8; 8.1)</td>
<td>41.2 (38.5; 43.9) [53]</td>
<td>38.3 (34.9; 41.8) [46]</td>
<td>-2.9 (-8.9; 3.1)</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
### Table 16: Correlation between changes in main outcomes and age

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General practice</strong></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>-0.15</td>
</tr>
<tr>
<td>Home visits</td>
<td>-0.08</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>0.09</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>-0.05</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>-0.20</td>
</tr>
<tr>
<td>Home visits</td>
<td>-0.08</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>0.03</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>0.01</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>0.16*</td>
</tr>
<tr>
<td>Physical health</td>
<td>0.13</td>
</tr>
<tr>
<td>Mental health</td>
<td>-0.01</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
8.2 Discussion of results

8.2a Demographics

Overall demographics for the sample are reported in table 6. Data from a total of 202 participants was available for analysis. The majority were male (55.9%) aged 73 years and relatively spread across east and west Kent. In terms of model, 56.4% received care from the community matrons with 17.3% and 26.2% receiving care from general practitioners/district nurses and specialist nurses respectively. The majority received regular monitoring (70.8%). The major underlying chronic conditions were COPD (61.4%), CHD (61.4%) and Diabetes (37.1%). The majority (60.9%) had more than one underlying chronic condition.

Demographics of the sample by region are presented in table 7. Significant differences by region are observed in terms of model of care with a dominance of specialist matrons in east Kent and a dominance of general practitioners/district nurses in west Kent. In addition regular monitoring is more prevalent in east Kent than west Kent. Populations in west and east Kent are statistically similar on all other demographic variables.

Demographics by monitoring type are presented in table 8. Results indicate an interaction between region and monitoring type reported earlier. In addition significant differences were observed in terms of model of care with both specialist and community matrons employing regular monitoring far more than sporadic monitoring. In terms of underlying chronic condition regularly monitored patients were significantly more likely to be categorised as having COPD and CHD and significantly less likely to be diagnosed with hypertension.

Demographic factors by model are presented in table 9. East Kent is dominated by the specialist matron model and regular monitoring is provided by both specialist and community matrons. In terms of underlying conditions the general practice/district nurse model has significantly more cases of hypertension and significantly fewer cases of CHD, COPD and participants with greater than one chronic condition than either the specialist or community matron models.

It is apparent from the demographic analysis that interactions are present in terms of region and model and in terms of model and monitoring. Both specialist and community matron populations are significantly more likely to include populations with COPD and CHD and populations with more than one underlying chronic condition.

8.2b Outcome analysis – overall

Overall outcomes are presented in table 10. Measures of central tendency, confidence intervals and population numbers at baseline and six months are presented along with analysis of the mean difference between time points and the associated confidence intervals. The measure of central tendency provides an indication of what statistically is the most likely value for an individual in the population and the confidence interval provides an indication of where the value lies in the general population. Analysis has not been conducted on change scores because this is not an appropriate method of analysis. Both parametric and non-parametric estimates of mean differences have been created adjusting for any covariance.
Significant differences are observed for a number of outcomes at 6 months. There is a reduction of 0.5 per participant in terms of home visits and GP surgery visits. Community nurse phone calls and home visits increase by 0.5 over the 6 month period. Accident and Emergency (A&E) visits decrease by 0.5 and inpatient bed days decrease by 1.5 days per participant.

In terms of patient self-reported quality of life scores at baseline it is apparent that the population has poorer physical health than the general population but similar mental health to the general population.

Significant increases in general health 2.2 (CI 0.1 – 5.4) and physical health 2.8 (CI 0.6 – 5.1) are observed over the 6 month period but no significant changes in mental health.

8.2c By region

Outcomes at baseline, 6 months and mean differences by region are presented in table 11. No significant differences are observed in west Kent for any outcome. In east Kent significant reductions in surgery phone calls (0.5), home visits (0.5), GP surgery visits (1.0) and practice nurse visits (0.5) are observed between baseline and 6 months. Significant increases in community matron phone calls (1.0) and home visits are observed (0.5). In terms of acute care significant reductions in A&E visits (0.5) and inpatient bed days (6.0) are observed. Physical health significantly increases by 3.8 points (CI 0.5 – 7.1) suggesting a clinically important increase in physical health.

8.2d By monitoring

Outcomes at baseline, 6 months and mean differences by monitoring are presented in table 12. In the sporadic monitoring condition significant reductions are observed in practice nurse surgery visits (0.5) but significant increases in inpatient bed-days (0.1). In the regular monitoring condition significant reductions are observed in terms of general practice phone calls (0.5), home visits (0.5), GP surgery visits (1.0) and practice nurse surgery visits (-0.5). Significant increases in community matron phone calls (1.0) and home visits (0.5) are also observed. Significant reductions are observed in outpatient appointments (0.5), accident and emergency department visits (0.5) and inpatient bed-days (5.0). In terms of self-reported outcomes a significant increase in general health is observed (2.2 CI 0.1 – 5.4).

8.2e By model

Baseline and six month outcomes by model are reported in table 13. Mean differences and associated confidence intervals by model are reported in table 14.

In the specialist matron model significant reductions are observed in terms of GP home visits (0.5), accident and emergency department visits (0.5) and inpatient bed-days (7.5). Significant increases are observed in terms of community matron phone calls (1.5) and home visits (1.0) and self-reported physical health (8.7 CI 2.3 – 15.0). No significant differences are observed in the general practitioner/ district nurse model. In the community nurse model significant reductions are observed in terms of GP home visits (0.5), GP surgery visits (2.0), practice nurse visits (1.0), accident and emergency department visits (0.5) and inpatient bed-days (1.5). Significant increases are observed in terms of self-reported general health (2.2 CI 0.1 – 5.4).
8.2f By long term conditions

Only two long term conditions had sufficient unique cases to make them accessible to analysis COPD and CHD. The baseline, 6 month and mean differences and associated confidence intervals are reported in table 15. For participants with COPD significant increases were observed in terms of self-reported general health (5.4 CI 0.1; 7.5). In CHD participants significant increases were observed in community matron phone calls (0.1) and community matron home visits (1.0) and significant reductions in accident and emergency department visits (0.5).

A correlation analysis of number of comorbid conditions and outcomes found no effects suggesting that the number of comorbidities is not associated with greater or lesser changes in the outcome measures.

8.2g By age

The most powerful analysis for exploring the relationship between outcomes and age is a non-parametric spearman rank correlation. If no effects are observed in this analysis any further analysis such as splitting the population into age groups will also yield no statistically significant results. The correlation analysis is presented in table 16. Only one significant correlation was found between increasing age and changes in general health, suggesting that older people experience greater increases in general health. The correlation coefficient is 0.16 suggesting a significant but very weak association.

8.3 Outcome analysis conclusions

It is important to bear in mind that demographic differences exist between different monitoring approaches and different models and that these interact to make definitive conclusion difficult to establish. In addition, the quasi-experimental pre-post test design fails to adequately control for all potential confounding factors and provides evidence of association rather than evidence of causality.

With this in mind there appears to be relatively good evidence that regular monitoring by specialist or community matrons have the greatest impact in terms reductions in acute health-care use and increases in self-reported physical health. This impact is most noticeable in the specialist matron group.

The results of the study could be further underpinned by completing a longer term follow-up, possibly 18-24 months, and trying to minimise the impact of missing data by re-extracting data from GP records.

8.4 Economic analysis

In generating the economic analysis a number of assumptions have been taken. In the first scenario the costs associated in providing the service have been estimated by assessing the costs associated with training of relevant staff, staff time in providing the service derived from actual costs and the costs associated with providing the equipment. Costs associated with resource use before and after implementation have been estimated by averaged national sources derived from Department of Health reference costs. In the second scenario costs associated with capital costs of developing and implementing the infrastructure have been included. It is important to note that extrapolating infrastructure costs over a relatively small sample is probably an unreliable model, but the two scenarios can be seen as best and worse case cost scenarios. Costs have been attached on a per participant basis.
Health economic data is inherently skewed. In order to generate robust estimates of the relative costs and benefits the data has undergone simulation modeling using a bootstrapping technique in accordance with National Institute of Clinical Excellence guidelines. Bootstrapping involves the generation of a large number of simulated samples derived from the original sample using sample with replacement technique, in this case 1000 simulations. The resulting estimates are synthesised to provide robust estimates of the mean increase or decrease in cost and associated confidence intervals.

Table 17: Unit costs associated with economic analysis

<table>
<thead>
<tr>
<th>Unit</th>
<th>Cost in £</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse phone call</td>
<td>8.83</td>
</tr>
<tr>
<td>Home visit</td>
<td>70.00</td>
</tr>
<tr>
<td>GP at surgery</td>
<td>60.00</td>
</tr>
<tr>
<td>Nurse at surgery</td>
<td>17.00</td>
</tr>
<tr>
<td>Outpatient appointment</td>
<td>147.00</td>
</tr>
<tr>
<td>A&amp;E attendance</td>
<td>123.00</td>
</tr>
<tr>
<td>Inpatient bed day</td>
<td>254.00</td>
</tr>
<tr>
<td>Specialist Matron per hour</td>
<td>35.00</td>
</tr>
<tr>
<td>Community Matron hour</td>
<td>29.00</td>
</tr>
<tr>
<td>District Nurse per hour</td>
<td>27.00</td>
</tr>
<tr>
<td>Tele-monitoring equipment</td>
<td>1500.00</td>
</tr>
</tbody>
</table>

1 Unit Costs of Health & Social Care 2007 PSSRU University of Kent
2 Department of Health Reference Tariff costs 2007
3 Local reference cost
Table 18: Modeled changes in costs overall over 6 months

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean costs in £ (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall cost/ savings</td>
<td></td>
</tr>
<tr>
<td>Including capital infrastructure costs</td>
<td>-567.97 (-1405.99; 274.05)</td>
</tr>
<tr>
<td>Excluding capital infrastructure costs</td>
<td>-1878.47 (-2718.49; -1038.44)**</td>
</tr>
</tbody>
</table>

* significant at the 0.05 level
** significant at the 0.01 level
† applicable only to community and special matrons models

8.4a Results of economic analysis

Because of limitations in the available data economic analysis can only be conducted for community and specialist matron models.

Units of resources used in the data have been combined with unit costs of resources from a variety of sources. These sources include both local and national reference costs. Costs associated with GP, practice nurse, community and specialist matrons have been derived from the *Unit costs of health and social care* (Netten 2007) and these costs include additions for overheads, management and related capital costs. Outpatient appointments, accident and emergency visits and inpatient bed-days have been generated from the department of health reference tariff costs and include additions for transportation by NHS means where appropriate. Equipment costs, training and monitoring costs have been generated from actual local resource costs and allocated on a patient basis. Unit costs are presented in table 17.

Service delivery costs have been estimated using a cost for the delivery of training and telephone supervision of £9.90 per patient, a cost of monitoring patients over the 6 month period which averages £126 for sporadic and £379 for regular patients and the costs of the equipment. The equipment was used in the study for a period of 6 months but the estimated useful life of the equipment is 4 years, costs have been attributed on a pro-rata basis for the 6 month period £187.50. A second scenario has been developed which is similar to the first scenario but with the addition of capital infrastructure costs estimated at £1312 per patient. The two scenarios provide a best and worse case cost scenario for the economic analysis.

All costs in the study incurred within a 12 month time period so no discounting has been incorporated. Analysis has been conducted using bootstrapping to generate robust means and confidence intervals, 1000 sample replications have been conducted. Results of the economic analysis are presented in table 18.

Without the inclusion of infrastructure costs the telehealth intervention saved on average £1878 per patient and the confidence interval ranged from a saving of £2718 to a saving of £1038. This suggests that the telehealth intervention is significantly likely to save more than it actually costs to implement.
Our second analysis incorporates a capital infrastructure cost of the order of £265,000. In this scenario the mean cost saving per patient is £568 and this ranges from a saving of £1406 to an increase in cost of £274 per patient. This would suggest that even including high capital infrastructure costs the telehealth intervention would be 87% more likely to save than to cost.

In addition, it is worth bearing in mind that telehealth has significant positive impacts on both general and physical health.
9. Qualitative analysis

9.1 Discussion of comments from clinicians

As part of the qualitative analysis we collected comments from clinicians and also asked them for anonymised case studies of their patients. This information was key to understanding if the results were similar to the studies in the USA.

Clinicians involved in the trial were very positive regarding the use of telehealth as a tool. As this equipment also allows consultants access to the readings it can be a useful tool to consultants who do not see the patient daily.

“I had phone a call from the consultant who saw the patient today and he said he is the best he has ever seen him. Much more relaxed. The patient does say he feels much more supported now, so what a team we all are and the consultant thought it great that he could look at the data whilst the patient was in Clinic.”

Another matron commented:

“The patient went for her out patient’s appointment with the consultant today and took with her all the TeleHealth data. The consultant was really pleased with the information and her progress!”

In addition the use of the equipment can lead to a reduction in the need for Secondary Care follow up.

“72 year old gentleman with Fibrosing Alveolitis has been discharged from any future reviews with his respiratory consultant because he has remained stable since being monitored with the system and his consultant felt whilst he was being monitored this way there was no need for him to attend out patients.” (specialist community matron)

“Project officers were attending a demo on Friday with a consultant at the hospital, he mentioned (patient name withheld) and how amazed he was at the dramatically decreased admissions this man had into hospital following the installation of TeleHealth.” (specialist community matron)

The ability to monitor readings frequently can speed up a diagnosis and prevent further problems.

“It hasn’t specifically kept him out of hospital but his observations changed which led me to intervene, he then was referred to other agencies e.g. physio and stroke team where it was diagnosed he had had another stroke. It was picked up early that something was happening, I got the physio in for mobility assessments and the stroke team, the stroke team are still working with him, I feel it prevented a fall and all those complications if nothing else.” (Matron)
Male patient- TeleHealth installed at 3pm, possible infection detected by matron using TeleHealth results in phone call and visit, intervention in the shape of antibiotics around 4pm, all on the same day.

The direct benefit to clinical staff managing those patients varies from reduced unnecessary visits through use of telehealth to help triage, determining daily activity. Indeed GPs were beginning to recognize this and would refer patients accordingly.

“I will also ask Community Matron team to assess for TeleHealth monitoring at home, as this has shown to be extremely useful in early detection of exacerbations and preventing repeated hospitalization.” - (GP)

In some cases the readings have alerted staff to a problem.

“One of her patient's TeleHealth measurements was a bit bizarre - the blood pressure readings were really high. She contacted the GP who didn't want to know and said he couldn't do anything until the patient had his next ECG. She then contacted the cardiologist who (after she got past the secretary) agreed to see the patient that afternoon on the strength of the TeleHealth readings. He discovered that the patient was having a heart attack with no warning pain and whipped him off to Kent and Canterbury Hospital where he was immediately put in high dependency/intensive care. The cardiologist said that had he not been seen that afternoon he would have died.”

If a patient feels a slight change in their condition, anxiety can play a large factor and they or their carer may call the emergency services and therefore both feel reassured. However with telehealth, patients and their carers become more expert in what are their typical readings and are then able to contact services themselves armed with this knowledge. The readings are also beneficial to out of hours services.

“One of the matron's patients phoned SEADOC (South East Kent Doctors On Call) on a weekend, she told them that she was using the TeleHealth monitor, so they asked her to take her measurements and they would call back in 5 mins, the results of her measurements were OK and SEADOC told her he was glad she was using TeleHealth.”
- Shepway

A client's daughter was telling me today that she feels TeleHealth has given her peace of mind. She said that she used to worry that her father was putting on weight and could only ask him if he was feeling bloated. Now she can see if he is or not. If he has she gives him water tablets and then contacts the community matron and tells her what she's done. She says that the blood sugar readings have changed the way she gives him his food. She says that she can tell if he's been indulging the day before (and presumably keeps him on short rations the next day!). - Dover

Clinicin comments have shown that by using telehealth and knowing that a clinician is able to see their readings, patients become less anxious and reassured.

A Matron reported “One 71-year-old gentleman is much less anxious about his condition now he is on Telehealth. We have been able to pick up early signs of chest infection with him and treated him with oral antibiotics, and monitored his condition via Telehealth. His GP is also extremely pleased with the improvement in his anxiety levels.” - Ashford
“Another patient, a 72 year old lady, is also a lot less anxious because she knows she is being monitored regularly. Her blood sugars have been very erratic and because of this regular monitoring we have been able to change her insulin dosage and given her dietary advice to improve them.”

“Gentleman with end-stage COPD who was obsessed and anxious and always calling 999 and having lots of visit to the A&E. TeleHealth was introduced. Client and his wife now say what a difference it makes to have the monitor. They feel very reassured and make a lot less calls to 999.”

Other patients may contact their GP. A matron reported:

“The doctor was keen to inform me that in the two patients he has who are on the system, at the point of this story, for 2 weeks he has seen a noticeable reduction in anxiety and an increase in confidence. Anxiety is a quality causing a large amount of GP time in condition management. This is particularly interesting as the GP has not seen any EU net data on them as he as yet has no access!” - Ashford

Unfortunately as the people in this pilot did have bad health some have passed away. But importantly their family and friends spoke of the importance of telehealth to them in the last years of their life.

“Regretfully I need to advise you all that (patient name withheld) passed away yesterday. Some of you will have known her personally, as she attended the Kent Show last year, where she showed that she was quite a character. It was a real pleasure to have known her and her daughter wanted to say thank you for making the last years of her life fun and for enabling her quality of life to be such so that she could have fun. One of life’s ladies!”

“Sadly (patient name withheld) is now deceased, but while talking to his wife this morning re de-install, she was telling me how much this machine had helped her husband, she did his readings every day and kept a close eye on him, she told me how much it had helped her as well as he husband. She also said how easy it was to do and it was a real boon to their lives. When his stats reached critical level, which it did very quickly, the clinician told her to get an ambulance immediately, she did this and he died peacefully in hospital with her by his side. She wanted to say thank you”.

“This client is now deceased - but I spoke to his daughter yesterday, who couldn’t thank us enough for ‘giving him another year’, she firmly believes that without the TeleHealth machine her father would not have lasted this long and not had such a good last year, he loved the machine and was always on it, which kept him out of hospital unnecessarily.”

There are more clinical comments in Appendix 3.
9.2 TeleHealth Clinical Case Studies

The five case studies below show A&E visits & bed days of care before and after telehealth intervention

Case Study 1  3 months A&E 1-0 Bed days 17-0
Male aged 84

2 admissions in the previous year.
Previous Medical History (PMH): Severe Chronic Obstructive Pulmonary Disease, New York Hospital Association (NYHA) grade IV* Heart Failure, Chronic Kidney Disease (CKD) stage IV*, Atrial Fibrillation, Mitral Valve disease.

- Exacerbation of COPD noted on TeleHealth questions. Clinical indicators at that time were unremarkable. Steroids/ Antibiotics initiated after visit and examination.
- Resulting microbiology result confirmed infective exacerbation of COPD.
- Weight gain noted over weekend. Spironolactone initiated with consultant agreement given his renal function with good effect.

Case Study 2  6 months A&E 3-1 Bed days 32-3
Female aged 84

6 admissions in the previous year.
PMH: Ischaemic Heart Disease, Atrial Fibrillation (AF), Tricuspid valve regurgitation, Type 2 Diabetes, Right sided Heart Failure (HF), awaiting pacing.

- TeleHealth used to identify that as little as 1.5kgs of fluid overload as a significant threshold for patient to throw off arrythmias.
- Monitoring her weight, Blood Pressure and renal function we have successfully titrated diuretics several times to avoid potential admissions.
- TeleHealth data used to identify sensitivity to betablockers after titration of Bisoprolol 2.5mgs to 3.75mgs. Pulse rate dropped to 41.

Case Study 3  6 months A&E 1-1 Bed days 16-1
Male aged 49

5 admissions in the previous year.
PMH: I.H.D., Cerebral Vascular Accident (CVA), Hyperlipidaemia, Myocardial Infarction (MI) x2, Angina, Uncontrolled Hypertension, Parkinsons disease, Depression.
• Within 2 weeks of going onto the TeleHealth kit his systolic had fallen from 190mmhg to 140mmhg without any titration of his antihypertensives.

• His Consultant Stroke Physician feels that this is attributed the TeleHealth monitoring leading to a reduction in his anxiety.

• I admission recently as a result of a fall.

**Case Study 4**
**A&E 2-2 Bed days 16-0**

Male aged 80

PMH: COPD, Deep Vein Thrombosis (DVT), IHD, M.I. x 3, C.V.A. Mitral & Aortic Valve Disease/Replacement.

• Eliminated white coat syndrome element and as a result was found to be suffering from bradycardia within a few days of going onto the system.

• Resulting ECG showed 2nd Degree Heart Block along with other irregularities.

• Referral to Cardiologist resulted in the gentleman being fitted with a bivent pacemaker.

• Quality of life improved markedly. Clinical indicators improved.

**Case Study 5**
**A&E 3-0 Bed days 29-0**

Male aged 73

Prior to inclusion 3 hospital admissions in the previous year.

PMH: Right sided Heart Failure, Type 2 Diabetes, Fibrosing Alveolitis, Polycythaemia

• 1st intervention:

• Sudden increase in weight over a weekend of 3kgs prompted a visit. An increase in his diuretics was initiated after a clinical assessment.

• The resultant monitoring of his Blood pressure, Glycaemic control and weight ensured no further deterioration.

• 2nd intervention:

• Slight fall in his blood oxygen overnight prompted a visit. On examination an increase in coarse crackles was noted with a productive cough and an expiratory wheeze. Antibiotics and Steroids commenced with good effect.

• Microbiology confirmed an infective exacerbation.
9.3 Results from the patient satisfaction survey

A survey was undertaken with some participants to uncover any issues with the telehealth team, to highlight problems with the equipment and to ‘identify potential clients for involvement in a Telehealth Client Self Help Group’ (Patient Satisfaction Survey Appendix 4 2006). The survey also wanted to scope interest in forming a user group. The survey was both quantitative and qualitative. From suggestions in the survey a user group was set up.

The telehealth team conducted a telephone survey in order to:

- measure the level of client satisfaction with regards to the service they have received from the KCC telehealth team.

110 clients who were using telehealth at the commencement of the survey were contacted and over a three week period (29/11/06 – 20/12/06) feedback was successfully obtained from 86 (78%).

The telehealth team’s client satisfaction ratings have been extremely positive, the highest rating (93%) being recorded for the delivery and installation of the equipment and the equipment tutorial. The lowest rating recorded was for the usefulness of the information booklet and user manual (58%). The general consensus from the clients was that they did not find them very useful because the equipment tutorial was of such a high quality that they had no need to read them, this is reflected in the tutorial satisfaction score of 93%.

The average total satisfaction rating across all questions (see figure 4.1 on page 113) was 85% however when the score for the usefulness of the literature is removed this satisfaction rises to 90%. The questions that most closely reflect the level of service provided by the team members generate a satisfaction rating of 91%.

49% of telehealth users have had to contact the team at some point after installation and out of these 93% found it either “very easy” or “easy” to contact a member of the team. When a return call was needed, in 75% of cases this was made on the same day and in 80% of cases this was made within two days. 95% of clients rated the service they received as a result of contacting the team to have been “good” or “very good.”

Importantly 95% of those using telehealth thought that it had helped them manage their condition more effectively and 98% would recommend telehealth to others with similar conditions. Initial feedback suggests that the discrepancy between these figures is due to a few clients that believe that their condition is not severe enough to warrant being on telehealth (although this is not supported by professional medical opinion) but would recommend it to others who were older/worse health than themselves.

58% of clients said they would be prepared to talk to others with similar conditions about using the telehealth system and 43% would be interested in learning more about managing their own condition. The telehealth team contacted some of the clients in this group with the intention of setting up a TeleHealth Self Support Group.

30 clients put forward suggestions on how we could improve our service, the most common suggestions being that it should be possible to use telehealth for two way communication, accessories such as
batteries and thermometers should be provided and that the scales need to be of a better quality. Out of the 41 clients that wished to add further comments, 37 could be considered positive and 4 negative.

One client illustrated the benefit of telehealth “I woke up recently with a burst blood vessel in my eye and was very worried as I had recently had a stroke. I used the web cam facility to take a photograph of my eye and sent it through the machine to my Doctor. It was very reassuring when the Doctor rang back to say everything was ok and I had nothing to worry about.”

Other clients pointed to the reduction in hospital bed days that they now enjoyed “I’ve been ill for five years and in that time I’ve spent eight months in hospital. Since I’ve been on Telehealth my time spent in hospital has dramatically decreased. Some times I wouldn’t see a nurse for weeks and my condition would be drastically deteriorating without me knowing. Now a nurse sees my readings everyday it has been a life saver.”

Others also talked about the reassurance “I’m really pleased to have TeleHealth. It felt like we were on our own before. Combined with the Community Matrons it has given us a lot of confidence as before it felt like the Doctors had just given up on us.” another client stated “It’s a boost knowing that the nurse knows how I am every day.”

Another discussed how safe and empowered they felt “I’m very pleased with it. It’s a marvellous thing that is easy to work and makes me feel safer and more confident.”

Such comments as “Before using TeleHealth I was suffering from panic attacks now they are gone.” or “The machine in combination with the matrons has really picked me up.” show how clients value the service.

Clients also described how “TeleHealth has made life much easier with much less trips to the surgery.” and “It’s good service and has saved the nurses having to come around and see me every five minutes.”

But as well as decreasing bed days of care the data can alert clinicians to changes in condition “The machine saved my life. The matron picked up a deterioration in my condition immediately and I was rushed to hospital for life saving surgery.”

These findings along with the clinician comments show that telehealth has had a positive impact on clients. Further comments are available at the back of the Survey Report in Appendix 4.

In conclusion, although feedback as a whole has been extremely positive this survey has identified some areas where service improvements can be made. Therefore it was recommended that:

- The team feedback to Viterion with regards to the quality and usability of the scales, the relevancy of the questions, the advantages of a message alert tone, the ability to clear old messages off the screen and the supplying of blood sugar monitors with hypo alarms.

- The telehealth team reviewed the feasibility of supplying replacement batteries with the equipment.

- A call logging procedure is put into place for outside of office hours.
• A review is carried out of the literature to investigate the possibility of making it more generically useful.

• Investigate the feasibility of setting up a TeleHealth Self Help Group in association with the NHS's Expert Patient Programme.

The full survey and its results can be found at Appendix 4
10. Conclusion and implications

10.1 Findings

One of the questions behind the Kent TeleHealth Pilot was whether the UK study could replicate the findings from the USA Noel (2004), Chumbler (2005, 2009), Darkins (2008). A GP stated it was clear “That the technology will work in the UK environment.”. He did add that comparisons are difficult between countries as different models of health care exist, but despite that, the results in the UK have been very positive.

The Kent TeleHealth Pilot was designed to inform the decisions of policy makers and commissioners concerning the investment in and provision of telehealth across the county enabling people to live at home longer, reducing their risk of ill health and thereby reduce health and social care service utilisation and cost, give them more control over their management of care, and provide support for informal carers.

In so doing, the intention was, as far as possible, for the interventions to generate a financial return on investment, ideally to the point where the intervention largely pays for itself through reductions in more costly use of health and social care paid for by statutory agencies.

The study aimed to evaluate the impact of remote monitoring of a cohort of patients over a six month period of time and in a context previously unexplored. The main benefits identified were: increased access to health care, cost-effectiveness, improved health outcomes, better quality of care and better quality of life.

Regular monitoring shows -77 A&E visits and - 849 bed days of care for people contributing to the data.

Sporadic monitoring shows -11 A&E visits and +313 bed days of care for people contributing to the data.

The overall change is a saving of 88 A&E visits and 536 bed days (Table I)

A&E visits and bed days of care in Kent overall decreased. However there was an increase in hospital bed days in some sporadically monitored sites which may be due to a few individual patients. (See Tables 2 and 3 in Key Findings p26).

Although bed days did decrease, it is significant that patients symptoms were dealt with quickly and the technology alerted professionals through a change in readings or answers to questions. Importantly patients felt reassured and supported.

As noted in the analysis of the quantitative data, Section 8, overall contact with GPs and district nurses by phone, home visit, surgery visit and nurse visits decreased and the unplanned acute visits also decreased. Bed days of care for the GP/DN model increased (see Tables 2 and 14 p26 and p79). It is unknown if these were referrals straight to hospital and not via the unscheduled A&E route.
Statistically significant increases in mean contacts for community matron were observed for phone and home contacts and the unplanned acute visits and bed days of care decreased for this group depending on frequency of monitoring (See Table 12 p77). There was an increase in hospital bed days for sporadic monitoring (see Tables 2 and 3 p26).

On looking at the data for these two groups, it is important to note that increases in bed days are accounted for by a few patients, one of whom died. If that outlying data for these patients was removed there would be no change in bed days, for the remote monitoring group but a decrease in A&E visits.

Among those people who completed a baseline SF-12v2 questionnaire (n=97) and 4-6 weekly follow-up, there was a statistically significant improvement in the physical component summary scores. The highest scores are shown in the specialist matron model where general health increased by 5.4. (0.1:12.8) and the physical health increased by 8.7 (2.3:15.0). A score of over 4 is considered to be significant and such a high score is clinically significant.

The improvement was most pronounced in the patients from east Kent. There was a decline in mental component scores of less than one point which was not statistically significant (see Table 11 p76). Overall sporadic monitoring has an increase of 5.4 points.

It could be argued that given the understanding of the different models in which the overall movement of both physical and mental component scores occurs, this suggests the importance of the clinician in offering care and therefore providing reassurance, information and help to self manage. Telehealth may well be providing a support that contributes to a reduction in unplanned admissions following increased clinician telephone contacts or targeted visits. This may account for the decrease in bed days among those regularly monitored. One participant stated that “It’s a boost knowing that the nurse knows how I am every day.”

It appears that regular monitoring brings substantial increased savings. In one site where community matrons had specialist training, the majority of patients who had complex conditions, received telehealth, therefore bringing about a change in working practices. Thus greater targeting of patients brings more positive results. In other sites where the number of people on telehealth was low and a small proportion of a more varied caseload, this may explain why these cases are monitored less frequently - see Tables 12 and 14 (p77 and p79) for differences.

This is consistent with the findings of Chumbler et al. (2005) who reported that weekly monitoring of patients was not as effective as patients monitored on a daily basis and did not lead to savings in unscheduled A&E visits and bed days of care. Those monitored more frequently had a decreased likelihood of unscheduled hospital admissions and bed days of care. Very little other research has explored this area. As described by Chumber et al. (2005) this is consistent with the “just in time” care approach, in which health status is monitored in a proactive way to provide interventions before deterioration and improves the overall quality of care (Perlin et al. 2004).

The economic costing (which excludes GP/DN model) shows that using the figure of £1,500 for the telehealth kit which 179 patients are still using, the unit mean cost savings per patient over six months £1,878.47. (2718.49; -1038.44)** 95% CI (see Table 18).

An exploratory extrapolation of the costs of telehealth to the wider population of Kent is discussed in Appendix 5. A number of caveats need to be considered and these are also discussed in Appendix 5.
Results from the qualitative findings were extremely positive with 91% of people believing that telehealth has helped them manage their condition(s) more effectively and 98% stating they would recommend telehealth to other people.

People were successfully managed at home at end of life and an increase was seen in people being kept out of acute care at this time.

Most importantly patients, carers, relatives and clinicians were full of praise for the way that telehealth had changed practice and impacted positively on their lives.

10.2 Conclusion

Telehealth is an effective tool when the data is monitored regularly. The role that clinical skills play, coupled with the differences within the types of community matron model, indicates strongly that the more skilled the clinical resource and the better targeted that resource is, the more benefit there will be for the participant and service provider.

A GP stated that “There are various models of care that can be used to deliver the service to people with LTC’s using Telehealth as an important tool to assist the patients, carers and professionals in that care.

Some of these models seem to work better than others and that a targeted Nursing team (Specialist matron model) using daily monitoring can deliver great gains for all concerned. GPs can provide a very important clinical input in this type of team with their expertise and knowledge, of the medical conditions and the patients being cared for.”

The effects of the telehealth application on the clinical processes of care compared to the alternative (as pre-pilot) are significant. As can be seen from the findings, the effect on immediate health outcomes is significant. Telehealth did reduce the level of services or other appropriate care that might have been used (when comparing to pre-installation data). It also affected the timeliness of care and ensured that exacerbations were stopped before they became too serious.

A GP concurred with this and stated that “The patients and carers find this technology acceptable and easy to use and further become very enthusiastic about it, in the majority of cases. The patients and carers gain a great deal of confidence with this input and this helps them live better lives with less worry as they feel ‘looked after’. The professionals seem to be able to deliver timely interventions and aid crisis avoidance”

Improving Care and saving money (2010b) states that ‘The medium-term future holds two key challenges.’ Firstly ‘an increase in demand for health and social care associated with an ageing population and changing expectations and’ secondly, ‘a reduction in the growth of public sector funding for health and social care.’ The report adds that the ‘need to meet growing demands with diminishing resources will require greater emphasis on innovation and productivity’ will become even more important.

Telehealth can bring substantial cost savings to both the health and social care sector and benefits to the patient and carer. The cost saving to the patient is unnecessary visits to A&E, hospital or GP surgery. The clinician also saves travel in making unnecessary visits, hence the drive to reduce the carbon footprint of clinicians in the NHS is also achievable. People are supported to live independently and play their full part
in society by a co-ordinating partnership working between health and social services and other local agencies. Comments from a GP were “We can show that this technology does save bed days and therefore from a health economic perspective can save money and pay for itself. The system seems sustainable in the long term, 5 years now in Kent. I think it works.”

Using telehealth effectively, the clinician is able to significantly increase a person’s general and physical health. The mental health scores shown in the tables 10-13 are within the population norms (35-65). In addition it should be noted that any improvement in mental health scores lag behind general and physical health scores. A survey undertaken now may find that the scores have improved. The specialist matron model shows low mental health scores but it should be noted that they picked up in their caseload several people with depression who were then referred to the mental health teams.

People are kept out of hospital and A&E for unscheduled episodes of care. These unscheduled hospital admissions can cause stress and concern to themselves and their family. Carers are better supported and able to care for their relative at home and telehealth has been used where a person wished to stay at home for the last days of their life.

“Importantly telehealth is a tool and what the clinician gets out of it is dependent on what they put in to it. A confident practitioner is able to use telehealth to its full potential. If a clinician has a large number of people with co-morbidities, then telehealth is a proactive way to manage the caseload and triage the appointments and visits for the day. It changes the way a clinician works from being reactive to being proactive.” - Specialist Matron

“The more you exacerbate then the more you go down the disease progression route. Anyone can look at the data – the most important thing is what you do with the data and the skills and clinical decision making that impact on the person’s health and wellbeing and enable patients to manage their own health. Managing their own health is important and users will get to know their readings over time. It changes the relationship between professionals and patients and puts them on a more equal and less dependent footing because they have more knowledge about their readings.” - Specialist Matron.

This was confirmed by a GP who stated that “Professionals, patients and carers can look at when and where they need to be reviewed, rather than following old rituals, thus freeing everyone’s time. The patient and carers become ‘empowered’ to manage more their condition and to spot when they are deteriorating. It (telehealth) does not replace people or the personal touch but it can make for important changes in the way we work to care for these patients and probably others as well, as confidence builds.”

A specialist community matron said “I certainly found that the more complex the more morbidities a patient had, the more enhanced the care delivery from my point of view. If for example a patient had an exacerbation of their COPD, yet they also had Heart Failure and Diabetes, the introduction of certain medication could potentially have impact on their other conditions for example oral steroids can cause a worsening in glycaemic (blood sugar) control. In heart failure, diuretics can worsen glycaemic control.

Or the mere fact they had an exacerbation of their COPD could lead to heart failure exacerbation. I could monitor all their clinical indicators closely for this potential.
Telehealth can enhance patient safety, for example close monitoring of patients when new medication is introduced. I believe that telehealth has the potential for improving patient safety.”

Translating these observations into service delivery, there appears to be a range of care that could be assisted by the use of technologies. At one end of this spectrum there is the specialist care model where patients with a higher degree of health needs are monitored frequently and the information used to identify additional morbidities as they develop; manage medicines and their exacerbations much more closely but with more targeted contacts, and with the patient taking a more active role in their own health care. This model also applies to end of life scenarios whereby an individual may be enabled to stay at home where carers, family and friends have better access to the patient.

“Thank you for giving my father another year at home. I firmly believe that without the TH machine my father would not have lasted this long and not had such a good last year”
- Daughter of telehealth patient

Telehealth can provide reassurance to the worried patient and their carer that their needs are being met which may contribute to improvement in the quality of life. Therefore telehealth could have a role in patient education following readmission or for short term monitoring post discharge. The management of patient expectations and patient compliance would be key to the success of using telehealth in these scenarios.

The direct benefits to clinical staff appear to be reduced unnecessary visits, and a reduction in urgent changes to the day’s activity to respond to unscheduled care episodes (also referred to as just-in-time care). To derive the most sustainable and broadest range of benefits requires a move from using technology as a small scale intervention to adopting telehealth as part of the architecture of the service delivery model especially for those with complex co-morbidities. This is likely to provide the most cost effective solution as it may help to delay patients moving into more intensive care settings and also stop the ‘revolving door.’

Telehealth supports patients in their own home for longer and this has a potential impact on more expensive care settings (care homes, hospital). Telehealth provides a model of increased capacity and sustainability as well as providing a cost saving scenario for both the health and social care sectors.

Therefore it can be argued that the innovative and patient-centred model offered by the technology empowers patients and their carers to partake in the wider effective and sustainable benefits. In short, the closer you move care to the patient or service user, the wider the range, and the longer the benefits become; not just for service users, but for their carers, and for the services supporting them.

There were no specific correlation which showed the effectiveness of telehealth for a specific age group.

The findings from this study are consistent with findings in the literature such as Noel (2004), Meyer (2002) Chumbler (2005).
The delivery of this innovative and extensive pilot would not have been possible without the robust and established partnerships between the health and social care communities in Kent. The support from all partners was crucially important in working towards a shared vision. Without these partnerships, none of the organisations would have been able to so fully engage with and explore this important developing technology to benefit service users, carers and the health and social care sectors. A GP commented “It is a real example of that much talked of but rarely seen animal ‘Partnership Working’. It has been a pleasure to work with social care and other health partners. The pilot sets a good introduction to the Whole System Demonstrator Programme and I feel lights the way forward.”

10.3 Implications for further study

This exploratory study has generated many findings which could assist and point the way for further and more rigorous studies in their research design.

Any study must ensure that it has a dedicated team to project manage it, that both users and clinicians are fully engaged and that in the current financial climate there is stability in the delivery of the scheme. The workforce should have the core competencies to deliver the programme and any initiative should look at previous studies to understand possible issues. Where possible all data should be available to the evaluation team (see 8.3 p84) and therefore time needs to be allowed to concentrate on the data requirements at the commencement of any study. Informed consent for data gathering also needs to take place. Care needs to be taken to engage the patients who would benefit the most from any study.

The telehealth team collected much data but there are limitations in this pilot which must be acknowledged. The unscheduled A&E visits and bed days of care in this study were collected as a total of A&E visits and bed days of care over six months prior to installation and six months after installation. There are no details as to number or the length of hospital episode, the reason for the hospital episode or any associated costs. Had this data been collected then the economic analysis would have been more rigorous and not based on the average hospital bed day cost. Neither is there data on hospital readmission within 28 days. Any future study should collect this data along with changes to medication and changes made as a result of the telehealth monitoring. There are also limitations to the data in that we do not have any information on the bed days saved through early intervention although now clinicians are noting the results on the patient’s notes.

A robust carer’s survey would have been useful in gathering both quantitative and qualitative information. This could have included a validated carers’ stress burden survey. The current system of using telehealth concentrates on devolving the case management of an individual away from the GP practice to a community matron or specialist matron. This technology has the potential to bring large cost savings both to health and social care as can be evidenced from the economic model and savings in the analysis (Table 18).

But telehealth can also have other uses. In cardiac rehabilitation for example, many people access hospital and are given physical exercises to do at home. But they are often scared or anxious – however telehealth is a tool which can monitor them whilst they are doing exercise or using a Wii board. It can also check their weight and their medication. There is a far greater potential over and above its current use. This technology brings added value in delivering interactive services over a distance. It enhances the skills of professionals when used by appropriate staff.
Telehealth could be used for close monitoring of patients following discharge to reduce 28 day readmission rates. This may have the potential to reduce the need for intermediate care and reablement as well as social care costs. It would provide patients and carers with reassurance and support.

One clinician suggested “I think we need to also allow some play and experimentation with this technology to try in other areas e.g. midwifery – monitoring BP or Foetal hearts, with discharged patients,” whilst ensuring normal clinical practices are sustained to ensure patient safety.

Another potential application beyond this is in nursing homes. Telehealth can be used in this context by out of hours GP services and ambulance services to monitor patients remotely to assist in decision making regarding the appropriate course of action.

To derive the most sustainable and broadest range of benefits in all of these scenarios requires a move from using technology as a small scale intervention to adopting it for an entire caseload managed by a single clinician or clinical team. This is the most likely successful scenario but requires attention to change management to support the adoption of remote monitoring as a case and caseload management tool by clinicians. Clinical engagement can lead to the re-design of the current care pathways to adopt this technology. This is also likely to provide the most cost effective solution as well, as it may help to delay patients moving into more intensive care settings. A GP commented “Using the Telehealth kit needs to be viewed as part of a solution and to become a mainstream tool. I think Telehealth needs to be used well and selectively to have the most impact.” However the telehealth technology field is rapidly expanding and looking forward the GP added “We need to build development around ways of working rather than simply bits of kit, because surely things will develop and change over time. Telehealth needs to be considered a real job not an add on to someone’s busy day.”

As technologies become increasingly convergent across the health and social care economies, the preventing or delaying an individual’s progression into the costs associated with care as people move from one domain to another remains an issue for all services seeking to develop and exploit new efficiencies as a matter of necessity and indeed urgency.

To the individuals using the technology it does not matter whether it was the Local Authority or Health who invested in the idea and can be summed up by one satisfied user of the equipment.

“I’m very grateful that someone like Kent County Council is prepared to take the time to take care of me.” - Service user
### Table 19 Missing data by outcome

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General practice</strong></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>132 (65)</td>
</tr>
<tr>
<td>Home visits</td>
<td>132 (65)</td>
</tr>
<tr>
<td>GP surgery visits</td>
<td>132 (65)</td>
</tr>
<tr>
<td>Nurse surgery visits</td>
<td>132 (65)</td>
</tr>
<tr>
<td><strong>Community nurse</strong></td>
<td></td>
</tr>
<tr>
<td>Phone calls</td>
<td>125 (62)</td>
</tr>
<tr>
<td>Home visits</td>
<td>124 (62)</td>
</tr>
<tr>
<td><strong>Acute care</strong></td>
<td></td>
</tr>
<tr>
<td>Outpatients</td>
<td>123 (61)</td>
</tr>
<tr>
<td>A&amp;E visits</td>
<td>2 (0.5)</td>
</tr>
<tr>
<td>Inpatient bed days</td>
<td>2 (0.5)</td>
</tr>
<tr>
<td><strong>Patient outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>(High = good, low = poor)</td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>19 (9)</td>
</tr>
<tr>
<td>Physical health</td>
<td>30 (15)</td>
</tr>
<tr>
<td>Mental health</td>
<td>30 (15)</td>
</tr>
</tbody>
</table>
### Overall changes in A&E visits and bed days by centre and region

<table>
<thead>
<tr>
<th>Centre</th>
<th>Change in A&amp;E visits</th>
<th>Change in bed days</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>West Kent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearsted</td>
<td>-3</td>
<td>58</td>
</tr>
<tr>
<td>College Road</td>
<td>-1</td>
<td>187</td>
</tr>
<tr>
<td>DGS</td>
<td>-10</td>
<td>-76</td>
</tr>
<tr>
<td>Lenham</td>
<td>3</td>
<td>-51</td>
</tr>
<tr>
<td>Oakfield</td>
<td>0</td>
<td>108</td>
</tr>
<tr>
<td>Tonbridge</td>
<td>-4</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-15</strong></td>
<td><strong>232</strong></td>
</tr>
<tr>
<td><strong>East Kent</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ashford</td>
<td>-10</td>
<td>-125</td>
</tr>
<tr>
<td>Dover</td>
<td>-15</td>
<td>-217</td>
</tr>
<tr>
<td>Ham Street</td>
<td>-4</td>
<td>0</td>
</tr>
<tr>
<td>Shepway</td>
<td>-33</td>
<td>-420</td>
</tr>
<tr>
<td>Thanet</td>
<td>-6</td>
<td>7</td>
</tr>
<tr>
<td>Whitstable</td>
<td>-5</td>
<td>-13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-73</strong></td>
<td><strong>-768</strong></td>
</tr>
<tr>
<td><strong>Overall Total</strong></td>
<td><strong>-88</strong></td>
<td><strong>-536</strong></td>
</tr>
</tbody>
</table>
Appendix 3

Comments from clinicians

We have many comments from clinicians, and as well as illustrating the main text of the document, some are included here to highlight how positive clinicians regard telehealth.

Comments received during pilot (anonymised)

1. **As requested can I just point out that ALL of our patients on TeleHealth are success stories because they all benefit from it!** - Shepway

2. **Since using TeleHealth my colleague and I have found the system to be of enormous benefit in maintaining and improving the patient’s health status.** - Ashford

3. **For example a 79 year old gentleman with COPD and CHD was set up on the system recently and was found to be Bradycardic (low pulse). Subsequent investigations have identified that the patient will need to have a pacemaker fitted.**

4. **Similarly an 87 year old lady with COPD, with a history of frequent admissions for exacerbations has been managed successfully within the comfort of her own home by very early pharmacological interventions and physiotherapy and as a result has not needed any admissions to hospital.**

5. **With the help of TeleHealth, a Community Matron has managed down the contact she has with one patient from daily visits to just once a week. The patient initially following installation she continued to visit every other day, and has gradually reduced the contact.**

6. **The patient has an exacerbation of his COPD that the questions on telehealth over the weekend identified even though his readings were stable. Another example of the benefits for you. Look at his responses on sat, sun and today!** - Shepway

7. **Check out (patient name withheld) readings. As a result his medication has been stopped. Good news for TeleHealth.**

8. **Another Consultant has discharged (patient name withheld) to our care also as he is being monitored via TeleHealth.**

9. **The Community Matron is going to give client some medication that he can take himself if his blood pressure goes down in order to dilate his blood vessels and hopefully prevent an angina attack.** - Whitstable

10. **Client often had problems with falling and feeling dizzy. The community matron thought he might have postural hypertension. TeleHealth was installed and his BP was monitored when sitting and standing. This confirmed the matron’s diagnosis of postural hypertension. She noticed that one of the side effects of a medication he was using was postural hypertension. When this was discontinued his BP became normal.** - Thanet
11. Thanet matron says that most patients with COPD are very reassured by TeleHealth.

12. Another client, this time with diabetes, was also a frequent attendee at A&E. His blood sugar readings used to be anything between 2 and 20. Since TeleHealth his readings are much more stable.

13. The matron says that another client raves about TeleHealth, says he feels so much better. The matron went on to say the psychological effects are enormous. - Thanet.

14. The matron tells me that the client, who said that he has a GP son in New Zealand and wanted leaflets to send to him, is saying that his son is really enthused by it and is wondering how to get it over there. - Thanet

15. More locally, another of the matrons clients told me that a consultant friend of hers was very impressed and thought it a good scheme - and her GP is also very supportive of her using the machine. - Thanet

16. From the patients’ raised blood sugar readings and her answers to some of the questions, such as that she was passing more urine, the matron was alerted to the possibility that the patient may have a urinary tract infection. This proved to be the case and the patient is now taking antibiotics. - Dover

17. High blood pressure prompted the matron to suggest that the patient visited GP. He diagnosed an infection and gave her antibiotics and blood pressure pills. Someone from community matrons phoned to make sure she had visited GP. Beneficial effects of medication visible from measurements. The patient said this prevented another hospital admission. She also said that she has a protein C deficiency called thrombophilia, so catching raised BP very important as severe danger of stroke. In addition, while visiting the GP she mentioned to him that she was seeing flashing lights which she had thought was a symptom of high blood pressure, but which turned out to be something called Posterior Vitreous Detachment. - Thanet

18. I will chase up her BNP results which I understand you have requested and based on these she might require echo evaluation of heart function. I have also referred her to the Community Matron or assessment of TeleHealth monitoring at home, which is useful for severe COPD with anxiety attacks. GP - Shepway

19. I will ask the Respiratory Nurse to check his nebuliser as it does not seem to be working properly. I will also ask Community Matron team to assess him for TeleHealth monitoring at home, as this has shown to be extremely useful in early detection of exacerbation and preventing repeated hospitalisation. GP - Shepway

20. The Consultant has discharged the patient to the Community Matron team as she is being monitored so well with the assistance of TeleHealth. - Shepway

These are just a few of the quotes we have received. Other quotes from patients are included in the patient survey in Appendix 4.
Appendix 4

TeleHealth user satisfaction survey

TeleHealth Team

December 2006
Executive summary

The TeleHealth Team has conducted a telephone survey in order to measure the level of client satisfaction with regards to the service they have received and to identify potential clients for involvement in a TeleHealth Client Self Help Group. 110 clients were using TeleHealth at the commencement of the survey and over a three week period (29/11/06 – 20/12/06) feedback was successfully obtained from 86 (78%).

The TeleHealth Team’s client satisfaction ratings have been extremely positive (Fig 1), the highest rating (93%) being recorded for the delivery and installation of the equipment and the equipment tutorial. The lowest rating recorded was for the usefulness of the information booklet and user manual (58%). The general consensus from the clients was that they didn’t find them very useful because the equipment tutorial was of such a high quality that they had no need to read them, this is reflected in the tutorial satisfaction score of 93%.

![Fig 1](image)

Importantly 95% of those using TeleHealth thought that it had helped them manage their condition more effectively and 98% would recommend TeleHealth to others with similar conditions.

Although feedback as a whole has been extremely positive, the survey has identified some areas where service improvement may be possible with regards too; quality of the scales and other accessories, replacement batteries, out of hours calls and the usefulness of the literature.
Overview and background

Kent Adult Services directorate, recently awarded 3 stars for the fifth year in succession, has a deserved reputation for investment and innovation. The directorate is currently investing over £3m in the use of assistive technologies and £1m to pilot TeleHealth in particular.

The telehealth project is modelled on a similar scheme by the Puget Sound Veterans HealthCare Association, Seattle, Washington, USA and is at an early stage of development. There are over 100 patients currently enrolled in the pilot and we are rapidly moving towards the 250 mark. Patients taking part in the pilot are all over 18 and mostly elderly, they also suffer from one or more of the following ten conditions: chronic obstructive pulmonary disease; congestive heart failure; diabetes; depression; epilepsy; asthma; cancer; stroke; thyroid disorders; hypertension.

The aim of the Kent model of TeleHealth is to make a difference to the quality of peoples lives, improve their independence and empower them to self assess and monitor their own health condition. It offers the potential for people to self manage a wider range of social care interactions.

KCC is working collaboratively with stakeholder NHS health partners in the acute and primary trust sector to improve the life outcomes of a pilot group of people in Kent with chronic disease management requirements. The project is also continuing to engage new partners such as Age Concern, The Expert Patients Programme and other members of the community and Voluntary sector.

In order to assess and refine our quality of service, the TeleHealth Team has conducted a user satisfaction survey over a 3-week period, contacting 110 clients who have been using TeleHealth between 1 and 15 months.
1. Aims

To measure the level of client satisfaction with regards to the service they have received from the Kent County Council TeleHealth Team and to identify potential clients for involvement in a TeleHealth Client Self Help Group.

2. Objectives

- To contact all of the current participants in the TeleHealth pilot
- To record the opinions of all those on the pilot in regards to the quality of service they have received from the TeleHealth team
- To identify clients with an interest in learning more about managing their own condition(s)
- To identify clients who would be prepared to talk to others with similar conditions about participating in the TeleHealth pilot
- To acquire a range of feedback from those using TeleHealth monitors in order to gauge and, if necessary, improve our overall service delivery.

3. Methodology

- A questionnaire (Appendix A) was designed to be used as a tool to measure and record the level of client satisfaction as well as to identify potential clients to form a TeleHealth Client Self Help Group
- We wrote to all of our clients generally stating our objectives and that we would contact them within the next 14 days (Appendix B)
- The clients were surveyed by telephone over a three week period (29/11/06 – 20/12/06) and their opinions were directly recorded onto the questionnaires
- The questionnaires were filed to provide a hard copy record of the survey and the data recorded transferred into an electronic format
- Questions 1-5, 7 and 9 which relate directly to the team’s level of service, were measured using a scoring system of 0-4, 0 representing the lowest level of satisfaction and 4 the highest. The results for these individual questions were measured in number of respondents for each rating and displayed as bar charts in figs 4.2 – 4.6 & 4.9 – 4.1.1 and as a percentage figure of client satisfaction level in fig 4.1
- Questions 6 and 10 – 13 were recorded as percentages and displayed in a pie chart format (figs 4.7 & 4.1.2 – 4.1.5)
- Question 8 was recorded and displayed in as a chart (fig 4.9).
Questions 14 and 15, which were of a qualitative nature were recorded and displayed as a table (Q14) and as word for word quotations (Q15).

4. Results

110 clients were using TeleHealth at the commencement of the survey and feedback was successfully obtained from 86 (78%). Out of the remaining 24:

14 were too ill to talk, 5 were living with/married to someone else who had answered the survey and didn’t wish to participate also, 3 clients couldn’t be contacted within the three week period and 2 did not want to participate.

Graphical representations of results are as follows:

Rating of TeleHealth user satisfaction using overall percentage scoring.

Fig 4.1

<table>
<thead>
<tr>
<th></th>
<th>Scored Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Service</td>
<td>91.00%</td>
</tr>
<tr>
<td>Equipment Tutorial</td>
<td>93%</td>
</tr>
<tr>
<td>Delivery and Installation</td>
<td>93%</td>
</tr>
<tr>
<td>Quality and Useability of Equipment</td>
<td>85%</td>
</tr>
<tr>
<td>Usefulness of Literature</td>
<td>58.40%</td>
</tr>
<tr>
<td>Ease of Contacting Team</td>
<td>88%</td>
</tr>
<tr>
<td>Service from Contacting Team</td>
<td>89%</td>
</tr>
</tbody>
</table>

Scoring for Fig 4.1:

0% - 25% = very poor - poor
25% - 50% = poor - average
50% - 75% = average - good
75% - 100% = good - very good
Q1 How do you rate the overall service that you have received from the TeleHealth team?

Q2 How well did you think the team demonstrated/taught you how to use the equipment?
Q3 How happy were you with the delivery and installation of the equipment?

Fig 4.4

Q4 How happy were you with the quality and use-ability of the equipment?

Fig 4.5
Q5 How useful did you find the information booklet and user manual that were given to you at installation?

Fig 4.6

![Bar chart showing responses to Q5.]

Q6 Have you had to contact the TeleHealth Team for any reason since they first contacted you?

Fig 4.7

![Pie chart showing responses to Q6.]

51% No
49% Yes
Q7 If so, how easy did you find it to contact a member of the team?

Fig 4.8

Q8 If a member of the team was required to get back to you, then how quickly did they respond?

Fig 4.9
Q9 How well did you rate the service you received as a result of contacting the team?

Fig 4.1.1

Q10 Do you think that using the TeleHealth system has helped you manage your condition(s) more effectively?

Fig 4.1.2
**Q11 Would you recommend TeleHealth to others with similar conditions?**

Fig 4.1.3

- Yes: 98%
- No: 2%

**Q12 Would you be interested in learning more about managing your condition?**

Fig 4.1.4

- Yes: 43%
- No: 57%
Q13 Would you be prepared to talk to others with similar conditions about using the TeleHealth system?

Fig 4.1.5

Yes: 58%
No: 42%
Q14 Can you think of anything we can do to improve the delivery of our service?

30 clients put forward ideas on how we could improve our service:

<table>
<thead>
<tr>
<th>Suggestion</th>
<th>No. of clients</th>
<th>Proposed action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplying better quality scales. The present ones are not that user friendly and the feet tend to fall out.</td>
<td>3</td>
<td>A project officer to visit and demonstrate how to use the scales effectively. Feedback concerns to Viterion.</td>
</tr>
<tr>
<td>Improve the performance of the blood pressure monitor. It has a tendency to give out false readings and sometimes it can be difficult to get any reading at all.</td>
<td>2</td>
<td>Project officer to visit both clients to observe, retrain and replace if faulty.</td>
</tr>
<tr>
<td>More instruction is needed on the use of the camera and the graphs.</td>
<td>1</td>
<td>A tutorial from a PO to be arranged for the client.</td>
</tr>
<tr>
<td>More contact is needed from the TeleHealth team.</td>
<td>2 (married couple)</td>
<td>A project officer is to visit and discuss any issues.</td>
</tr>
<tr>
<td>Need to improve feedback. 2 messages in five weeks is not good enough.</td>
<td>1</td>
<td>Team to contact client’s Community Matron and clinician.</td>
</tr>
<tr>
<td>A thermometer should be supplied with the machine.</td>
<td>2</td>
<td>Review the feasibility of supplying thermometers with the equipment.</td>
</tr>
<tr>
<td>It would be nice to be able to communicate back through the machine.</td>
<td>4</td>
<td>To be discussed at next team meeting.</td>
</tr>
<tr>
<td>Someone in the TeleHealth Team available to answer the phone before 8am.</td>
<td>1</td>
<td>Investigate more efficient use of automated answering service.</td>
</tr>
<tr>
<td>Batteries should be supplied with the machine.</td>
<td>3</td>
<td>Review the feasibility of supplying clients with batteries.</td>
</tr>
<tr>
<td>Questions on the machine need to be more relevant to individual conditions.</td>
<td>2</td>
<td>Feedback to be passed on to Viterion and clinician.</td>
</tr>
<tr>
<td>A message alert tone in case there is an important message.</td>
<td>1</td>
<td>Feedback to be passed on to Viterion.</td>
</tr>
<tr>
<td>Still waiting on a peak flow attachment.</td>
<td>1</td>
<td>Project officer to check with matron and if needed deliver peak flow attachment.</td>
</tr>
<tr>
<td>The blood sugar monitor needs a hypo alarm.</td>
<td>1</td>
<td>Feedback to be passed on to Viterion.</td>
</tr>
<tr>
<td>A stethoscope should be supplied.</td>
<td>1</td>
<td>Inform client why we do not endorse the use of stethoscopes.</td>
</tr>
<tr>
<td>Suggestion</td>
<td>No. of Clients</td>
<td>Proposed action</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>----------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Digital transmission would be better. Dial up is noisy.</td>
<td>1</td>
<td>Review the feasibility of using digital transmission.</td>
</tr>
<tr>
<td>The wires at the back of the machine need to be tidier.</td>
<td>1</td>
<td>A visit to be arranged by Tech Services.</td>
</tr>
<tr>
<td>Would like to be able to use the video conferencing facility.</td>
<td>1</td>
<td>Tech support and the clients clinician have been contacted and this service is being arranged.</td>
</tr>
<tr>
<td>Would like to be able to clear old messages off the screen.</td>
<td>1</td>
<td>Feedback to be passed on to Viterion.</td>
</tr>
</tbody>
</table>
Q15 Are there any further comments you would like to make?

41 of the 86 (47.6%) clients surveyed wished to add a further comment, feedback was as follows:

- “The service is excellent”
- “I’m very very pleased”
- “TeleHealth has been very, very helpful”
- “I’m very happy with the machine and it has helped me reduce the dosage of my medicine”
- “I was very pleased when the machine wished me happy birthday”
- “I’m very grateful that someone like Kent County Council is prepared to take the time to take care of me”
- “I woke up recently with a burst blood vessel in my eye and was very worried as I had recently had a stroke. I used the web cam facility to take a photograph of my eye and sent it through the machine to my Doctor. It was very reassuring when the Doctor rang back to say everything was ok and I had nothing to worry about”
- “I’m really, really happy with the service”
- “I think you should pay for my batteries”
- “I’m very pleased and hope to keep the machine for a long time to come”
- “The Community Matrons are fantastic”
- “The service is excellent”
- “The nurse helping me with the machine has been superb and a tremendous help”
- “I wasn’t told that I had to pay for my batteries and I’m not happy about this”
- “A very handy machine and I’m very satisfied”
- “Everybody has been pleasant respectful and polite. They should be given a medal because they make you feel so at ease and give you time to let it all sink in- which is not common these days”
- “Sometimes the blood pressure does not read correctly and this can be scary”
- “The machine is very easy to use and the Community Matron gets onto me straight away if there is a problem”
Promoting and Sustaining Independence in a Community Setting

• “It’s a very good system”

• “I find the machine very easy to use and I am very pleased”

• “The machine is helping to keep me at home and out of hospital - I am very pleased about this”

• “The service has been first class”

• “Len Valley Surgery has not been in touch since Janine came”

• “It’s a wonderful invention that should be more widespread”

• “I’m really, really happy and it’s a very good service”

• “Before using TeleHealth I was suffering from panic attacks now they are gone”

• “The machine in combination with the matrons has really picked me up”

• “TeleHealth has made life much easier with much less trips to the surgery”

• “It’s a boost knowing that the nurse knows how I am every day”

• “It’s good service and has saved the nurses having to come around and see me every five minutes”

• “The machine saved my life. The matron picked up a deterioration in my condition immediately and I was rushed to hospital for life saving surgery”

• “I’ve been ill for five years and in that time I’ve spent eight months in hospital. Since I’ve been on Telehealth my time spent in hospital has dramatically decreased. Some times I wouldn’t see a nurse for weeks and my condition would be drastically deteriorating without me knowing. Now a nurse sees my readings everyday- it has been a life saver.”

• “I wouldn’t want to be without my TeleHealth machine”

• “It’s an excellent idea”

• “I’m really pleased to have TeleHealth. It felt like we were on our own before. Combined with the Community Matrons it has given us a lot of confidence as before it felt like the Doctors had just given up on us”

• “I’m very pleased with it. It’s a marvellous thing that is easy to work and makes me feel safer and more confident”

• “It’s absolutely brilliant and you couldn’t find any better or nicer and charming people that make you feel human again.”
"Very useful and I find it very satisfactory that there is someone else at the other end monitoring my problems and making me feel safe”

“I’m very happy, much happier than before I had it”

“TeleHealth has helped me save money by not having to pay to travel back and forth to the surgery.

“I find it a fantastic reassurance and I’m not so concerned about having to make Doctors appointments weeks ahead.”

5 Conclusion

The TeleHealth team’s client satisfaction ratings have been extremely positive, the highest rating (93%) being recorded for the delivery and installation of the equipment and the equipment tutorial. The lowest rating recorded was for the usefulness of the information booklet and user manual (58%). The general consensus from the clients was that they didn’t find them very useful because the equipment tutorial was of such a high quality that they had no need to read them, this is reflected in the tutorial satisfaction score of 93%.

The average total satisfaction rating for the whole survey was 85% however when the score for the usefulness of the literature is removed from the calculation this rises to 90%. Questions 1-3, 7 and 9 that most closely reflect the level of service provided by the team members generate a satisfaction rating of 91%.

49% of TeleHealth users have had to contact the team at some point after installation and out of these 93% found it either “very easy” or “easy” to contact a member of the team. When a return call was needed, in 75% of cases this was made on the same day and in 80% of cases this was made within two days. 95% of clients rated the service they received as a result of contacting the team to have been “good” or “very good”.

Importantly 95% of those using TeleHealth thought that it had helped them manage their condition more effectively and 98% would recommend TeleHealth to others with similar conditions. Initial feedback suggests that the discrepancy between these figures is due to a few clients that believe that their condition is not severe enough to warrant being on TeleHealth (although this is not supported by professional medical opinion) but would recommend it to others who were older/worse health than themselves.

58% of clients would be prepared to talk to others with similar conditions about using the TeleHealth system and 43% would be interested in learning more about managing their own condition. The TeleHealth Team will contact some of the clients in this group with the intention of setting up a TeleHealth Self Support Group.

30 clients put forward suggestions on how we could improve our service, the most common suggestions being that it should be possible to use TeleHealth for two way communication, accessories such as
batteries and thermometers should be provided and that the scales need to be of a better quality. Out of the 41 clients that wished to add further comments, 37 could be considered positive and four negative.

In conclusion, although feedback as a whole has been extremely positive this survey has identified some areas where service improvements can be made. Therefore it is recommended that:

- The team feedback to Viterion with regards to the quality and usability of the scales, the relevancy of the questions, the advantages of a message alert tone, the ability to clear old messages off the screen and the supplying of blood sugar monitors with hypo alarms

- The TeleHealth Team reviews the feasibility of supplying replacement batteries with the equipment

- A call logging procedure is put into place for outside of office hours

- A review is carried out of the literature to investigate the possibility of making it more generically useful

- Investigate the feasibility of setting up a TeleHealth Self Help Group in association with the NHS’s Expert Patient Programme.
### Appendix 4a: Copy of the survey used

Client satisfaction survey

**Client Name____________**

1. How do you rate the overall service that you have received from the TeleHealth team?
   - V Poor
   - Poor
   - Average
   - Good
   - V Good

2. How well did you think the team demonstrated/taught you how to use the equipment?
   - V Poor
   - Poor
   - Average
   - Good
   - V Good

3. How happy were you with the delivery and installation of the equipment?
   - V Unhappy
   - Unhappy
   - Neither
   - Happy
   - V Happy

4. How happy are you with the quality and use-ability of the equipment?
   - V Unhappy
   - Unhappy
   - Neither
   - Happy
   - V Happy

5. How useful did you find the information booklet and user manual that was given to you at installation?
   - No use
   - Not very
   - Average
   - Useful
   - V Useful

6. Have you had to contact the TeleHealth team for any reason since they first contacted you?
   - Yes
   - No

7. If so, how easy did you find it to contact a member of the team?
   - Couldn’t Contact
   - Difficult
   - About Average
   - Easy
   - V Easy

8. If a member of the team was required to get back to you, then how quickly did they respond?
   - V Poor
   - Poor
   - Average
   - Good
   - V Good
9 How well did you rate the service you received as a result of contacting the team?

<table>
<thead>
<tr>
<th>V Poor</th>
<th>Poor</th>
<th>Average</th>
<th>Good</th>
<th>V Good</th>
</tr>
</thead>
</table>

10 Do you think that using the TeleHealth system has helped you manage your condition(s) effectively?

Yes | No

11 Would you recommend TeleHealth to others with similar conditions?

Yes | No

12 Would you be interested in learning more about managing your condition?

Yes | No

13 Would you be prepared to talk to others with similar conditions about using the TeleHealth system?

Yes | No

14 Can you think of anything we can do to improve the delivery of our service?

_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

15 Are there any further comments you would like to make?
Appendix 4b: Client contact letter

Kent TeleHealth Pilot.

The TeleHealth Team aims to provide the very highest levels of service to its clients at all times. One of the ways in which we do this is by seeking feedback from you on what you think of our performance. Talking to you about what you think of our services is helpful to us with regards to improving our service to you. The best way to do this is to talk to you over the phone. It is for this reason that I will be telephoning you within the next couple of weeks to ask you a few short questions on how you regard the quality of our service. It won’t take long and you are welcome to have someone there to listen in with you. I will also be giving you the opportunity to put forward any points of view or ideas that you may have. I will call during sociable hours between 10am and 5-30pm and if it is not convenient I will be more than happy to call back, there is also no obligation on your behalf to take part.

However if you do not want me to call or have any questions, do not hesitate to contact me on YY.

Yours sincerely

TeleHealth team
Appendix 5

Extrapolation of study costs to Kent population

In this section we report the results of an economic modeling exercise in which costs associated with the study sample are extrapolated to the wider populations of east and west Kent and the county of Kent as a whole.

A number of caveats need to be considered in the interpretation of this data. Firstly the data is based upon a quasi-experimental study and while some evidence of effectiveness exists, particularly in reductions of length of stay, the reliability of estimates is compromised through the experimental design in that potential confounding or biasing factors are not adequately controlled for. Secondly the availability of data limits the number of factors including in the model. Three sources of data are incorporated in the modeling exercise; the results of the study for the sample where adequate economic indicators could be ascertained, an extrapolation using aggregate Hospital Episode Statistics of emergency admissions for CHD, COPD and Diabetes over the period and details of patients with chronic conditions maintained on Quality Outcome Framework (QOF) registers in general practices across Kent at the time of the study. Each of these involves a loss of accuracy and impact upon the reliability of the results.

An appropriate analytical strategy to increase the precision of estimates would involve a difference in differences analysis (Bertrand et al 2004). This approach utilises individual patient level hospital activity data to extrapolate small area locality changes and model these changes over increasing geographic areas. Allied to this the approach uses different categories, both temporal and geographic, to adjust for potential confounding factors and implements propensity score analysis to create a variety of matched-controlled populations to adjust for changes observed on a micro and macro-level. This enables a more accurate and reliable estimate of the costs associated with an intervention and allows greater precision in estimation. The data required for this analytical approach was not available for the analysis conducted.

The approach taken is to provide estimates based upon the available information while maximising the value of information gathered as part of the original study. The first element of the analysis using aggregate HES data is to estimate the impact of telehealth on a population of patients across Kent who are hypothesised to have an unstable chronic condition that results in an emergency admission. Patients with an emergency admission with a primary diagnosis of CHD, COPD or Diabetes over the year 2006 – 2007, resident in Kent were derived from Hospital Episode Statistics. These are detailed in Table 21. These admissions indicate that more episodes are observed for CHD than either COPD or diabetes and that these are similar across east and west Kent.

Table 21: Emergency admission episodes by condition 2006/07

<table>
<thead>
<tr>
<th></th>
<th>CHD</th>
<th>Diabetes</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>2399</td>
<td>341</td>
<td>1454</td>
</tr>
<tr>
<td>East Kent</td>
<td>2221</td>
<td>315</td>
<td>999</td>
</tr>
<tr>
<td>All Kent</td>
<td>4620</td>
<td>656</td>
<td>2453</td>
</tr>
</tbody>
</table>
An episode is defined as a complete period of care. As the intervention is patient based we need to consider the numbers of patients admitted rather than the number of admissions. Table 22 indicates the number of patients experiencing an emergency admission over the period.

Table 22: Emergency admissions for patients by condition 2006/07

<table>
<thead>
<tr>
<th>Condition</th>
<th>CHD</th>
<th>Diabetes</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>2041</td>
<td>271</td>
<td>1029</td>
</tr>
<tr>
<td>East Kent</td>
<td>1803</td>
<td>232</td>
<td>723</td>
</tr>
<tr>
<td>All Kent</td>
<td>3844</td>
<td>503</td>
<td>1752</td>
</tr>
</tbody>
</table>

The next step in the analysis is to look at the Quality Outcome Framework (QOF) registers for the period for each of the chronic conditions, table 23. These registers indicate the numbers of patients with each of the three conditions registered with general practices in the region.

Table 23: QOF Registers across Kent by condition 2006/07

<table>
<thead>
<tr>
<th>Condition</th>
<th>CHD</th>
<th>Diabetes</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>26960</td>
<td>31182</td>
<td>12424</td>
</tr>
<tr>
<td>East Kent</td>
<td>20897</td>
<td>24666</td>
<td>8720</td>
</tr>
<tr>
<td>All Kent</td>
<td>47857</td>
<td>55848</td>
<td>21044</td>
</tr>
</tbody>
</table>

Table 24 indicates the percentage of patients on QOF registers who experienced an emergency admission in the period. It can be seen that the percentage of CHD and COPD patients is similar at 8% and the percentage of diabetes patients is about one-tenth of that observed for COPD and CHD. Differences are also observed for east and west Kent across conditions with patients in east Kent more likely to be admitted than those in west Kent.

Table 24: Percentage of QOF register experiencing an emergency admission 2006/07

<table>
<thead>
<tr>
<th>Condition</th>
<th>CHD</th>
<th>Diabetes</th>
<th>COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>7.57</td>
<td>0.87</td>
<td>8.27</td>
</tr>
<tr>
<td>East Kent</td>
<td>8.62</td>
<td>0.94</td>
<td>8.37</td>
</tr>
<tr>
<td>All Kent</td>
<td>8.03</td>
<td>0.90</td>
<td>8.32</td>
</tr>
</tbody>
</table>
The telehealth intervention has the patient as the unit of analysis rather than the condition. As a patient may be listed more than once on the QOF register and in the re-admission statistics if they have more than one chronic condition, we adjust the patient re-admissions by a figure to account for multiple chronic conditions. Table 25 indicates the numbers of patients admitted across conditions accounting for any co-morbidities.

**Table 25: Adjusted number of eligible patient admissions to account for multiple co-morbidities**

<table>
<thead>
<tr>
<th>Region</th>
<th>Adjusted Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>2205</td>
</tr>
<tr>
<td>East Kent</td>
<td>1820</td>
</tr>
<tr>
<td>All Kent</td>
<td>4025</td>
</tr>
</tbody>
</table>

In this analysis we hypothesise that those most eligible and most likely to benefit from telehealth care are those who experience an emergency admission during the period. This is seen as a surrogate marker of stability. Using this hypothesis and the economic data generated in the trial we estimate that if telehealth was provided across Kent to all of those eligible over 2006/07 then the cost savings would be of the order of £7,560,000 excluding costs associated with infrastructure and £7,480,000 if we include the costs associated with the infrastructure. Infrastructure costs include the provision of facilities to monitor telehealth and the costs of the monitoring equipment. As the extrapolation covers a greater population than the study from which the base figures are derived economies of scale in actual costs have been incorporated. In order to estimate the reliability of these estimates we employed a bootstrapping technique to manage the variability in the estimates. These provide a range of possible values where we are 95% confident the true estimate lies. Including the infrastructure costs this confidence ranges from a cost saving of £9,345,000 to a cost saving of £3,840,000. Excluding any infrastructure cost the range is a cost saving of £10,942,000 to a cost saving of £4,180,000.

**Table 26: Mean health care costs (savings) over six months for all emergency admissions over a 12 month period in 2006/07 by region in £ 000**

<table>
<thead>
<tr>
<th>Region</th>
<th>Excluding infrastructure</th>
<th>Including infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>4142</td>
<td>4098</td>
</tr>
<tr>
<td>East Kent</td>
<td>3418</td>
<td>3382</td>
</tr>
<tr>
<td>All Kent</td>
<td>7560</td>
<td>7480</td>
</tr>
</tbody>
</table>

A second approach to analysing the available data involves creating a variety of potential scenarios whereby assumptions regarding the proportion of patients on QOF registers can be combined with
assumptions regarding the variability in observed effect. Table 27 provides an estimate of actual patients on QOF registers accounting for potential co-morbidities. Table 28 incorporates these figures to provide a contingency table exploring the relationship between QOF register coverage and potential effect where infrastructure costs are not included.

Table 27: Adjusted number of eligible patients on QOF register to account for multiple co-morbidities

<table>
<thead>
<tr>
<th>Region</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Kent</td>
<td>42340</td>
</tr>
<tr>
<td>East Kent</td>
<td>32567</td>
</tr>
<tr>
<td>All Kent</td>
<td>74907</td>
</tr>
</tbody>
</table>
Table 28: Cost comparison comparing QOF proportion eligible and estimated effect for Kent.

<table>
<thead>
<tr>
<th>Percent of QOF Patients eligible</th>
<th>Estimated effect (Costs in £1000's)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1407 1266 1125 984 844 703 562 422 281 140</td>
</tr>
<tr>
<td>90</td>
<td>12639 113975 101311 88647 75983 63319 50655 37991 25327 12663</td>
</tr>
<tr>
<td>80</td>
<td>112568 101311 90054 78797 67541 56284 45027 33770 22513 11256</td>
</tr>
<tr>
<td>70</td>
<td>98497 88647 78797 68948 59098 49248 39398 29549 19699 9849</td>
</tr>
<tr>
<td>60</td>
<td>84426 75983 67541 59098 50655 42213 33770 25327 16885 8442</td>
</tr>
<tr>
<td>50</td>
<td>70355 63319 56284 49248 42213 35177 28142 21106 14071 7035</td>
</tr>
<tr>
<td>40</td>
<td>56284 50655 45027 39398 33770 28142 22513 16885 11256 5628</td>
</tr>
<tr>
<td>30</td>
<td>42213 37991 33770 29549 25327 21106 16885 12663 8442 4221</td>
</tr>
<tr>
<td>25</td>
<td>35177 31659 28142 24624 21106 17588 14071 10553 7035 3517</td>
</tr>
<tr>
<td>20</td>
<td>28142 25327 22513 19699 16885 14071 11256 8442 5628 2814</td>
</tr>
<tr>
<td>15</td>
<td>21106 18995 16885 14774 12663 10553 8442 6331 4221 2110</td>
</tr>
<tr>
<td>10</td>
<td>14071 12663 11256 9849 8442 7035 5628 4221 2814 1407</td>
</tr>
<tr>
<td>5</td>
<td>7035 6331 5628 4924 4221 3517 2814 2110 1407 703</td>
</tr>
<tr>
<td>2</td>
<td>2814 2532 2251 1969 1688 1407 1125 844 562 281</td>
</tr>
<tr>
<td>1</td>
<td>1407 1266 1125 984 844 703 562 422 281 140</td>
</tr>
</tbody>
</table>
In order to interpret table 28 we need to consider first the potential numbers of patients on the QOF registers who may be eligible for telehealth and second we need to consider what we consider to be a reasonable estimate of the effect. As the proportion of patients on the QOF register increases it would be reasonable to assume that the estimated effect would decrease. The decrease in effect would in part be due to the inclusion of a less severe population therefore less likely to benefit. So, for example, inclusion of 10% of the QOF register may have an economic saving that ranges between £14,071,000 and £1,407,000. Table 28 should be seen as a set of potential scenarios for consideration and serious consideration needs to be made of work-force factors and infrastructure support in any interpretation, it provides a set of guidelines for consideration in the planning process.

The economic modeling has been based upon the available information but care needs to be taken in the interpretation. The original study was a quasi-experimental study based upon a small sample of patients for whom full economic data was available. In addition, the study only measures health care resource use and does not account for any use of social care resources.
Appendix 6: Bibliography


Carrier, J. (2009) Managing Long Term Conditions and Chronic Illness in Primary Care Abingdon; Routledge


Department of Health (2002) Securing our Future Health; Taking a long term view (Wanless report) London; HMSO

Department of Health (2004a) Improving Chronic Disease Management London: HMSO

Department of Health (2004b) Chronic Disease Management: A compendium of information London: HMSO

Department of Health (2004c) The NHS Improvement Plan: Putting People at the Heart of Public Services London: HMSO


Department of Health (2005a) Supporting people With Long-Term Conditions: An NHS and Social Care Model to Support Local Innovation and Integration London: HMSO

Department of Health (2005b) Supporting people with long term conditions: Liberating the talents of nurses who care for people with long term conditions London: HMSO

Department of Health (2005c) How a Community Matron can help you with your long term condition London: HMSO


Department of Health (2005i) *Case management competences framework for the care of people with long term conditions* London: HMSO

Department of Health (2006a) *Our health, our care, our say: A new direction for community services* Cm; 6737 London: HMSO

Department of Health (2006b) *Supporting self care - a practical option: Diagnostic, monitoring and assistive tools, devices, technologies and equipment to support self care* London: HMSO


Department of Health (2008a) *Raising the Profile of Long Term Conditions Care-A compendium of Information* London: HMSO


Department of Health (2008c) *Ten things you need to know about long term conditions* Available at webarchive.nationalarchives.gov.uk/+/www.dh.gov.uk/en/Healthcare/Longtermconditions/DH_084294 First accessed on 29.01.10


Department of Health (2010a) *Improving the health and well-being of people with long term conditions. World class services for people with long term conditions: information tool for commissioners* London: HMSO


Promoting and Sustaining Independence in a Community Setting


Kings Fund (2007) Improving care for long term conditions - a reading list London: Kings Fund


NHSMA & SfH (2005) Community Matron Competency Framework - no named publisher


PCNRU, (2005) Primary Care Nursing Research Unit, et al. Supporting experienced hospital nurses to move into community matron roles. London :


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Promoting and Sustaining Independence in a Community Setting


