TELEmetric supported Self-monitoring of long-term COndiTions

The impact of a telemetric blood pressure monitoring service in people who have had stroke/TIA. Randomised controlled feasibility study

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Tele-health programme

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1. Introduction

1.1 Self-monitoring in long term conditions

Long-term conditions are a major healthcare challenge.[1] As the population ages more people are living with long-term conditions rendering the current, clinician-centred models of management unsustainable in the longer-term.[2] NHS policy increasingly encourages people to self-manage their condition with additional professional support for those at greatest risk.[3] Systematic reviews indicate that engaging patients in self-monitoring and management can improve clinical outcomes in asthma[4] but the evidence that self-monitoring alone is beneficial in hypertension[5] and other chronic conditions including diabetes[6] is equivocal. This may be because adherence to both lifestyle advice and prescribed medication for these groups is poor generally [7] but also because feedback from clinicians is often infrequent, potentially adding to patient anxiety in the presence of abnormal self-monitored readings.[8]

Monitoring is, in itself, an intervention which alters behaviour. The theoretical model developed by Glasziou et al. describes the complementary and evolving roles of periodic professional support and on-going patient self-monitoring.[9] This approach resonates with two key health service policies: the drive for technological solutions to healthcare problems [10]; and the importance of expert patients and self-management of long-term conditions[11,12] While some evidence can be gleaned from international research into telemetric solutions for chronic disease management and the encouraging results from UK and international pilot studies[13-17], there is little research into the cost-effectiveness of telehealthcare interventions[18] and there remains a pressing need to evaluate rigorously such interventions in a UK NHS setting.

Effective interventions need to reflect patients' needs, enable professionals to adapt their working practices and address organisational infrastructure. Telemetric systems enabling patient self-monitoring and relay of information to clinicians can potentially improve integration between self-management and professional support, as well as facilitate intensive monitoring and aggressive intervention when needed.

The service model to be tested is shown in Appendix 16.1. The systems can work on a range of technology platforms and with multiple measuring devices, facilitating seamless care for patients with several co-morbidities. The Telescot research programme focuses on four disease areas which account for much long-term morbidity in the population, a high proportion of consultations in primary care and are major causes of hospitalisation, namely: chronic obstructive pulmonary disease (COPD); hypertension; blood pressure reduction after stroke/transient ischaemic attack (TIA); diabetes and obesity.

1.2 The Telescot research programme

Our programme of work sits within the MRC framework for the development and evaluation of complex interventions.[19] Building on existing literature[13;20;21,] and in an iterative process using insights from completed and on-going exploratory and pilot work[22], we have designed Phase II & III randomised controlled trials using a suggested framework for complex interventions.[23] These will evaluate how telemetry aided, supervised self-monitoring affects the management of long-term conditions in four different contexts (largely asymptomatic conditions using the example of hypertension; symptomatic, potentially unstable and progressive conditions using the example of COPD; an older, more disabled group with challenging management targets using the example of hypertension among stroke/TIA survivors; co-morbid conditions using the example of diabetes, hypertension and weight management). Each will incorporate qualitative and quantitative process evaluations, which are increasingly recognised as being critical to the subsequent implementation. [24, 25]

The following will be performed for each condition:

A randomised controlled trial to evaluate the clinical effectiveness of telemetrically supported self-monitoring (a randomised controlled feasibility study in stroke / TIA).

A qualitative study to improve understanding of the impact of telehealthcare interventions on patients, carers and healthcare professionals, and to explore the facilitative factors and barriers to implementation in patients and practices.

Health economic analysis from the perspective of both the NHS and the patient, to provide the evidence on cost-effectiveness and to inform the role of telehealthcare in the NHS.

1.3 The trial of tele-monitoring in people who have had a stroke / TIA

Stroke is the second most common cause of death in the world next to ischaemic heart disease. Around 9% of all deaths are caused by stroke.[26] Annually, around 8,500 Scots suffer a first stroke, of whom 75% are over 65 years[27] with an estimated absolute increase of 30% in people experiencing a first stroke in 2010 compared with the early 1980s.[28] Including first and recurrent stroke, the annual incidence in Scotland is approximately 13,000[29]. Increased blood pressure is the most important reversible risk factor for first or recurrent stroke, with risk increasing by about one third for every 10mmHg increase in systolic blood pressure. Patients with a previous stroke or TIA are at particularly high risk of subsequent stroke, mitigated by long term reduction in blood pressure.[30.31]. Research evidence suggests that the greater the reduction in blood pressure, the greater the benefit, at least down to about 130/70mmHg, but few achieve this challenging target [32] There is some evidence that self-monitoring may help people improve their blood pressure control [33] although this is not a consistent finding.[34] However, the qualitative arm of the HITS randomised controlled trial (ISRCTN72614272, full protocol available at www.telescot.org) suggested that telemetry enhanced the impact of home monitoring by providing almost real time sharing of the individual's blood pressure status between patients and their health care providers, making it difficult for either of them to ignore the readings. This protocol describes a trial specifically in stroke/TIA patients with suboptimal blood pressure control, comparing telemetrically supported self-monitoring of blood pressure with normal care in general practice.

Why is a separate trial needed for this patient group? People who had previous stroke / TIA were excluded from the HITS trial because they are an important sub group of the hypertensive population, with a lower blood pressure target, in whom effects of telemetric monitoring may differ and so be masked by inclusion in the wider trial. Clinical experience within the team suggests that people who have had a stroke/TIA tend to be more motivated in the management of vascular risk factors (including blood pressure) and may perceive that they have a great deal to gain from telemetry enabled home monitoring. A small pilot study published by a team from St Georges Hospital [35] suggests that elderly stroke patients can accurately self monitor their blood pressure, but it was not clear how representative the subjects were of stroke patients in the community. However, the additional telemetry equipment (a mobile phone or modem) increases the complexity, possibly making it potentially less acceptable and/or more difficult to manage for people with disabilities and in some cases may increase the burden on carers. In addition, increased anxiety as a result of home monitoring, which we have identified in a small number of patients in the nested qualitative section of the HITS trial, may be an issue in this group. Moreover, some doctors and nurses had concerns about the potential risks of increasing medication, for example hypotension and falls, and in some cases both healthcare professionals and patients were unwilling to increase medication to reach the target. This may become a greater issue for stroke/TIA patients whose increased age, higher level of disability and lower blood pressure target may make them more vulnerable to adverse effects of increasing medication. Thus a trial is needed to establish whether or not this technology is of net benefit to these patients.

Why is a pilot trial needed? In order to design a trial which can be run effectively we need to know more about the group of post-stroke / TIA patients who are likely to be willing or able to participate. Overall we expect this group to be older and more disabled than the participants in the HITS trial. The mean age of patients recruited from hospital after recent stroke to take part in the St Georges home monitoring trial [35] was 73 years compared with 61 years for those taking part in the HITS trial. It is not known to what extent this older group and their carers will be willing to try out such technologies or to be randomised in a trial. Nor do we know the level of disability in people identified through stroke registers in general practice. In addition, 31% of the patients who were screened for the HITS trial had blood pressure within normal limits on ambulatory monitoring. We do not know how well controlled stroke patients' blood pressures are when checked by daytime ambulatory monitoring. A large study of the use of an angiotensin receptor blocker to reduce recurrent stroke found recurrent stroke rates to be lower than projected with no difference between the intervention and control groups and the researchers concluded that this was because subjects' blood pressure was generally well controlled and there was little scope for improvement[36]. Thus a pilot trial is needed to

determine the feasibility and design of a large-scale trial of telemetrically supported home blood pressure monitoring in this patient group.

2 Aims

The aim is both to test the feasibility of implementation and possibly refine the intervention as well as to inform the conduct of a randomised controlled trial in a cohort of patients drawn from general practice stroke / TIA registers whose BP as documented in their GP records is currently sub optimally controlled.

3 Research Questions for feasibility trial

3.1 What is the participation rate in the pilot trial?

3.1.1 What is the response rate to patient information?

3.1.2 How disabled are those who respond, and how does this affect their ability to use the equipment?

3.1.3 What proportion of those willing to be randomised already have optimally controlled blood pressure on daytime ambulatory monitoring?

3.1.4 Are the proposed recruitment and randomisation procedures appropriate for this patient group?

3.2 What is the level of compliance with the intervention amongst people recruited to the trial?

3.2.1 What proportion of those in the active arm

- Provide regular readings (at least weekly) without help
- Provide regular readings (at least weekly) with help
- Provide less regular readings or stop using the equipment

3.3 What is the variation in the proposed outcome measures for the large-scale trial (see section 4)?

3.4 What are the experiences and opinions of people who have had a stroke / TIA of this service (including impact on behaviour, mood, positive and negative experiences and change in relationship with their healthcare provider)?

3.5 What are healthcare providers' experiences and opinions of this service?

3.6 How might the intervention be improved to meet the specific needs of people with TIA / stroke?

Questions, 3.1 and 3.2 and 3.3 by the pilot trial and questions 3.4, 3.5 and 3.6 will be answered by the qualitative study.

4 Proposed Outcome Measures for the full trial

4.1 Primary Outcome measure

Difference in mean daytime systolic blood pressure measured by ABPM between intervention and control groups at 6 months.

4.2 Secondary outcome measures

Physiological

- Difference in mean diastolic blood pressure measured by ABPM between intervention and control groups at 6 months
- Difference in surgery measured systolic and diastolic blood pressures at 6 months

Cost-effectiveness

- Resource use: number of attendances at practice nurse, GP, A&E and out-of-hours care number of telephone/email contacts with practice nurses/GPs (taken from GP

practice records), days in hospital during the six months in the study, prescriptions for anti-hypertensives.

- Quality Adjusted Life Years (QALYs)

Self-efficacy/enablement

- EQ-5D [37]
- Stroke Impact Scale 3.0 [38]
- Hospital Anxiety and Depression Score [39]
- Modified Rankin Scale [40]

Engagement with process

- Compliance with monitoring and self-management will be assessed using the electronic monitoring record.
- Need for help with using the equipment (short questionnaire devised for the study)

Adverse events

- All adverse events will be recorded, but specifically we will note falls, dizzy spells, postural hypotension. Adverse events will be assessed by the Telescot Programme Manager (Prof Brian McKinstry- a general practitioner) for seriousness. Only SUSARS will be subject to expedited reporting

5 Methods

Original section 5.1 “Initial Qualitative Study” removed completely

5.1 Pilot Randomised controlled trial

5.1.1 Trial design

Researcher blinded randomised controlled feasibility study

5.1.2 Setting

All the research will be carried out in Lothian in approximately five socio-economically diverse general practices.

5.1.3 Participants

5.1.3.1 Inclusion:

Patients over 18 years of age in around five GP practices with a history of stroke/TIA, whose most recent office measurement and subsequent daytime average ambulatory systolic blood pressures both exceed 130 mmHg.

5.1.3.2 Exclusion:

Secondary hypertension; hypertension being managed in secondary care, surgery measured blood pressure of ≤120/60 mmHg or ≥220mmHg systolic at baseline research visit, terminal illness or major concurrent illness where treatment is likely to affect the ability to self-monitor, stroke within the last 3 months major surgery within the last 3 months; unable to consent; unable to use self-monitoring equipment alone with no easy access to help, atrial fibrillation.

5.1.4 Sample structure and sample size

The sample size will be 56 patients, randomised in a 3:1 ratio with 42 in the active treatment arm and 14 in the control arm. This ratio will maximise the amount of data available from which to assess compliance with the active treatment. If 6/42 (14.3%) were found to be in an outcome group of interest, this would give a confidence interval around the estimate of 6.7% to 27.8%. We feel that this is a tight enough confidence interval to be informative for the design of the large-scale trial. In a previous randomised trial on blood pressure management in the same geographical area, loss to follow-up was 11%.

5.1 5 Recruitment

We will recruit five socioeconomically diverse practices using the South East node of the Scottish Primary Care Research Network. Training in using the telemonitoring equipment for the practices will be provided by the researchers.

We anticipate a target recruitment rate of five patients a week over 12 weeks. We plan to recruit around 11 to 12 patients from each practice (n=56). This will give around 8 to 9 patients using the system in each practice which is probably the minimum required for practices to see this as an additional service. Small practices unlikely to recruit this number of patients may also be included if they are also using the system for other patients (e.g. diabetes patients). Potentially eligible patients will be identified from practice computer records. GPs will send these patients a letter outlining the study and inviting them to express an interest via an interest reply slip. For stroke patients this correspondence will include the patient information letter in regular format, stroke adapted format and in audio CD format. Stroke patients who are known to be compromised in a way that would impede their engagement with this process will be contacted by a member of the practice staff to ensure that they have received the information in an accessible format and that they are able to respond and return the reply slip if interested. Patients expressing an interest will be contacted by the researcher who will arrange an appointment to see them at the practice (or at home if necessary) and an explanation of the intervention will be given.

5.1.6 Confirmation of eligibility and consent

Following an explanation of the intervention, the equipment will be demonstrated and the patient will be given the opportunity to consider if they will be able to use it, will be able to get help to use it if necessary, or will be unable to use the equipment. The researcher will obtain informed consent from patients who are willing and able to participate in the trial.

Consenting patients will have BP measured electronically three times (a mean of the second and third will be calculated) in line with usual monitoring practice, and daytime ambulatory monitoring using a Spacelabs 902 monitor initiated. In the unlikely event that surgery measured blood pressure is ≤120**/60 mmHg** or ≥220mmHg systolic, the patient will not be eligible for randomisation.

5.1.7 Randomisation

On return of the ambulatory monitoring equipment, patients whose average daytime ambulatory systolic blood pressure exceeds 130mmHg will be asked to complete a number of questionnaires as baseline measurements including Hospital Anxiety and Depression Score (HADS), EQ 5D and Stroke Impact Scale for Disability. Patients will be assessed using the Modified Rankin Scale and with regard to level of help that may be required from a carer in the use of the equipment. They will be randomised using a remote system provided by Edinburgh Clinical Trials Unit (accessible by telephone if necessary) and blindly allocated to telemetric-supported self-monitoring or usual care. An equal number of TIA and stroke patients will be randomised to the trial. As this is a pilot trial and ability to use the system is an essential component of the feasibility, allocation will be 3:1 in favour of the intervention group stratified by stroke / TIA.

The patient will be informed about the arm of the trial to which they have been assigned and given appropriate information. All patients will be provided with an information pack on lifestyle measures to reduce blood pressure to ensure that outcomes are not inadvertently influenced by unequal provision of information resources. Intervention patients will be taught how to use the equipment (their electronic record will have been previously set up and will be removed if they are allocated to the control group). Given that the guidance from NICE which is currently out for consultation is for diagnosis of hypertension to be based on daytime ambulatory monitoring and subsequent management based on office monitoring, both measurements will be reported to the patient's GP practice via a local protocol.

5.1.8 Initial optimisation of care and self-management education

Throughout the trial, patients will be reviewed according to clinical need by their usual clinical advisors. In addition, patients will be encouraged to contact their doctor in the usual way in emergencies or if otherwise concerned. Therapeutic algorithms for both controls and intervention will follow local guidelines, based upon the NICE/BHS guidelines 41 (see Appendix 16.2).

5.1.9 Protection against bias

Baseline data will be collected prior to randomisation and allocation will be carried out remotely via the clinical trials unit. It is not possible to blind the clinicians or patients to the allocation potentially introducing bias in subsequent care. All outcome trial data collection will be undertaken by a different researcher, blinded to allocation. Patients will be requested not to reveal which arm of the trial they are in.

5.1.10 Trial interventions

The intervention group will be given BP monitors which use Bluetooth to transmit readings via a (supplied) mobile-phone or SMS modem to a remote server. They, their GP and practice-nurse will have access to this record via the internet. Users will receive automated text or email feedback. The system can be personalised and set to provide reminders to check BP and alerts to both the user (via mobile-phone) and GP practice (via email/fax) if the rolling mean BP remains high. If a user is unable to manage texts or email, reminders/alerts can be posted/phoned to them.

Participants will be shown how to use the monitoring system. The user will also be given telephone and email contacts for the practice nurse and encouraged to make contact if their blood pressure remains high to discuss lifestyle factors and drug treatment. Drug treatment changes may be made every 6 weeks based on home monitoring results. Practice nurses will be encouraged to review regularly the alerts sent about patients whose blood pressure remains high or has not been checked within the agreed time frame. They may choose on clinical grounds to contact the patient to offer further treatment/support.

Users will be encouraged to check their blood pressure 10-20 times over a few days to establish a reliable mean and then about 4 times a month if their mean blood pressure is at or below the target of 130/80mmHg. If blood pressure is above the target and any changes to medication or lifestyle are made, the users will be encouraged to undertake another more intensive period of monitoring in order to establish the impact on the rolling mean. The guidance will not be restrictive – this tool is being provided to enable patients to understand their blood pressure better and manage their own health.

Participants allocated to the control group will be seen by the nurse or GP according to their usual care schedule. In a recent audit, patients with poorly controlled blood pressure in Lothian had it checked an average of 3.5 times in six months.

Both groups will be given written information including suggestions about initiating lifestyle changes and information on how long these might take to impact on their blood pressure (measured as a rolling mean over 10-20 readings).

5.1.11 Follow up measures

Patients will remain in the trial for six months after which the baseline measures will be repeated. Patients in the intervention arm will return the equipment.

Use of healthcare resources (number and duration of hospital admissions), practice and out-of-hours consultations, routine reviews for BP, prescriptions for anti-hypertensive drugs, adverse events) will be extracted by a researcher blind to allocation from the patients' primary care records. Tele-monitoring records will be retrieved and analysed for compliance with monitoring, time interval between loss of control and change of treatment.

5.1.12 Data collection and statistical analysis

As this is a feasibility study with a small sample, data analysis will be descriptive only and used to inform the potential size of a large-scale trial.

5.2 Qualitative studies of experiences of participating professional and patients

A sub sample of participants recruited to the pilot trial will be recruited to a nested qualitative study and interviewed about their experiences of using the equipment and participating in the trial. The interviews will be semi-structured with the interview guide informed by the main themes from analysis of qualitative data from the HITS trial (perception of risk posed by raised blood pressure, previous experience of treatment, experience in using the equipment, self management, treatment preferences and use of services, anxiety and reassurance) and the themes identified in the 'trial development focus groups'.

An additional major area to be explored with this group will be their experience of stroke / TIA and how it has affected the way they manage their health. At least 10 participants from the intervention group will be recruited for interview. (The data will be analysed using the framework developed in the HITS trial and as the numbers increased if data saturation has not been reached in new themes raised by the stroke patients or their clinicians or carers). Carers will also be invited to take part in interviews if appropriate and may be interviewed alone if they indicate a wish for this. A maximum variation sample in relation to patient age, social class, disability and blood pressure control at recruitment will be sought. At least 10 doctors or nurses using this system for stroke / TIA patients will also be interviewed and their data combined with the HITS data. Anticipated themes based on the HITS trial include the way patients use/change their use of health services, self management, practice organisation and the impact of working towards a target blood pressure.

Interviews and focus groups will be audio taped and transcribed in full. In recognition that the voices of people with communication issues resulting from stroke have been frequently ignored / misinterpreted by healthcare researchers[42,43], and on the basis of evidence acquired from existing research[44,45] 'talking mats'[46] will be used to assist with dialogue and the construction of understanding during the interviews and focus groups with patients. Data analysis will be thematic. As well as exploring the anticipated themes outlined above, researchers will also specifically search for emergent, unanticipated themes. Constant comparison (checking experiences against those of others in the sample) will ensure that the thematic analysis represents all perspectives and negative cases will be sought. Verification will be through recoding of random sections of transcript by another researcher, research team discussion of coding conflicts and feedback of the analysis to research participants.

5.3 Economic analysis

The economic analysis will asses the variation in the measures required for the cost-effectiveness analysis in order to inform the full trial. From the NHS perspective, the relevant outcome measures for the cost-effectiveness analysis are costs to the NHS and QALYs. QALYs will be derived from the responses to the EQ-5D. Health service use (number and duration of hospital admissions), practice and out-of-hours consultations, routine reviews for BP, prescriptions for anti-hypertensive drugs, adverse events) will be extracted by a researcher blind to allocation from the patients' primary care records. The costs of the tele-monitoring equipment and the set-up costs will be estimated. Resource use estimates will be combined with unit costs obtained from standard sources. Simple descriptive statistics will be used to explore variability in costs and QALYs.

6 Exit Strategy

It will be clear in the study information that the patient will be expected to return the equipment after 6 months and that their practice will not be able to support this type of service outside the trial.

7 Outcomes of feasibility study

The quantitative and qualitative data will be used to provide a description of the experiences and views of stroke patients, their carers and healthcare providers of using telemetry enabled home blood pressure monitoring, plus the numbers and types of stroke patients likely to be recruited. This would inform the design and recruitment strategy of a phase III RCT. There are no predetermined go/no go criteria for the RCT, and the factors to be considered are shown in Appendix 16.3.

8 Publication Strategy

We aim to publish the results of the study, in a peer reviewed journals, and present at international conferences. We will also inform participants of the results both directly and through stroke support organisations.

9 Risk Management Strategy

The main risks associated with this study are data security within the telemetry system, contamination between the intervention and control groups, home monitoring resulting in the identification of problems (e.g. extremes of blood pressure measurement or onset of atrial fibrillation) which need intervention and create excess workloads for practices, and equipment failures.

9.1 Data security within the telemetry system:

It will be clear to the patient that their data and chosen identifier will be held by themselves on an independent website, with access by their care provider and the research team. After initial set up, the only identifiable data variable which is sent via the internet is the serial number of the blood pressure monitor. This is used for the patient log in. Patients will be given a credit card sized document reminding them of the website and their user name. They will be able to give permission to other clinicians managing their care to view their results if they wish.

9.2 Contamination between the intervention and control groups

The decision to randomise at the patient rather than the practice level avoids the methodological difficulties associated with cluster randomisation but raises the possibility of contamination; the research also affecting the way patients in the control group are treated. This has been considered carefully. If the new model of care appears to be effective, professionals may try more intensive monitoring and treatment for the control group. However, we think this is unlikely. The control group (4 patients) will only form a small proportion of the stroke / TIA patients with suboptimal blood pressure control in each practice. Increasing the intensity of monitoring and treatment change without the home monitoring service would require a lot of additional appointments. Also, the control group will have been recruited and assessed by the research nurses so, although the practice nurses will not formally be blinded to the fact they are in the study, they will not be particularly aware of them. As an additional check, data on patient contacts for 6 months prior to the study will be collected to see if there is a major change during the study.

9.3 Home monitoring revealing problems which require intervention

It is possible that home monitoring may reveal something which is of concern. This could include very high blood pressure (very high average blood pressure is unlikely given the ambulatory monitoring at the start of the study, but single high readings will occur), low blood pressure causing symptoms or the patient being unable to record his/her blood pressure (possibly because of the onset of atrial fibrillation). The written information will tell the patient what to do in each instance and the patient will also be sent an automated alert via the system advising them what to do. Any adverse events will be recorded by GPs on a form and this will be entered onto the database. These will be monitored monthly and reported to the trial steering committee as a standing item.

9.4 Excess workloads for practices

It is not envisaged that, when fully operational, the home monitoring service will involve any more work for practices than the current system, although it is recognised that all patients in the trial will have sub-optimally controlled blood pressure and this may require additional input at the start of the trial. However, additional work for any particular practice will be kept to a minimum by limiting the number of patients recruited in each practice to 18.

9.5 Equipment Failures

There is no maintenance contract for the equipment loaned to the patient - non functioning blood pressure monitors and phones will be replaced from a small stock held by the trial manger. The functioning of the system will be audited by checking the online records of at least 10% of users against the stored values in their blood pressure monitors.

10 Project Team and Task Allocation

The overall project will be led by Dr Janet Hanley

Statistical support will be provided by Dr Steff Lewis

Health economics support will be provided by Dr Marjon van der Pol

Clinical advice will be provided by Dr Cathie Sudlow

Research nurses will be employed through the Wellcome Trust Clinical research Facilities in Edinburgh

11 Project Management and Quality Assurance

The project team, consisting of key grant holders and research staff, will meet weekly.

The project will be overseen by the independent programme steering group which will comprise the chief investigator; an independent chairperson; the applicants, trial staff and representatives of the funding body; and a patient representative (if possible). Three experienced trialists have agreed to oversee the individual RCTs for the telehealth programme of which this trial is a part, although separately funded; Professor Lewis Ritchie (hypertension and stroke), Professor Chris Griffiths (COPD trial) and Professor Anne-Louise Kinmonth (diabetes).

The study will be carried out to GCP standards and managed within the Research Governance Framework. Ethical approval will be sought via the National Research Ethics Service and management approval from NHS Lothian.

The Independent Trial Steering Committee has taken on the role of a data monitoring committee. Adverse events will be analysed on a regular basis and where necessary the ITSC will be empowered to terminate the study should there be any safety concerns to ensure the rights and well being of the trial participants. If examination of unblinded data is required to make a decision about the continuation of the study for any reason then an experienced independent trial statistician will be appointed to review the data and advise the committee.

12 Timescale

Timescale: Recruitment is anticipated to start in Autumn 2011. Further details of the timescale are shown in the chart in Appendix 16.5.

13 Reporting

Six monthly progress reports and a final report will be provided to the funder in the format required. Reports will also be provided as required for the programme management group, steering group and data monitoring committee.

14 Finance

The project is funded by an applied programme grant from the Chief Scientist Office. This award does not include university full economic costs.

The funding is managed by NHS Lothian;

A service level agreement will be developed between NHS Lothian and the University of Edinburgh for the clinical trial activity to be carried out by Edinburgh University;

Support for science costs will be sought to recompense GP practices for time spent setting up this study including record searches and review.

Additional funding for equipment and enhanced research support has been provided by Chest Heart and Stroke Scotland, the High Blood Pressure Foundation, Scottish Centre for Telehealth and Edinburgh CHP.

Service level agreements will be developed with the Wellcome Trust Clinical Research Facility, the Scottish Primary Care Research Network, and with practices out with NHS Lothian as appropriate, to reflect their contribution to the study.

15 References

1. Auditor General for Scotland. Managing Long Term Conditions. 2007. Edinburgh, Audit Scotland.
2. Wanless, D. Securing our future health: Taking a long-term view. 2010. London, HM Treasury.
3. Scottish Executive. Delivering for Health. 2005. Edinburgh, Scottish Executive.
4. Gibson PG, Powell H, Coughlan J, Wilson AJ, Abramson M, Haywood P et al. Self-management education and regular practitioner review for adults with asthma. Cochrane.Database.Syst.Rev. 2003;CD001117.
5. Fahey T, Schroeder K, Ebrahim S. Interventions used to improve control of blood pressure in patients with hypertension. Cochrane.Database.Syst.Rev. 2006;CD005182.
6. Farmer A, Wade A, Goyder E, Yudkin P, French D, Craven A et al. Impact of self monitoring of blood glucose in the management of patients with non-insulin treated diabetes: open parallel group randomised trial. BMJ 2007;335:132.
7. Messerli FH, Williams B, Ritz E. Essential hypertension. Lancet 2007;370:591-603.
8. Peel E, Parry O, Douglas M, Lawton J. Blood glucose self-monitoring in non-insulin-treated type 2 diabetes: a qualitative study of patients' perspectives. Br.J Gen.Pract. 2004;54:183-8.
9. Glasziou P, Irwig L, Mant D. Monitoring in chronic disease: a rational approach. BMJ 2005;330:644-8.
10. Department of Health. Information for health: an information strategy for the modern NHS 1998-2005. 1998. London, Department of Health.
11. Department of Health. The Expert Patient: A new approach to chronic disease management for the 21st century. 2001. London, The Stationery Office.
12. Department of Health. Improving Chronic Disease Management. 2004. London, The Stationery Office.
13. Shea S, Weinstock RS, Starren J, Teresi J, Palmas W, Field L et al. A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus. J Am Med.Inform.Assoc. 2006;13:40-51.
14. McMahon GT, Gomes HE, Hickson HS, Hu TM, Levine BA, Conlin PR. Web-based care management in patients with poorly controlled diabetes. Diabetes Care 2005;28:1624-9.
15. Marrero DG, Vandagriff JL, Kronz K, Fineberg NS, Golden MP, Gray D et al. Using telecommunication technology to manage children with diabetes: the Computer-Linked Outpatient Clinic (CLOC) Study. Diabetes Educ. 1995;21:313-9.
16. Casas A, Troosters T, Garcia-Aymerich J, Roca J, Hernandez C, Alonso A et al. Integrated care prevents hospitalisations for exacerbations in COPD patients. Eur.Respir.J 2006;28:123-30.
17. Niesink A, de Weert, an Oene G, ., Schrijvers AJ. The effects of integrated care for COPD patients on quality of life. Review and research design. Prim.Care Resp.J 2006;15:2001.
18. Whitten PS, Mair FS, Haycox A, May CR, Williams TL, Hellmich S. Systematic review of cost effectiveness studies of telemedicine interventions. BMJ 2002;324:1434-7.

19. Medical Research Council. A framework for the development and evaluation of RCTs for complex interventions to improve health. 2000. London, Medical Research Council.

20. de Toledo P, Jimenez S, del Pozo F, Roca J, Alonso A, Hernandez C. Telemedicine experience for chronic care in COPD. IEEE Trans.Inf.Technol.Biomed. 2006;10:567-73.

21. Clark RA, Inglis SC, McAlister FA, Cleland JG, Stewart S. Telemonitoring or structured telephone support programmes for patients with chronic heart failure: systematic review and meta-analysis. BMJ 2007;334:942.

22. Pinnock H, Slack R, Pagliari C, Price D, Sheikh A. Understanding the potential role of mobile phone-based monitoring on asthma self-management: qualitative study. Clin.Exp.Allergy 2007;37:794-802.

23. Campbell NC, Murray E, Darbyshire J, Emery J, Farmer A, Griffiths F et al. Designing and evaluating complex interventions to improve health care. BMJ 2007;334:455-9.

24. Oakley A, Strange V, Bonell C, Allen E, Stephenson J. Process evaluation in randomised controlled trials of complex interventions. BMJ 2006;332:413-6.

25. Bonell C, Oakley A, Hargreaves J, Strange V, Rees R. Assessment of generalisability in trials of health interventions: suggested framework and systematic review. BMJ 2006;333:346-9.

26. CJ Murray and AD Lopez, Mortality by cause for eight regions of the world: Global Burden of Disease Study, Lancet 349 (1997), pp. 1269–1276.

27. http://www.sign.ac.uk/pdf/sign108.pdf, last accessed 18/5/11

28. Coronary Heart Disease/Stroke Task Force Report, http://www.sehd.scot.nhs.uk/publications/cdtf/cdtf-16.htm. Last accessed 18/5/11

29. http://www.isdscotland.org/isd/6537.html, last accessed 18/5/11

0. Lewington S, Clarke R, Qizilbash N, Peto R, Collins R, Prospective Studies Collaboration

Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. Lancet. 2002;360(9349):1903

31. Peter M Rothwell, Ale Algra, Pierre Amarenco. Medical treatment in acute and long-term secondary prevention after transient ischaemic attack and ischaemic stroke. Lancet 2011; 377: 1681–92

32. PROGRESS Collaborative Group. Randomised trial of a perindopril-based blood-pressure-lowering regimen among 6,105 individuals with previous stroke or transient ischaemic attack. Lancet. 2001;358(9287):1033

33. Cappuccio F, Kerry S. Blood pressure control by home monitoring: meta analysis of randomized trials. BMJ 2004; 329: 145.

34. Godwin M, Lam M, Birtwhistle R et al. A primary care pragmatic cluster randomized trial of the use of home blood pressure monitoring on blood pressure levels in hypertensive patientswith above blood pressure target blood pressure. Fam Practice2010; 27: 135–42.

35. John Shaw, Sally Kerry* Yvette Adjei-Gyamfi, Jenny Tulloch, Denise Coster, Shanika Sharma and Pippa Oakeshott. Are stroke patients' reports of home blood pressure

readings reliable? Cross-sectional study Family Practice 2011; 28:118–122

36. Salim Yusuf,,.Hans-Christoph Diener, Ralph L. et al Telmisartan to Prevent Recurrent Strokeand Cardiovascular Events. N Engl J Med 2008;359:1225-37.

37. Brooks R, Rabin R, de Charro F, (eds): The Measurement and Valuation of Health Status Using EQ-5D: A European Perspective: Evidence from the E

38. SIS:Version 3.0: Duncan PW, Bode RK, Min Lai S, Perera S; Glycine Antagonist in Neuroprotection Americans Investigators. Rasch analysis of a new stroke-specific outcome scale: the Stroke Impact Scale. Arch Phys Med Rehabil. 2003 Jul;84(7):950-63

39. Zigmond A, et al. The hospital anxiety and depression scale. Acta Psychiatrica Scandinavia 1983;67:361-70

40 Bonita R, Beaglehole R. "Modification of Rankin Scale: Recovery of motor function after stroke."Stroke 1988 Dec;19(12):1497-1500.

41. www.nice.org.uk/CG034 ast accessed 24/11/07

42.Carlsson, E., Paterson, B.L., Scott-Findlay, S., Ehnfors, M., and Ehrenberg, A. 2007. Methodological issues in interviews involving people with communication impairments after acquired brain damage. Qualitative Health Research, 17(10):1361-71.

43. Kroll, T. 2011. Designing mixed methods studies in health-related research with people with disabilities, International Journal of Multiple Research Approaches, 5: 64-75.

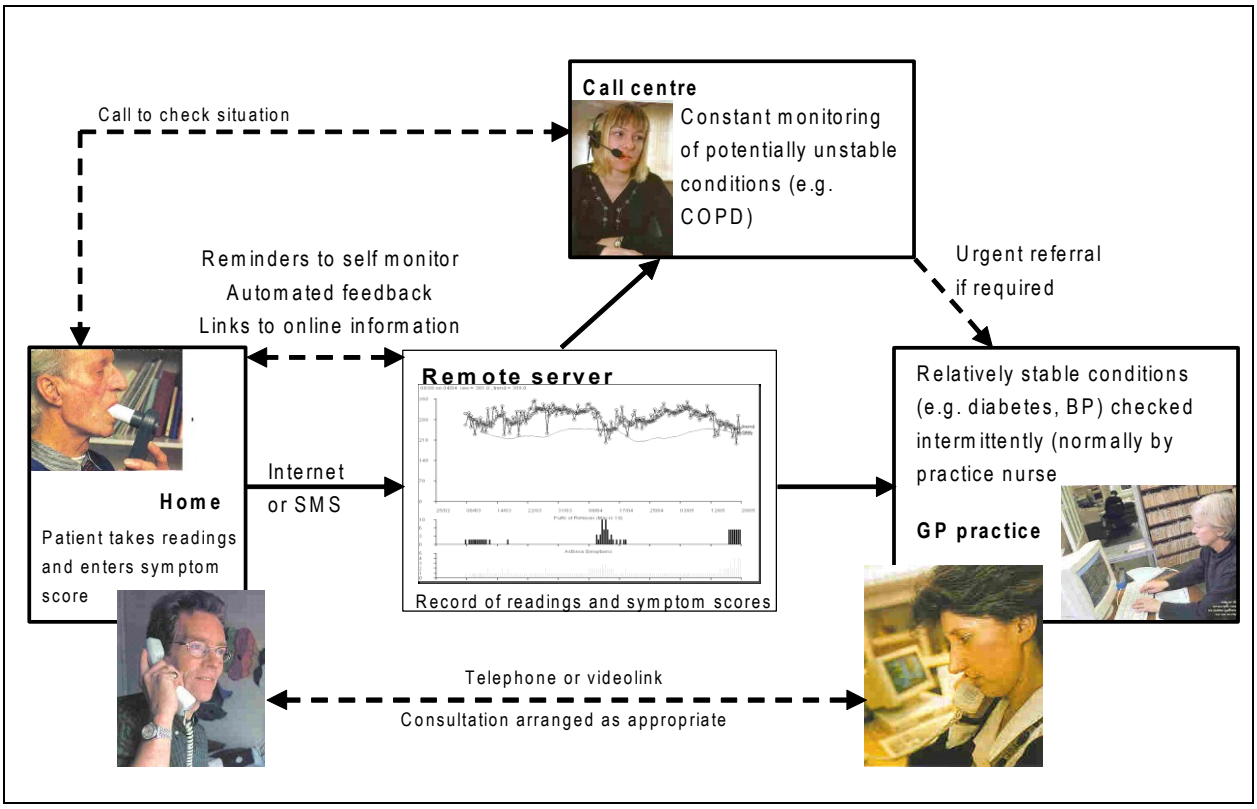
44. Murphy J. 2006. Perceptions of communication between people with communication disability and general practice staff. Health Expectations. 2006 Mar;9(1):49-59.

45. IRISS Insights Report 2: Effectively engaging and involving seldom heard groups: http://lx.iriss.org.uk/sites/default/files/resources/iriss-insight-2-1.pdf

46. Talking Mats Development and Research Centre: http://www.talkingmats.com/

16 Appendices

16.1 Model of telemetry supported self care



This model illustrates an overview of tele-monitoring. Two models are under consideration in our programme.

- In COPD (a potentially unstable condition) patients daily symptoms scores are scrutinised by a call-centre team who will contact the patient when responses to symptom questionnaire fall outside expected parameters or if readings are not transmitted. According to protocol, they will observed the following day, or referral made to a clinician who will be able to consult with the patient (either face-to-face or remotely via telephone or video-link) and arrange treatment as necessary.
- In the other models automatic responses to readings will be fed back to patients advising them if they need to contact their clinician (based on mean average of their results) or reminding them to take readings. Clinicians will view the patient record at regular intervals and contact patients by phone, email or text to give advice. Patients can also view results on line.

16.2 Rapid Treatment Protocol. A Protocol for managing blood pressure in patients where home monitoring permits rapid escalation of treatment.

This rapid treatment protocol is based on the Lothian Hypertension guidelines with the addition of timing suggestions and one change. The addition of a thiazide which is an optional first step in the Lothian Hypertension guideline (and also the NICE hypertension guideline) is delayed until step 3 because thiazides take some weeks to show an effect.

Treatment steps if control not achieved		
	Step 1	Calcium Channel Blocker or ACE inhibitor depending upon age (≥ 50 CCB) – low dose
	⬇	
After 2 weeks	*Dose titration*	*After 2 weeks dose titration of first drug (e.g. 5 to 10 mgs amlodipine or 10 to 20 mgs lisinopril)*
	⬇	
After a further 2 weeks	**Step 2**	Calcium Channel Blocker and ACE inhibitor
	⬇	
After a further 2 weeks	*Dose titration*	*After 2 weeks dose titration of second drug (e.g. 5 to 10 mgs amlodipine or 10 to 20 mgs lisinopril)*
	⬇	
After a further 2 weeks	**Step 3**	Add a thiazide
	⬇	
After a further 4 weeks (thiazides take longer to work)	**Step 4**	Add a ß blocker or spironolactone
	⬇	
After a further 4 weeks	**Step 5**	Add whichever of step 4 had not been added

16.3: Key questions for the pilot trial

Questions to determine the need for a large-scale separate trial, using a protocol similar to HITS, with this patient group	How the pilot trial will answer them
Is there any evidence that the patients recruited to the pilot study differ significantly to those in the HITS trial either demographically or in terms of their blood pressure profile?	Age, sex, BP at start and end of pilot, anxiety
Is there any evidence of differences from the HITS trial in approach to BP management and response to intervention by either patients or professionals?	Qualitative study Use of the system determined from the system log
Questions to determine the feasibility of a trial using a slightly modified HITS protocol	How the pilot trial will answer them
What proportion of the potentially eligible post stroke population approached are a) willing to take part? b) eligible on screening?	Records of numbers of patients identified as eligible and proportion who agreed to participate.
What is the likely attrition rate?	We will monitor withdrawals (with reasons where proffered) and loss to follow-up (e.g. because death, moving, incapacity)
What factors encouraged (or discouraged) participation?	Qualitative interviews with participants, and support groups
Questions to refine the intervention	How the pilot study will answer them
Is there any need to refine the intervention for this patient group?	Qualitative study and analysis of requests for help to trial manager (who will be acting as system manager for the pilot)
Questions to inform future research	How the pilot trial will answer them
Is there any evidence of need for a redesigned trial of an intervention to improve blood pressure control with this population using either a) a different recruitment strategy? b) a different intervention? c) both?	This will be a judgement based on all the information above

16.4 Theoretical framework for telehealth studies

The technologies being trialled in this programme enable frequent self monitoring, organisation of the resultant data, and sharing of the data between patients and healthcare professionals in a way which has not been previously available in Primary Care. This is a complex intervention involving the following elements:

- Self monitoring. Although everyone monitors their own health, for most of the patients involved in this trial, formal measurement of symptoms and vital signs will be new to them as it was previously the responsibility of healthcare professionals. The exceptions will be blood glucose measurement for the diabetic patients and blood pressure monitoring for the 30% of patients that our pilot work suggests already own their own home monitors.
- The information itself. In most cases the parameters of interest have not been routinely and frequently monitored so the data, in conjunction with the way in which it is organised and shared, provides novel information about the condition and its control to the patients and their healthcare professionals.
- The organisation of the data. The systems used in these trials are able to organise and display the data provided in different ways e.g. an average blood pressure. They also provide some interpretation of the data based on pre-determined parameters.
- Automated feedback and reminders. The systems used in this trial are able to provide timely reminders and automated feedback for patients, which will not have been previously available to them.
- The way in which the data are shared and used. The data record will be almost instantly available to both patients and healthcare professionals.

It is hypothesised that tele-monitoring will impact at three levels:

1. Patients may improve their knowledge and understanding of their condition as they monitor and receive timely and relevant feedback on their situation.
2. Professionals may feel more confident to offer self-management within the structure and on-going supervision of tele-monitoring.
3. Appropriate access to services may be facilitated by the tele-monitoring as patients become more confident when they need help and advice and with the easy sharing of monitoring data.

The theoretical model developed by Glasziou *et al*. describes the complementary and evolving roles of periodic professional reviews and on-going patient self-monitoring.[1] A newly diagnosed condition is assessed and brought under control with professional support, before the patient assumes responsibility for self-management as the stable maintenance phase is established.

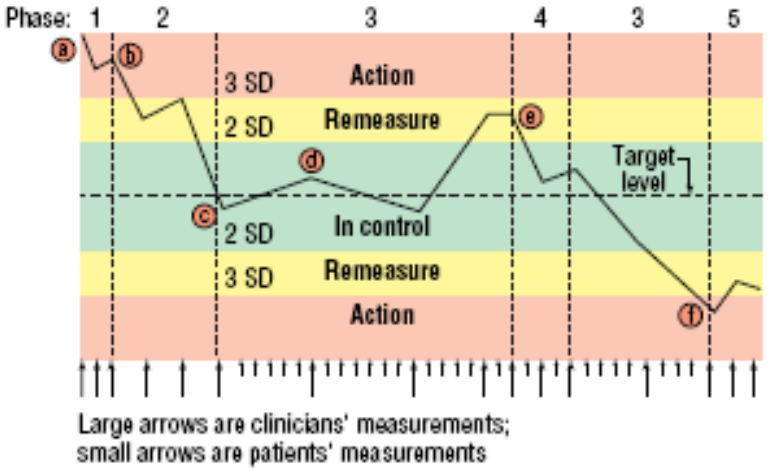


Figure 1. The five phases of treatment monitoring. After Glaziou *et al*.[1]

The context for the tele-monitoring trials is the maintenance phase where patients are monitoring a relatively stable situation, and expected to act (either by initiating treatment, or seeking appropriate professional advice) if measurements fall outside pre-defined limits. The impact of this will vary according to the condition being monitored. For people with an

asymptomatic condition such as hypertension this may the first time they have been aware of their control of a daily basis. Patients with COPD often have difficulty distinguishing the onset of an exacerbation from a 'bad day',[2, 3] and one possible mode of action is that tele-monitoring will define exacerbations more clearly and increase patient's confidence to commence treatment promptly.

Kennedy argues for a whole systems approach to the provision of effective support for self-care.[4]

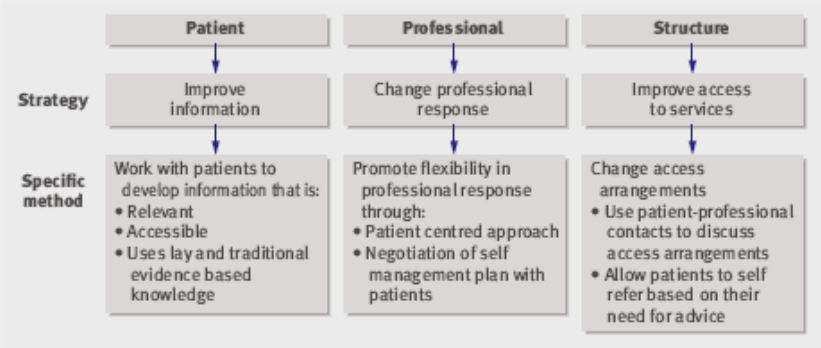


Figure 2. Example of an intervention based on a whole systems perspective. After Kennedy *et al*.[4]

The anticipated outcomes are dependent on changes to behaviour: i.e. whether patients and/or professionals successfully use the equipment and change the way they manage the long term conditions being monitored. However, the way people act when they come into contact with an innovation does not always appear logical. There is a large literature on both the diffusion of innovations literature and health behaviour change, both underpinned by social learning theory which suggests people's perceptions of a situation determine how they behave.[5] Factors likely to influence this include

- self-efficacy, or belief in one's ability to perform a behaviour.[6]
- Perceived benefits weighed against perceived barriers to the action.[7,8]
- Perceptions of the attitudes of important others to the behaviour.[6,9]
- Reinvention and identity.[6,10]

The 'diffusion of innovations' model is the most comprehensive description of how new technologies (including behaviours) are adopted.[6] It includes a pattern of how an innovation spreads through a social group, a comparison of characteristics of those who adopt the innovation at different stages of its spread, and a staged model of the innovation-decision process (knowledge, persuasion, decision, implementation, confirmation), which an individual goes through when deciding to adopt or reject an innovation. Factors which may influence this process include the mode of communication (e.g. the presence of a change agent), prior conditions (including previous practice, felt needs and problems, innovativeness and norms of the social system), perceived characteristics of the innovation, disruptive or competing technologies or path dependence which may lock other technologies in place. A (self) criticism of this model is that it does not explain why individuals adopt or reject particular innovations at an early stage, sometimes seemingly irrationally.[6]

A related, but more explanatory model, the 'technology transfer communication and feedback' model[7] suggests that much of the unpredictability in the adoption of new technologies arises because individuals do not share a common perception of it or their need for it.[7] It introduces the concepts of technology push (the perceived merits of the new technology), and market pull (the perceived need for the new technology), both being required for the successful transfer of the new technology into practice.

Because of the complexity of the intervention, the explanatory aspect of this programme will be qualitative and involve interviews, focus groups and observation with patients, professionals, carers, and service planners. It will explore prior perceptions and conditions, the experience of using the system, and changes to perceptions and behaviour. The initial topic guides and data coding frame will be based on the factors identified by the diffusion of innovations, social learning theory and our pilot work, but will be developed iteratively and be open to new approaches. The exceptions to the qualitative approach will be that patients will be asked to complete a quantitative measure of self-efficacy in chronic disease,[11] and (in the case of COPD) an assessment of knowledge about the respiratory condition.[12] The 'Self-

Efficacy for Managing Chronic Disease' scale is widely used and will give some comparability with other research.

A specific aim of the qualitative work will be to explore the apparent paradox or tension in this service model where the aim is to increase self-care, but the model also increases professional surveillance of the patient. Our qualitative pilot work with hypertensive patients showed that even patients who were very committed to self-management welcomed this, but was not detailed enough to explain why. Work in the fields such as asthma monitoring and obesity management have also highlighted this paradox – that interventions which apparently take some control away from patients can result in their feeling of overall control increasing.[13, 14] These are important issues in a policy context which advocates increasing self-care.

1. Glasziou P, Irwig L, Mant D. Monitoring in chronic disease: a rational approach. BMJ 2005;330:644-8
2. Adams R, Chavannes N, Jones K, Subbe-Ostergaard M, Price D Exacerbations of chronic obstructive pulmonary disease - a patients' perspective *Prim Care Respir J* 2006; 15: 102-9
3. Calverley P, Pauwels R, Lofdahl G-G, Svensson K, Higenbottam T, Carlsson L-G, Stahl E. Relationship between respiratory symptoms and medical treatment in exacerbations of COPD. *Eur Respir J* 2005; 26: 406-413
4. Kennedy A, Rogers A, Bower P. Support for self care for patients with chronic disease. *BMJ 2007*; 335: 968-970
5. Bandura A (1977) *Social Learning Theory*, Prentice-Hall, Englewood Cliffs, New Jersey
6. Bandura A (1986) *Social Foundations of Thought and Action – A Social Cognitive Theory.* Prentice-Hall, Englewood Cliffs, New Jersey
7. Rogers E (2003). *Diffusion of Innovations*, 5th Edition, Macmillan, London
8. Williams F, Gibson DV. *Technology Transfer: A Communication Perspective*. Sage, Newbury Park 1990
9. Mittman BS, Tonesk X, Jacobson PD. Implementing Clinical Practice Guidelines: Social Influence Strategies and Practitioner Behaviour Change. *Quality Rev Bull* 1992; 18: 413-422
10. Ogden J, *Seeing the light: sustained behaviour change and the process of reinvention*. The British Psychological Society 2007. http://www.dhp2007.org.uk/document-download-area/document-download$.cfm?file_uuid=F9AEFFB0-1143-DFD0-7EA4-7FB84D95F79C&ext=doc
11. Stanford Patient Education Research Center. *Self-Efficacy for Managing Chronic Disease 6-Item Scale.* http://patienteducation.stanford.edu/research/secd6.html
12. Hyland M, Jones R, Hanney K. The Lung Information Needs Questionnaire: Development, preliminary validation and findings. *Respir Med* 2006; 100: 1807-1816
13. Pinnock H, Slack R, Pagliari C, Price D, Sheikh A. Understanding the potential role of mobile phone based monitoring on asthma self-management: qualitative study. *Clin Exp Allergy* 2007*; 3: 794–802*
14. Ogden, J., Clementi, C., Aylwin, S., Patel, A. (2005) Exploring the impact of obesity surgery on patient's health status: a quantitative and qualitative study. *Obesity Surgery;* 15: 266-272.

16.5 Timescale

	April 2011	May 2011	June 2011	July 2011	August 2011	September 2011	October 2011	November 2011	December 2011	January 2012	February 2012	March 2012	April 2012	May 2012	June 2012	July 2012	August 2012	September 2012	October 2012	November 2012	December 2012	January 2013	February 2013	March 2013
Stroke (CSO)																								
develop protocol																								
produce study paperwork																								
source devices																								
Ethics & R&D																								
Database development																								
practice recruitment strategy																								
nurse training																								
recruit patients																								
baseline measures																								
qualitative work																								
endpoint measures																								
database lock																								
health economic analysis																								
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