Evaluation of the NHS England Innovation Test Bed at Care City

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1. Executive Summary

Care City

Care City is an innovation centre focused on healthy ageing and social regeneration in outer North East London. The Care City Test Bed had the stated aim of promoting the adoption of technology and other innovations to have a marked beneficial impact on the sustainability of health and social care services among those aged 65 and over in this region through work in three clusters: long-term conditions, dementia and carer resilience.

In its long term conditions cluster, Care City supported the adoption of technology to improve access to preventative services relevant to falls and stroke. It also sought to facilitate the adoption of innovation to identify and support people that could benefit from early intervention to increase self-care, with a view that this would improve health outcomes and reduce demand on health and social care services in the medium to long term.

In its dementia cluster, Care City set out to facilitate access to innovations intended to support more person-centred care, and peer-to-peer support intended to reduce isolation. Reflecting the fact that deprived communities benefit less from research and the participation in research, Care City sought to boost local participation of its population in dementia research.

Recognising the increasingly valuable role played by informal carers in supporting the work of the health and social care system, Care City was keen to explore how innovation could improve the support available to them.

Care City's ambition was to conduct real world testing of innovations, with funding of innovations on business-as-usual terms and with innovations tested in routine clinical settings, and with innovations or their use adapted in response to the findings of iterative testing.

Evaluation aims

This report summarises an evaluation of the work of Care City conducted by a team of Operational Researchers and Health Economists from University College London. It had two overarching aims: to assess the extent to which the innovations selected by Care City from a

longlist prepared by NHS England were adopted by the local system, assessing their likely impact through analysis of routinely available data and, where appropriate, health economic modelling; and to identify broader learning relevant to the design and operation of an innovation Test Bed within this and other health and social care systems. This work is augmented by work to capture the experience of staff and members of the public using the innovations conducted by UsCreates and a process evaluation conducted by a team from NatCen (both of which are reported separately).

The innovations

Having initially selected 9 innovative interventions from the NHS England longlist and two information products to facilitate iterative testing and evaluation, Care City conducted substantive tests of 3, alone and in combination with other innovative products and service design.

Kinesis QTUG™, which uses accelerometers and a set of algorithms to give a quantified assessment of gait and falls risk from the standard timed up and go test, was used among over 65s by pharmacy assistants in community pharmacy and by health care assistants in primary care. As a result of these tests, the Care City team combined the use of **Kinesis QTUG™** among over 65s by health care assistants in primary care with, for those identified at medium risk of falling, use of the **Salaso** online platform of physiotherapy exercises to reduce falls risk.

A social prescribing tool was developed by **HealthUnlocked** with considerable input from the Care City team. It was designed to be incorporated within the EMIS GP information system and was enabled within 10 GP practices, allowing GPs to generate and email to patients a tailored set of recommendations for community services and online resources to support their wellbeing.

KardiaMobile™, a device for use with smart phones to record electrocardiograms and identify possible atrial fibrillation, was used among over 65s by health care assistants in dedicated clinics in primary care. It was also used by pharmacy assistants in community pharmacies with results forwarded to GPs. Based on findings of these pilots, the team at Care City developed and implemented a new pathway for community screening for atrial fibrillation based on the use of **KardiaMobile™** among over 65s by pharmacy assistants in community pharmacies, with those identified by the device as being in atrial fibrillation or having an unclassifiable rhythm invited to a dedicated clinic for assessment and, where appropriate, prescription of anticoagulants to reduce stroke risk.

Evaluation methods

Our service evaluation comprised the development of logic models to understand how adoption of each innovation could lead to improved outcomes and/or reduced costs, use of routinely collected data to assess use of the innovations and subsequent activity and information recorded in primary and secondary care, health economic modelling and a soft systems analysis to understand differing perspectives on the proper role and function of an innovation Test Bed.

For the early substantive tests of **KardiaMobile™** in primary care, we analysed data relevant to AF diagnosis, stroke risk scoring and anti-coagulation prescribing from participating practices and from comparator practices, using Statistical Process Control methods to identify any changes in diagnosis and prescribing. For those patients tested, we constructed simple flow charts to present data relating to AF, cardiology, stroke-risk management and other service utilisation from primary and secondary care.

We constructed a model to estimate the impact on costs and outcomes of a programme of annual screening for AF with **KardiaMobile™ in a community pharmacy setting with onward referral to a dedicated clinic.** The model was populated using evidence from the literature relating to AF, the attendant stroke risk, the cost and impact of strokes and the cost and effectiveness of anticoagulation to reduce stroke risk. Data from the Care City pilot were used to estimate the cost of the pathway as implemented.

For the testing of **Kinesis QTUG™** in primary care, practice level analysis was performed to see whether there was an impact on the number of falls risk assessments recorded as having been conducted and, among those, the proportion of patients recorded as having been given falls risk advice or referred to a falls prevention service.

Health Economic analysis of the combination of **Kinesis QTUG™** and **Salaso** was based on construction of a decision tree to incorporate the diagnostic accuracy of **Kinesis QTUG™**, the effectiveness of the exercise programmes underpinning the Salaso tool in reducing falls and the known costs and impact on quality of life associated with falls.

For the testing of the **HealthUnlocked social prescribing tool**, our analysis was limited to data relating to the generation of email prescriptions and subsequent access by patients of the web-based resources.

The soft systems methodology (SSM) analysis focused on exploring the roles and responsibilities of a Test Bed, and in particular any misalignments in the perspectives of different stakeholders on this issue.

This analysis drew heavily on 27 discussions with stakeholders representing different worldviews (innovators, health care commissioners, health care provider organisations, local authorities, the academic health science network and Care City). It also incorporated 2 years' worth of a broader SSM process of immersion by the research team conducted alongside these semi-structured conversations. It was supplemented by an analysis of the tasks and activities conducted by the Care City team over the course of their work to date, in general and in specific relation to the tests of **KardiaMobile™** and the development of the AF screening pathway.

Findings

Use of **KardiaMobile™** by health care assistants in General Practice led to an increase in AF diagnoses not seen in comparator practices but was not associated with an increase in the proportion of diagnosed cases that started on anticoagulation within 3 months of diagnosis. Screening in community pharmacy was shown to be feasible but onward referral to general practice was inconsistent, with additional concerns reported to Care City re increased workload for GPs.

The novel AF screening pathway developed by Care City was shown to be feasible. Health Economic modelling of the pathway suggests that annual screening of over 65s using such a pathway would be a cost-effective use of NHS funds with an incremental cost-effectiveness ratio of £1989 per QALY. The pathway appears cost-effective even with low utilisation of the clinic and a low rate of confirmed diagnoses.

The use of Kinesis QTUG™ by health care assistants in General Practice led to an increase in recorded falls risk assessment and, among those assessed, an increase in the provision of falls risk advice and referrals to falls prevention services, compared to comparator practices.

The testing of the combination of Kinesis QTUG™ with the Salaso online platform of physiotherapy exercises is ongoing. Health economic analysis suggests that this innovation could be cost-effective but only if compliance is consistent with the literature. It would be more cost-effective and potentially cost saving if targeted at the over 75s.It should also be noted that a proportion of patients are being provided with paper copies of the exercises due to them having insufficient internet access to make full use of the intervention.

The HealthUnlocked social prescribing tool was successfully incorporated into EMIS and used by 67 GPs across 10 practices to send social prescriptions to patients by email. The

prescriptions related most frequently to resources on healthy eating, weight loss and getting active. Just under half of patients emailed a social prescription clicked through to access it.

All stakeholders were in agreement that the selection process for adopting innovations had not been ideal and that this had a number of consequences that impacted on the work of the Test Bed. The role and responsibilities of a Test Bed in two key areas relating to the selection of innovations emerged as important and yet somewhat contested: aligning innovations to local priorities and needs and; the recruitment and 'termination' of innovations.

A perspective shared by several stakeholders was that the project status of the Test Bed hindered a continual process of engagement with new innovations and a more graduated process of selection that could ensure that innovations taken forward under the Test Bed were aligned with system priorities, financial context and the operational details of how the current services and the professionals staffing them work. Such a process may have benefited the innovations which were not adopted at an appreciable scale by Care City.

Conclusion

The combination of falls risk screening in general practice using Kinesis QTUG™ with a prescription to falls prevention exercises on the Salaso online platform looks promising and could be cost-saving if restricted to over 75s. However this is heavily dependent on compliance and should be reviewed once testing is complete.

The combination of screening for atrial fibrillation in community pharmacy by pharmacy assistants using **KardiaMobile™** with onward referral to a dedicated clinic is very likely to be a cost effective use of NHS funds.

As with many innovations, further spread of these is likely to be reliant on sharing of learning from implementation and on local adaptation rather than simple roll-out. To this end, the development by Care City of resources (the service blueprint, standard operating procedures etc.) for sharing with other localities is particularly valuable.

Valuable insights from our discussions with stakeholders identified shared perspectives on how the selection of innovations could be improved and a range of perspectives on the proper role and function of the Test Bed, which will be the focus of future discussions.

A key recommendation is that Test Beds and innovators give careful consideration to the changes required to patient pathways and other work flow for benefits to be realised. This is especially relevant when there is a long chain of necessary steps between the point of using an innovation and the accrual of improved outcomes and/or lower costs.

2. Health and Care Challenge being addressed

Care City is an innovation centre focused on the dual challenge of promoting healthy ageing and social regeneration in North East London. It was launched as a joint initiative between Barking and Dagenham Council and the North East London NHS Foundation Trust prior to the call for Innovation Test Beds by NHS England.

The Care City NHS Innovation Test Bed incorporates other local authorities (Havering, Redbridge and Waltham Forest),other NHS organisations (Barking, Havering & Redbridge University Hospitals NHS Trust, BHR CCG, Waltham Forest CCG, BHR GP Federation) and the third sector (Carers of Barking & Dagenham, Age UK Redbridge, Barking and Havering) and had the stated aim of promoting the adoption of technology and other innovations to have a marked beneficial impact on the sustainability of health and social care services among those aged 65 and over in this region.

While the focus of Care City's work narrowed over time, it is valuable to revisit the initial challenges that it set out to address, not least as this is essential context for the evaluation of what was achieved. The system and societal challenges initially targeted by Care City are reflected by how the initial set of selected innovations was divided into clusters:

Long term conditions:

> The footprint of the Care City NHS Innovation Test Bed includes the London Borough with the highest proportion of older people (Havering) and, although Barking and Dagenham is one of London's youngest boroughs, it's population does not age healthily, with comparatively low healthy life expectancy.
>
> The Care City NHS Innovation Test Bed sought to support the adoption of technology to improve access to preventative services in two clinical domains – falls and stroke - where North East London faces particular challenges. It also sought to facilitate the adoption of innovation to identify and support people that could benefit from early intervention to increase self-care, with a view that this would improve health outcomes and reduce demand on health and social care services in the medium to long term.

Dementia

> As with other parts of the country, the region represented by Care City faces the challenge of caring for and supporting a growing population of people with Dementia. Care City set out to facilitate access to innovations intended to support more person-centred care, and peer-to-peer support intended to reduce isolation. Reflecting the

fact that deprived communities benefit less from research and participation in research, Care City sought to boost the participation of its population in dementia research.

Carer Resilience

Based on a recognition of the valuable role played by informal carers, the impact that caring has on the wellbeing, health, resilience and employment of those with caring responsibilities, and the inadequacy of a model that copes with reducing budgets by relying more and more on informal carers without supporting them, Care City was keen to explore how innovation could improve the support available to informal carers.

Clearly, long term conditions, dementia and carers is a very broad remit. While the focus of Care City's work narrowed as work progressed and some innovations fell away, the essential challenge remained that of supporting adoption of innovations with the potential to make the health and social care system more "sustainable" by improving access to preventative services in an affordable way and by directing people to non-statutory services intended to support wellbeing.

In terms of the challenges to innovation in the health and social care system that Care City set out to address, Care City's ambition was to conduct real world testing of innovations, with funding of innovations on business as usual terms, with innovations tested in clinical settings, and with innovations or their use adapted in response to the findings of iterative testing.

3. Overview of the Test Bed intervention

Rather than focus solely on the innovations and combinations of innovations that have been subject to substantive testing, we review here the initial set of innovations selected by Care City from the initial NHS England list of innovation partners, those innovations that joined the Test Bed at a later point and the substantive tests that were implemented by the Care City team.

3.1 Initially selected innovations

The initial set of innovations selected was as follows:

Cluster 1 - Long term conditions:-

- **Kinesis QTUG™** - predictive analytics using accelerometer data from mobility assessments and other patient data to quantify risk of falling;
- **KardiaMobile™** - a device for use with smart phones to record electrocardiograms and, employing algorithms, identify normal sinus rhythm, atrial fibrillation or other, unspecified, arrhythmias that warrant further investigation;
- **Health Navigator** - use of predictive analytics to identify patients at risk of becoming high users of health care services, and use of telephone based coaching to help patients manage their health and navigate the health care system.

Cluster 2 - Dementia:-

- **MyBrainBook** - a web based tool for people with recently diagnosed dementia to upload key reminiscences, information about the key people in their life, their concerns and their priorities for their care;
- **Join Dementia Research** - a web-based tool designed to increase local participation in dementia research;
- **HealthUnlocked** - supported, web based “communities” intended to provide peer support and peer education, boosting self-management.

Cluster 3 - Carer resilience:-

- **Canary Care** – a set of motion sensors and door sensors placed around the home to identify deviations in the activities of a client and to send alerts to that client’s carers if the data suggest, for instance, that an external door has been left open, the client is

not using the kitchen, or the client is habitually not spending the night in their bedroom.

- **St Bernard** – wearable technology for people with dementia that aims to facilitate prolonged independent living by providing carers with an alert if the client leaves an agreed “safe area”.

- **supportspace** – a web based tool that matches the requirements of people for personal social services with relevant providers and that provides the Local Authority with an audit trail.

Two information products were also selected as innovation partners with the view that these would be important to the evaluation of the other innovations by facilitating access and analysis of routine data on service use among patients and clients using the innovations:

- **Health Analytics** - a linked acute and primary care data set;

- **Orion Health** - linked community health and community mental health data.

3.2 Innovations partnering with the Care City Test Bed at a later point

As the Care City Test Bed progressed and in response to testing, it worked with the following supporting innovations:

- **Sonar** Informatics developed an interoperability platform to facilitate consistent information gathering across community pharmacies involved in Care City testing and the sharing of information essential to the operation of the novel atrial fibrillation pathway (see below).
- **Salaso** Health Solutions have developed a home exercise prescription platform with high-definition video exercises facilitating the prescription of exercise to patients and standardised patient reported outcome measurement (PROMs) functionality.
- **GaitSmart** is a validated gait analysis tool that provides an objective report on the mobility of an individual, identifying areas of issue in that person’s mobility as well as the severity of any deficits.

Note also that **HealthUnlocked**’s initial plans for a peer-support community among people with dementia were replaced by the development of a social prescribing tool.

3.3 Substantive testing of innovations

We list below what we have termed the substantive testing of innovations, by which we mean those tests that resulted in use of the innovation concerned among a steady flow of local people:

the use of **Kinesis QTUG™** among over 65s by pharmacy assistants in community pharmacy with onward "signposting" of people identified as being at high risk of falls.

the use of **Kinesis QTUG™** among over 65s by health care assistants in dedicated clinics in primary care settings.

the use of **Kinesis QTUG™** among over 65s by health care assistants combined with, for those identified at medium risk of falling, generation using **Salaso** of a bespoke set of physiotherapy exercises to reduce falls risk (see appendix 1 for more details of this innovation).

the use of **KardiaMobile™** among over 65s by pharmacy assistants in community pharmacy with onward "signposting" to GP of people identified by the device as being in atrial fibrillation or having an unclassifiable rhythm.

the use of **KardiaMobile™** among over 65s by health care assistants in dedicated clinics in primary care.

the distribution of **KardiaMobile™** devices to General Practices.

the design and implementation of a new pathway, supported by **Sonar** for community screening for atrial fibrillation based on the use of **KardiaMobile™** among over 65s by pharmacy assistants, with those identified by the device as being in atrial fibrillation or having an unclassifiable rhythm invited to a dedicated clinic subject to remote review of the Kardia ECG trace by an arrhythmia nurse specialist (see appendix 2 for more details of this innovation).

The implementation of the **HealthUnlocked social prescribing tool** within EMIS, a GP patient management system, to allow GPs to generate and email to patients a tailored set of recommendations for community services and online resources to support their wellbeing.

3.4 Other attempts to support adoption of innovations

Considerable work was also performed by the Care City team in attempting to get other innovations to the point of substantive testing. Given the valuable learning gained from our discussions with Care City staff, commissioners and innovators related to the remit, position and operation of Care City and the wider Test Bed Programme, we list these below:

numerous meetings and discussions with **supportspace** to understand their offer to Local Authorities and the facilitation of discussions between **supportspace** and the London Borough of Barking and Dagenham;

numerous meetings and discussions with **Health Navigator** to understand their service and the shared risk and saving model underpinning their business offer to commissioners and the facilitation of discussions between **Health Navigator** and BHR CCG;

substantial work identifying and engaging with teams across the local health and social care system concerning the potential for **Canary Care** systems to enhance the service offered to patients or clients and/or improve the accuracy or efficiency of needs assessment (thirteen teams in total, with testing plans developed and started in some cases);

facilitation of numerous meetings between **JDR** and NELFT regarding the incorporation of a JDR tick box to the information systems of NELFT memory services;

events to present **MyBrainBook** and **St Bernard** to staff in NELFT memory services and work with clinicians to support them in procuring **MyBrainBook** and in assessing the suitability of **St Bernard**.

use of **GaitSmart** by health care assistants among over 65s in primary care settings to generate a prescription of home-based exercises for patients.

4. Aims of the evaluation

Position of evaluation with respect to the testing of innovations

Our work was conceived as a service evaluation rather than a piece of research. This reflected the position of our evaluative work with respect to the choice and testing of innovations, in that the evaluation team did not have or seek direct input to the design of the test implementation of innovations facilitated by Care City. This was in keeping with the aim of Care City to introduce the testing of innovation with local services as part of "business as usual" rather than run artificial pilots in controlled contexts less relevant to the real world of health and social care delivery. We note here that, prior to and during the evaluation, two members of the evaluation team (Utley and Crowe) had separate seconded roles at Care City and that Utley currently does some paid work for NELFT as a researcher-in-residence at Care City as part of his portfolio of work. We note also that, given the longer-term role of the Test Bed as providing unbiased advice on innovation to the local health economy from a position of neutrality, we saw no conflict in involving Care City staff in the evaluation process or in crediting their contribution to publications etc.

Overarching aim

We set out to provide Care City, as an innovation centre existing prior to the NHS England programme and with plans to continue beyond the end of that programme, with a formative evaluation encompassing data analysis relevant to the innovations being tested (to guide iterative refinement of innovations and how they were being used) and a soft-systems analysis to inform the operation of Care City and the evolution of its role within the local health and social care economy, augmented by summative health economic evaluation. Through our data analysis, we aimed to demonstrate how routine data could be used to support the evaluation of innovation on a longer term basis (and without recourse to academic partners) and establish the fitness for this purpose of the two facilitative information products (**Health Analytics and Orion Health**).

Specific aims

Our specific aims were to:

i) Understand the supposed mechanisms whereby adoption of each innovation would lead to the impact on outcomes, experience and health and social care system costs.

ii) Measure the adoption of innovation in terms of those key points in the sequence of mechanisms identified at (i) observable over the time frame of the Test Bed programme and within the routine data sets available to us.

iii) Identify learning from the analyses at ii) relevant to the iterative refinement and testing of innovations and their adoption.

iv) Develop, where feasible and appropriate, pragmatic health economic models to understand the likely health economic impact of stable innovations, including determination of whether innovations represent a cost-effective use of health service funds.

> With respect to **the novel pathway of screening for AF in community pharmacy followed by referral to a dedicated clinic**, we aimed to answer the question of whether a screening program for over 65's at the community pharmacy level using the **KardiaMobile™** device, with onward referral to a nurse led AF clinic, versus no screening, is a cost-effective use of NHS resources.
>
> We aimed to ascertain the relative cost and benefits of screening all over 65's with the **Kinesis QTUG™** device, and treating those identified with a risk of falling of 50% and above with the **Salaso** online platform, versus no falls screening (note this differs from the 50%-70% risk band employed in the Care City testing). Secondary aims here included identifying subgroups of the population in which screening + intervention would be most cost-effective and to identify further research required to improve confidence in the cost-effectiveness results.

v) Understand the (potentially differing) perspectives of the Test Bed team, Local Authorities, Innovators, Commissioners, Service Providers and other key stakeholders on the roles and responsibilities that a Test Bed should play and have to be a valuable and sustainable component of the health and social care economy in North East London.

vi) in this context, review the role played, tasks performed and responsibilities adopted by the Care City NHS Innovation Test Bed to date.

5. Overview of evaluation methods used

5.1 Research governance and ethics

After preparing a study protocol, to determine the appropriate approval route for our work we consulted the Health Research Authority (HRA) "Defining Research" guidance (http://www.hra.nhs.uk/documents/2016/06/defining-research.pdf, updated in June 2016). We determined that the project conforms most closely to the current definition of "Service Evaluation" rather than "Research".

Having established that NHS REC review was not required, we submitted our evaluation protocol to UCL REC for review. Following discussion with the Chair, UCL REC issued a letter of exemption.

We submitted the study protocol and the UCL REC exemption to the North East London NHS Foundation Trust (NELFT) Research Office for review. Following discussion with NELFT staff, we produced a revised protocol (v2.0), which made minor modifications to make clear the study's classification as a service evaluation. The service evaluation was then registered with the NELFT Audit Team.

5.2 Methods used

Our evaluation drew upon the disciplines of Operational Research and Health Economics. This work is augmented by work to capture the experience of staff and members of the public using the innovations conducted by UsCreates and a process evaluation conducted by a team from NATCEN (both of which are reported separately). We set out below the methods used to address the specific research aims detailed in section 4.

5.2.1 Preparation of logic models

For each of the initial set of innovations, discussions with innovators and the Care City team were held to establish an Action Effect Diagram comprising the logic model for that innovation. Working back from the ultimate goals related to system finances and patient wellbeing, we identified the sequence of links between these goals and the adoption of the innovation concerned. From this, we then identified metrics associated with each step that could potentially be obtained from locally held routine data. We also identified links that were

justified based on existing clinical or epidemiological knowledge, those that were assumptions and those that were acknowledged as uncertain.

5.2.2 Use of routinely collected data to assess activity and service use

For the substantive tests of **KardiaMobile™**, **Kinesis QTUG™,** and drawing on the logic models developed, we requested routine data from health service partners (in anonymised or anonymised and aggregated form) considered relevant to understanding the impact of innovations.

For the early substantive tests of **KardiaMobile™** in primary care, we requested GP practice level data relevant to AF diagnosis, stroke risk scoring and anti-coagulation prescribing, using the GRASP-AF list of Read codes developed by the University of Nottingham [AFReadCodeListheartjnl-2012-303472supp_appendix11] for participating practices and for a set of non-participating practices matched by deprivation and the proportion of the registered population over the age of 65 based on the information available at Public Health England's National General Practice Profiles [https://fingertips.phe.org.uk/profile/general-practice/data#page]. We requested data for a 5 year period to establish a baseline before the testing (among all patients registered over this period rather than just those still registered at request date) and for the period after the testing.

We constructed Statistical Process Control charts to assess whether the introduction of **KardiaMobile™** testing was associated with a beneficial impact on the identification of atrial fibrillation and management of the attendant stroke-risk. Among the practices running dedicated clinics, we used the t-chart to establish whether there was a reduction in the time between successive new diagnoses of AF, as recommended for detecting change in the occurrence of rare events [http://www1.coe.neu.edu/~benneyan/papers/g_chart_overview/]. We then used the p-chart to assess whether there was any change over time at these practices in the proportion of patients with a new diagnosis of AF that were prescribed anti-coagulants within 3 months of diagnosis. We then conducted identical analyses among the corresponding matched practices to check whether any observed changes were observed at sites not using **KardiaMobile™**.

We repeated this approach for the group of 11 practices where **KardiaMobile™** devices were distributed without stipulation as to how they were to be used, and the corresponding matched practices.

As a separate analysis, we requested data relating to AF, cardiology, stroke-risk management and other service utilisation from primary and secondary care for the cohort of individual patients tested and constructed a simple flow chart to report these data.

A similar flow chart was constructed relating to the cohort of patients from the testing of **KardiaMobile™** in community pharmacy prior to the development of the new pathway. For the testing of the new pathway, patient flows along this pathway were constructed using data from the Sonar information system, and these data fed into the health economic analysis of the new pathway (see 5.2.4).

For the testing of **Kinesis QTUG™** in primary care, practice level analysis was performed based on data relating to the number of falls risk assessments recorded as having been conducted and, among those, the proportion of patients recorded as having been given falls risk advice or referred to a falls prevention service, pre- and post- the start of the pilots.

For the testing of **Kinesis QTUG™** in community pharmacy, we sought data from community based falls services (prevention and response), primary and secondary care relating to the cohort of patients tested.

For the testing of the **HealthUnlocked social prescribing tool**, our analysis was limited to data relating to the generation of email prescriptions and subsequent use by patients of the web-based resources.

5.2.3 Feedback of analysis to inform iterative design of testing

We were unable to meet this aim of the evaluation due to markedly different arrangements for data access being put in place than had been originally envisaged and agreed in outline by system leaders, the fact that the planned partnership with Orion Health did not progress and a number of other issues.

5.2.4 Health Economic Analysis

5.2.4.1 KardiaMobile™

A discrete Markov-chain model was constructed to model and compare relevant health economic costs and outcomes among over 65s under two scenarios: a programme of annual screening for AF with **KardiaMobile™ in a community pharmacy setting with onward referral to a dedicated clinic** (the model developed and tested by Care City) versus no

such programme. In both scenarios, the prospect of patients being diagnosed and treated within General Practice was accounted for.

Analysis was performed to estimate the incremental costs and benefits of implementing the program at a national level based on the available data from the Care City NHS Innovation Test Bed. Sensitivity analysis was performed to elicit key variables that influence cost-effectiveness and robustness in our results. Other outcomes included an estimate for the number of strokes that would be averted and the cost per stroke averted.

To populate the model, we used evidence from the literature relating to the prevalence of AF in community settings, the sensitivity and specificity of the **KardiaMobile™** device, the stroke risk associated with atrial fibrillation and the lifetime costs and effectiveness of anticoagulant therapy in reducing this risk. The modelled cohort was of patients matching the inclusion criteria for the Care City pathway (over 65 and without symptomatic AF) and the average CHA_2DS_2VASc score for the area. From a breakdown of the pathway and patient flows through the pathway, we estimated the cost of the pathway as implemented.

Full detail on the methods employed here can be found in appendix 3.

5.2.4.2 Kinesis QTUG™ with Salaso

To conduct the health economic analysis of the combination of **Kinesis QTUG™** and **Salaso**, a decision tree was built in Microsoft Excel in order to incorporate the relevant evidence of costs and benefits of a falls risk assessment tool with onward referral to an online platform where patients will be prescribed falls reduction exercises. The economic model was based on but not identical to the pathway at Care City. Only the costs incurred by the NHS and social services and benefits incurred to the patient (as measured by quality adjusted life years gained, QALYs) were accounted for in our analysis.

As is standard, the economic modelling was set in the context of the next best alternative, which in this case would be the standard of care in the UK for falls screening. In the Care City footprint, and in general in the UK, there is no mandated national screening program for falls. Therefore, a 'do nothing' comparator was chosen, i.e. a patient either falls or does not fall in the year.

Full details of the methods employed here can be found in appendix 4.

5.2.5 Perspectives on the roles and responsibilities of a Test Bed

Soft systems is an operational research approach developed specifically to address complex multi-perspective issues through systematic learning about the problem, decision processes

and mechanisms of change [Checkland P, Poulter J. Soft systems methodology. Systems approaches to managing change: A practical guide. Springer; 2010. pp. 191–242. Available: http://link.springer.com/chapter/10.1007/978-1-84882-809-4_5].

Our first phase of discussions focused on Care City staff and the organisational issues facing Care City given changes in leadership and project management and other personnel changes. The findings from this process were fed back to the current Care City leadership.

The second phase of the soft systems methodology (SSM) analysis focused on exploring the roles and responsibilities of a 'Test Bed entity' with respect to fostering the beneficial adoption of innovation, and in particular any misalignments in the perspectives of different stakeholders on this issue.

The stakeholder perspectives ('worldviews') we explored were:

- Innovators [covering 6 of the innovations, including 3 'dropped' innovations]
- Healthcare commissioners [BHR CCG, Waltham Forest CCG]
- Healthcare providers [NELFT and BHRUT]
- Local authority [Barking & Dagenham LA, Havering LA]
- AHSN [UCLP]
- Care City [past and present members, including both 'implementation' and 'strategic' roles]

Our analysis drew heavily from detailed notes taken at n=27 semi-structured conversations with people spread across these worldviews. It also incorporated 2 years' worth of a broader SSM process of immersion (participation in and non-participant observation of meetings, events, working processes and study of the espoused aims and vision of the test bed as set out in bid documents and public facing web material etc.) conducted alongside these semi-structured conversations.

A core part of the analysis involved developing 'CATWOEs', 'Root definitions' and 'Activity diagrams' for each worldview. These conceptual models were then analysed with a view to highlighting misalignments, key issues and probing questions that could usefully inform future discussions with and between stakeholders.

A list of those involved in the semi-structured conversations with the research team, by organisation and role, can be found in appendix 5.

5.2.6 Activities performed and responsibilities adopted by the Care City team

The soft systems work also entailed an analysis of the activities performed by the Test Bed implementation team. Workshops with Care City staff were held to capture the range of activities and tasks they had been engaged in under a number of different domains. A graphic was then constructed arranging these activities in terms of where on an innovation pathway they sit and in terms of the strategic or operational nature of the work done.

For one innovation (purposely sampled as one of those viewed as a success) we then logged and classified documentation prepared by the team, meetings and events held and communications as a way of illustrating the volume and nature of the “leg work” put in by the implementation team to facilitate the adoption of innovation.

6. Key Findings

The full set of logic models, in the form of Action Effect Diagrams annotated with potential metrics developed for the initial set of innovations can be found in appendix 7 (note these were not fully developed for the innovations that left the Test Bed fairly early in the process).

We present first the findings of quantitative analyses that relate to the key substantive tests facilitated by Care City and their iterative design. We then present findings from the Soft Systems Analysis relating to other innovations and to perspectives on the role and responsibilities of an ongoing Test Bed.

6.1 Innovative technology for screening over 65s for risk of falling

Care City facilitated testing of Kinesis QTUG™ in 2 GP practices. From baseline and post-implementation data in these practices and comparator data from matched practices, it was clear that recorded falls risk assessment increased markedly in the participating practices (from 2% of registered over 65s per year to 9%) and not in the comparator practices, and that the recorded provision of falls risk advice and referrals to falls prevention among those screened increased also**.**

Data on assessments and events thereafter in primary care among patients assessed in the participating practices are shown in figure 1 below. Corresponding data on use of secondary care are shown in appendix 6.

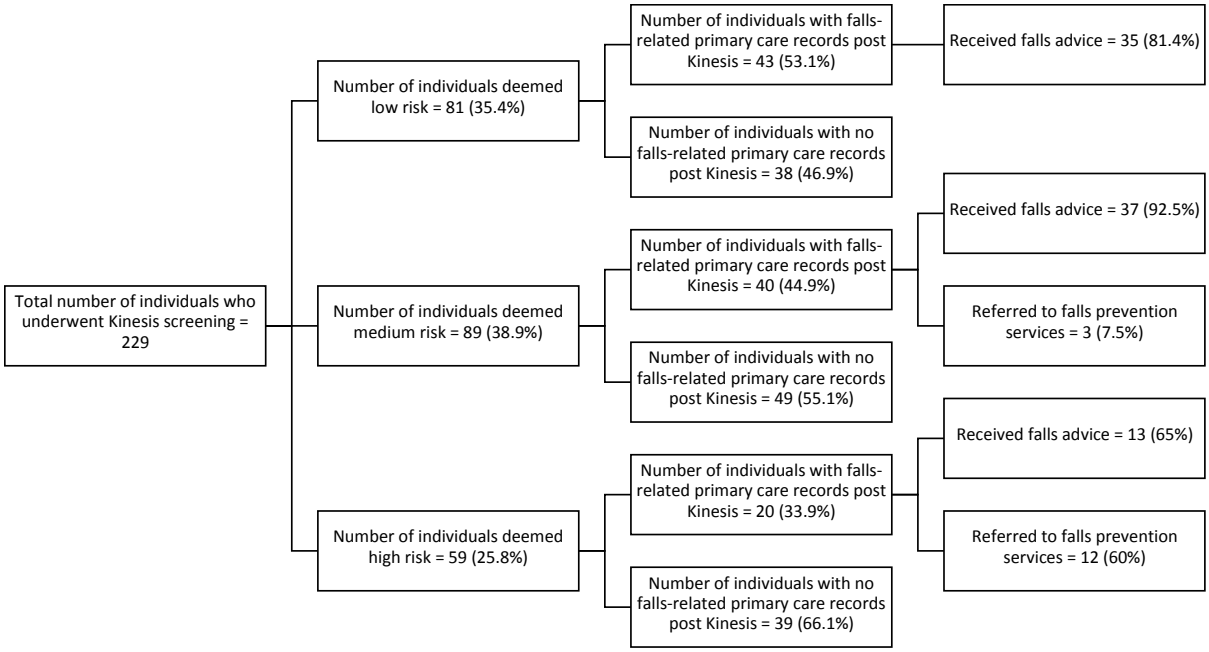


Figure 1: Phase 1 Kinesis screening in general practice and post-Kinesis primary care activity for screened individuals

Equivalent data for the 125 people tested using Kinesis QTUG™ in one of 4 community pharmacies showed that only 1 of the 31 people identified as being at medium or higher risk of falling in the next year were recorded to subsequently have had falls advice provided by their GP or referral to a falls prevention service. Data from the falls prevention service provider (received after the end of the test bed) indicate that 2 patients from this cohort were referred to their service within 3 months of Kinesis screening.

In response to a sense among those involved in the testing that, at least locally, the value of screening for falls risk was constrained by the accessibility of falls prevention services, the Test Bed team recruited the Salaso online platform of physiotherapy exercises to work in combination with Kinesis QTUG™.

Testing of this combination, whereby patients assessed as being at 50-70% risk of falling in the next year are given access to a tailored set of exercises from the Salaso platform proven to reduce risk of falls and patients at higher than 70% risk are referred to a falls clinic, is ongoing at the time of writing and is set out in the appendix 1.

Our health economic analysis focused on the evaluation of a slightly different model whereby all patients with an estimated risk of falling in the next year above 50% are provided with access to the Salaso platform (chosen to be more relevant to the national picture where provision of falls clinics is inconsistent). This was compared to the case of there being no systematic quantified falls risk assessment.

This modelling suggests that this combination of Kinesis QTUG™ assessment and Salaso among the over 65s would incur net costs of £15 per patient per year and yield an increase in quality adjusted life years (QALYs) of 0.0008 per patient per year. Comparing the estimated cost per QALY of £17,595 to the £20,000 threshold value currently recommended by NICE indicates that this would likely be a cost-effective use of NHS funds. Given that the cost of the programme is dominated by the staff time involved in conducting assessments and associated administrative tasks, there is little scope for innovators to improve cost-effectiveness.

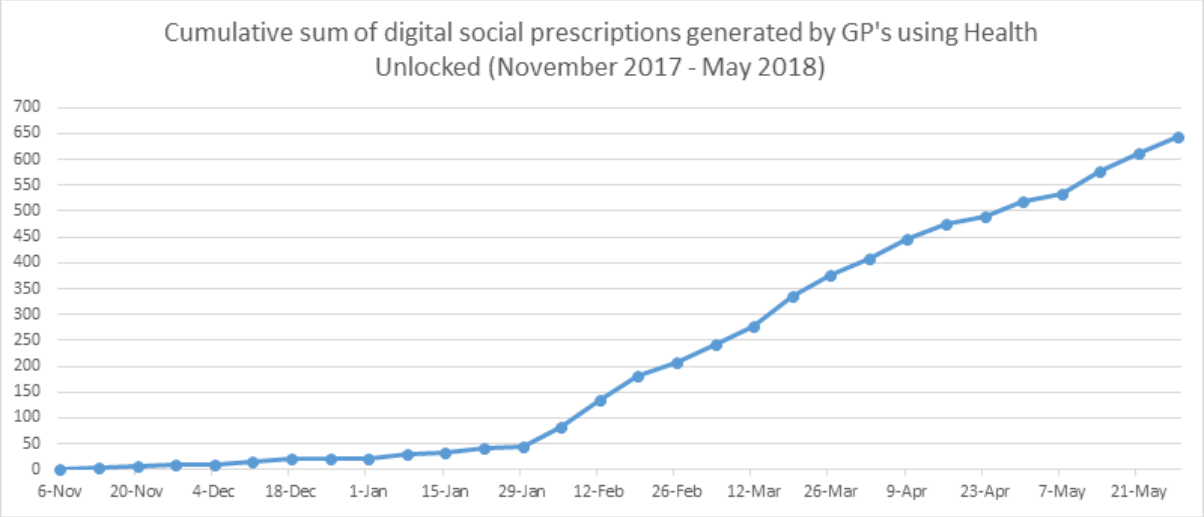
However, the modelling suggests that such a programme would be cost-saving if restricted to the over 75s, with an estimated saving of £73.54 per patient assessed per year and an increase in QALYs of 0.0006 per patient assessed per year.

Several caveats apply to this analysis, perhaps most notably the (necessary) assumption made about compliance to the 12-week exercise programme in the absence of compliance data from the Care City pilot at the time of analysis. If compliance was 50% rather than 70%, the ICER is estimated as £31,000. Note that collection of data from which one can infer compliance is a key component of the Salaso platform, so the assumption of 70% compliance (which was taken from the related literature) could be revisited. It should also be noted that a proportion of patients are being provided with paper copies of the exercises due to them having insufficient internet access to make full use of the intervention.

Full details of the health economic analysis performed can be found in appendix 4.

6.2 Social prescribing in General Practice

The HealthUnlocked social prescribing tool, incorporated into the EMIS patient record system, was enabled in 10 GP practices. The chart below shows the accumulation of the 643 social prescriptions that have been generated by 67 different GPs in the period since. Of the 643 patients that were sent a social prescription by email, 310 (48%) opened the email and clicked through to see their prescription on the web.



Each prescription comprised one or more links to resources or local services, each relevant to one of 15 indications selected by the prescribing GP. The most frequent prescriptions were combinations of resources and information related to healthy eating, weight loss and getting active, with other frequent prescriptions relating to anxiety, low mood and dementia (see appendix 6). From the web analytics data available to HealthUnlocked, only aggregate data is available on the click through from the prescription and so it was not possible to assess the proportion of patients that click through to the resources recommended in their prescription.

6.3 Screening for Atrial Fibrillation among the over 65s in general practice and community pharmacy settings

Initial testing by Care City of the use of **KardiaMobile™** to screen over 65s for atrial fibrillation involved tests in 12 community pharmacies and in dedicated health care assistant led clinics in 3 GP practices.

In the chart in figure 2, the dates of new AF diagnoses in individuals over 65 across the first phase Kardia pilot practices (2 in Barking and Dagenham, 1 in Redbridge) are plotted on the x-axis and the number of days between successive AF diagnoses is plotted on the y-axis. The time period used spans the baseline (January 2012 – January 2017) and the intervention (February 2017 – July 2017). The central limit corresponds to the mean number of days between successive AF diagnoses which is 12 days across this group of 3 practices. Rules for determining a special cause state that a run of eight or more points in a row above or below the central limit indicates a shift in the data.

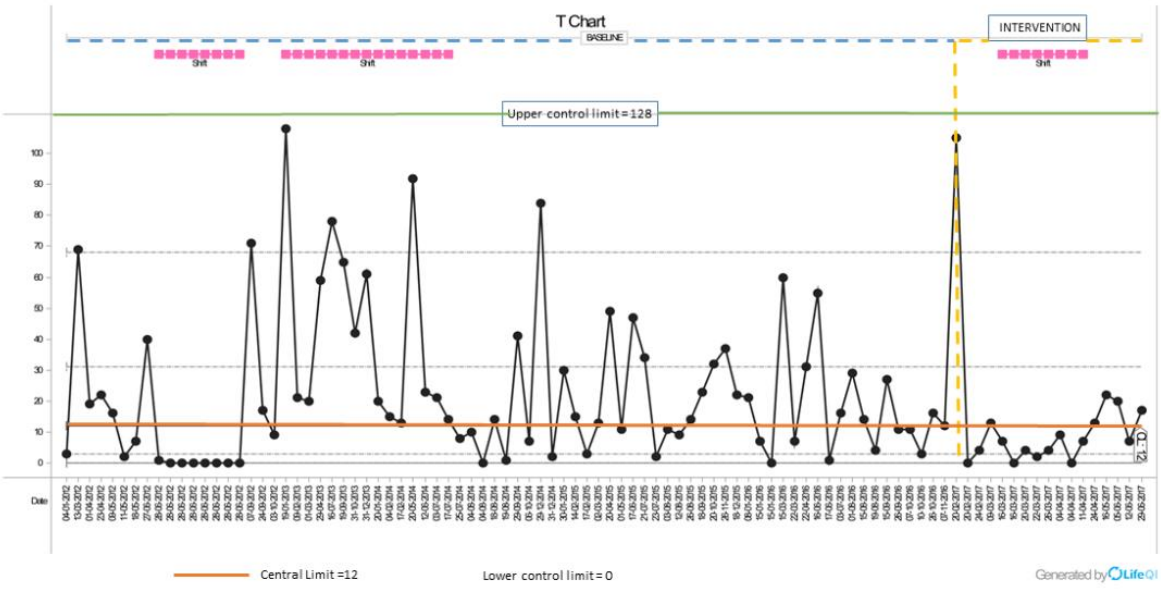


Figure 2: A t-chart of the time between successive diagnoses of atrial fibrillation across the three GP practices involved in the phase 1 testing of KardiaMobile™, before and after the start of the Kardia pilot

In the above chart, post-commencement of the Kardia pilot, there is a sequence of 10 points below the central limit. This indicates a genuine reduction in the time between AF diagnoses at these practices.

There was no contemporaneous change at comparator practices suggesting it is reasonable to assume that this increase in diagnoses was linked to the introduction of dedicated clinics using **KardiaMobile™**. In contrast, there was no discernible change in the time between successive AF diagnoses among the separate group of practices that were simply provided with a **KardiaMobile™** device.

For the practices with dedicated clinics, the p-chart constructed showed no increase in the proportion of patients newly diagnosed with atrial fibrillation that were prescribed anti-coagulants within 3 months of diagnosis.

Patient level data from 2 out of the 3 participating practices is shown in figure 3 below. Data relating to secondary care use is shown in appendix 6.

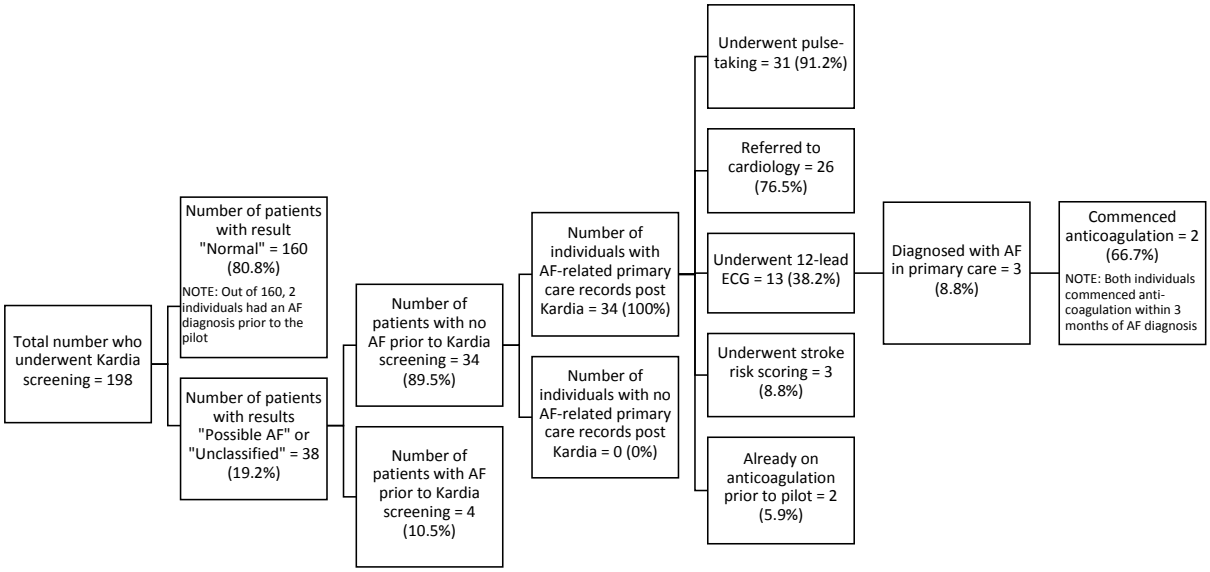


Figure 3: Phase 1 Kardia screening in general practice and post-Kardia primary care activity for screened individuals

The corresponding data for those tested in community pharmacy (in the absence of the novel pathway) is shown in figure 4 below. It can be seen that a lower proportion of those identified as possibly having AF or as having a trace unclassifiable by the **KardiaMobile™** algorithm had subsequent diagnostic activity with their GP and there was just one new diagnosis of Atrial Fibrillation among the 377 patients screened.

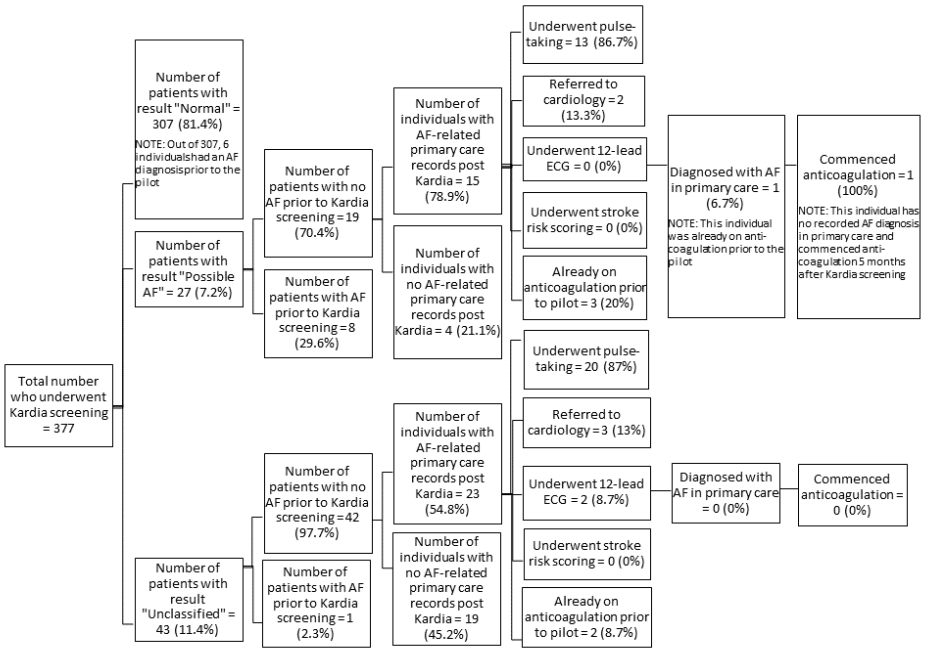


Figure 4: Phase 1 Kardia screening in community pharmacy and post-Kardia primary care activity for screened individuals

Data on secondary care use among these patients (shown in appendix 6) show no support for one early concern that screening in community pharmacy could inadvertently lead to an increase in A&E attendance from screen positive patients.

6.3.2 The novel pathway

The experience of these tests led the Care City team to develop and implement the novel pathway with the intent of ensuring that positive screening results led to further assessment and to reduce time taken for confirmed diagnosis and treatment initiation. The pathway developed is set out in appendix 2. The observed patient flows through this pathway are set out in figure 5 below. Note that subsequent review of the ECG traces by a consultant electrophysiologist indicated that more patients could have been diagnosed with AF and commenced on anti-coagulation than was achieved in the clinic, prompting discussions around how to improve clinician awareness and confidence in the sufficiency of a single lead ECG trace to identify AF and other means of supporting decision making in such a clinic in the future.

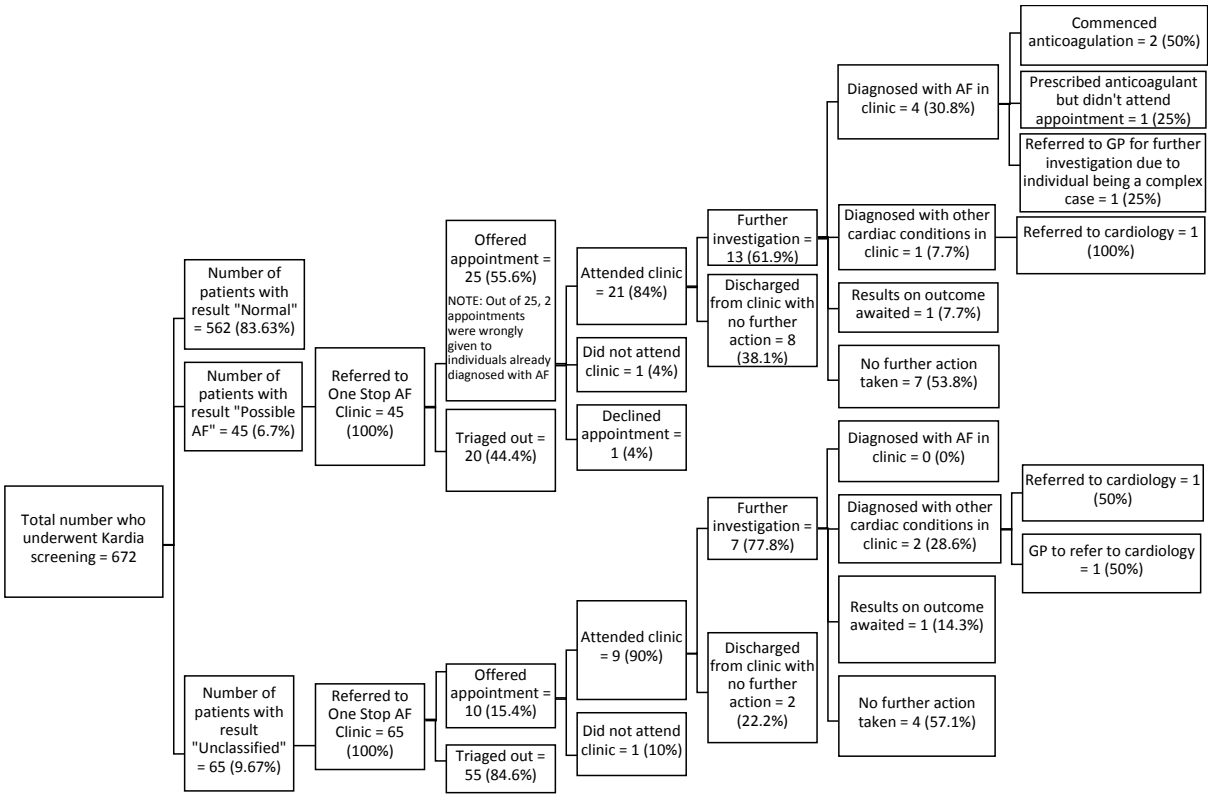


Figure 5: Patient flows through newly developed pathway involving Kardia screening in community pharmacy and onward referral to a dedicated clinic

Our health economic analysis of the pathway (built largely on extant knowledge but incorporating local data where possible) modelled lifetime costs and outcomes among a cohort of over 65s being screened annually using this pathway compared to the costs and outcomes that would accrue with no such pathway in place. In the base case analysis, the mean per patient lifetime cost of no screening was estimated to be £10,370, whilst the mean per patient lifetime cost of screening with onward referral to a rapid referral AF clinic was estimated to be £11,105. This is the average cost per patient from the simulated cohort of 1000 patients. Therefore, the incremental per patient cost of the pathway was estimated to be an additional £735.

The mean per patient estimated QALYs for the no screening comparator was 15.89, over a life time horizon. In the screening group, this was estimated to be 16.26, an incremental gain of 0.37 QALYs per patient. The base case incremental cost-effectiveness ratio was therefore £1,989 per QALY gained, indicating that the pathway would very likely be a cost-effective use of NHS funds under this base set of assumptions.

We also estimated that in the no screening case, we would expect 195 strokes per 1000 person cohort and 155 strokes per 1000 person cohort in the screening case. This suggests a net reduction in observable strokes of about 40 strokes per 1000 person cohort over a lifetime horizon.

In the table below we show the model predictions for the number of patients attending the clinic and the number of confirmed AF diagnoses with those observed in reality.

	Predicted by model (per 1000 simulated patients in year 1)	Predicted by model (per **672** simulated patients in year 1)	Observed in 7 month pilot
Attend AF clinic	10.8% (108/1000)	10.8% (73/672)	4.5% (30/672)
Receive AF diagnosis	4.6% (46/1000)	4.6% (31/672)	0.6% (4/672)

The discrepancy in the clinic attendance rate is potentially down to some of the early problems experienced with trace quality in some community pharmacies and the omission from the model of the triage step. The discrepancy in the diagnosis rate is considered to be

dominated by the issue around confidence in the sufficiency of a single lead ECG trace to identify AF mentioned above.

Given these discrepancies, we evaluated a scenario in which we replicated the number of patients that attended the clinic and received an AF diagnosis with what was observed in the pilot, i.e. 30 and 4 respectively. This was done by artificially varying the true positive and false positive rate of the **KardiaMobile™** device and basing the cost per patient use of the clinic on the Care City data of 30 attendances over 7 months (£1,393 per patient visit to the clinic). This significantly altered the cost-effectiveness results (table below) however the cost-effectiveness decision does not change:

	Screening		***No Screening***		
	Costs	***Effects (QALys)***	***Costs***	***Effects (QALYs)***	***ICER***
Base case	*£11,105*	*16.26*	*£10,370*	*15.89*	*£1,989*
Using observed data	*£11,940*	*16.04*	*£10,369*	*15.89*	*£10,512*

Full details of the health economic analysis of the novel pathway can be found in appendix 3. We note that, because we modelled the effect of anti-coagulation on stroke incidence using results compiled across many study populations, it is intrinsically difficult to comment on how accurate these estimates are for the Care City population. We took the best available evidence from the literature and where possible tried to match patient populations to the Care City population. The relative risk reduction in strokes due to OAC treatment (a key parameter in the model) comes from a Cochrane systematic review (see appendix 3 for details) which collates evidence from several trials and it is not possible to adjust for comorbidities in our transition probabilities without the raw data. Another key parameter (underlying stroke risk) uses the validated CHA_2DS_2VASc score, which in itself changes according to 'comorbidities' such as hypertension, diabetes and CHF. We take the average score from CCG data in the population of interest to better model our simulated patients. As with all economic modelling, the prime concern was the disease of interest and our work was

constrained by the depth and availability of data. Comorbidities could be addressed in a large scale clinical trial within the population of interest and observe long term outcomes in relation to stroke incidence with and without the intervention.

6.4 Canary Care

The Care City team explored the potential adoption of Canary Care with a total of 13 teams across health and social care, including memory services, discharge teams in the acute Trust, social workers putting in place packages of care for patients on discharge and for longer term needs, warden assisted housing, and those responsible for sleeping and waking night nursing. In each case, there was an appreciation among professionals of the benefits that having objective assessment of daily activities could have in assessing or reviewing care needs, and detailed plans for testing were developed for several use cases and a small number of systems bought and installed successfully. But these did not lead to substantive testing.

Reasons cited included financial and practical issues around the time taken to sanction the use of and install the product in clients' home in a timely manner. The view of the evaluation team based on the broader Soft Systems analysis is that the lack of substantive adoption of Canary Care was partly due to the wide range of potential applications (with different professionals taking a different view on who it would be appropriate for or best for) and partly due to an intrinsic problem with information products. In its core, designed use of providing rich information to family members to support their care of an individual, the value lies in the provision of information itself (in terms of the reassurance it gives family and individual) with the recipients able to put this information in the context of their rich knowledge of the individual and their ongoing communication with the individual. For services, it can be argued that information products are valued in terms of the decisions they inform. While professionals could see how Canary Care would give a richer picture of the needs of patients or clients, it was not entirely clear how this information would or could be brought into the decision making processes and in some instances whether professionals had the time to incorporate additional sources of information to their decision making.

6.5 Tasks and roles performed by Care City staff

The two workshops with the Care City implementation team identified a list of 150 distinct activities / tasks that they had been involved in or taken responsibility for, at different levels of granularity. These were captured under 14 identified domains of activity. The graphic below (Figure 6) shows these domains by their nature (strategic or operational) and where they occur on the timeline of the testing of an innovation.

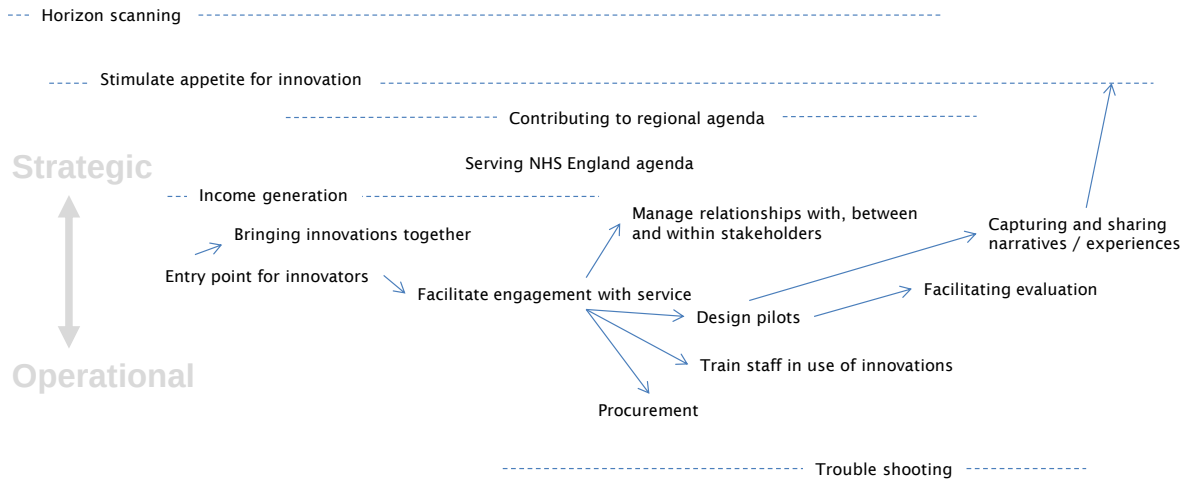


Figure 6: Domains of activity undertaken by Care City for the implementation of the Test Bed

The novel AF screening pathway is viewed by the Care City team as one of its major successes and there has been considerable interest in replicating the model. As an indication of the amount of work put into the design and implementation, figure 7 shows the accumulation over time of the over 400 documents created by Care City related to the testing of **KardiaMobile™** that culminated in the pathway, sub-classified by the domain of activity they fall under. The team were involved in 112 meetings and events relevant to the adoption of **KardiaMobile™** in North East London over this period.

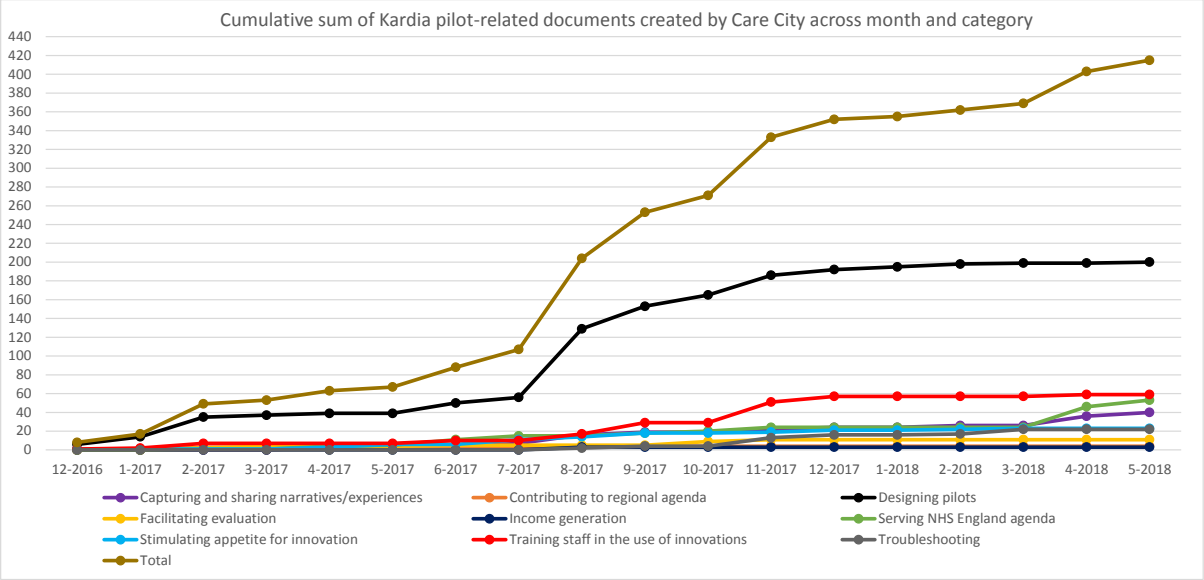


Figure 7: Cumulative sum of Kardia pilot-related documents created by Care City across month and category

6.6 Stakeholder perspectives on the role and function of a Test Bed

The world views of innovators, commissioners, providers, local authority, the AHSN and Care City as identified through the soft systems analysis are presented in appendix 8. The initial feedback to Care City from the soft systems work focussed on the challenges of knowledge management and the gathering of local intelligence for the team following a change in leadership and project management and considerable flux in staffing. Here we focus specifically on alignments and misalignments in the perspectives of stakeholders (including Care City) on the proper role and function of a Test Bed in the future. These are grouped under the topics of selection of innovations, testing of innovations and broader roles.

6.6.1 Selection of innovations

The Care City leadership selected 30 candidate innovations from a long-list of 250 innovations provided by NHS England, choosing those relevant to healthy ageing (40) and then rejecting 10 of these based on the quality of the innovators' submissions. Innovators were then invited to pitch to panels comprised of front line staff and representatives of Care City partner organisations. Innovations were only selected if the whole panel was supportive.

All stakeholders were in agreement that this process was not ideal and there were many suggestions for how this could work better in the future. The role and responsibilities of a Test Bed in two key areas relating to the selection of innovations emerged as important and yet somewhat contested: aligning innovations to local priorities and needs and; the recruitment and 'termination' of innovations.

6.6.1.1 Alignment of innovation with population need

While consistent with the overarching ambitions of the Test Bed, Care City staff and system stakeholders felt (to varying degrees) that the innovations selected were not, in the event, very well aligned with the priorities, needs and context of the local system. This apparent shift in perspective from the selection process might speak to the inevitable difficulty of representatives from an organisation (however senior) having a detailed understanding of current priorities and how work is currently done across a wide range of constituent services. It may also speak to the differing level of scrutiny brought to bear when supporting something on a panel and signing off on paying for something and implementing. Perhaps unsurprisingly, innovators felt that their own innovation was addressing a very important need/priority.

While some at Care City felt there was a role for a Test Bed in identifying population need, others in the Test Bed and other stakeholders felt that this responsibility lay with commissioners and local authorities through the JSNA (Joint Strategic Needs Assessment) process and other existing work streams. All stakeholders agreed that the innovations involved in a Test Bed should address important needs within the population served. Although not articulated by stakeholders, this implies that a key task for a Test Bed may be to work with system stakeholders to go from an agreed assessment of population needs to a set of priorities for innovation, specifically focusing on need that is potentially reducible through innovation. There was recognition among Care City and system partners that greater input from the communities served would be important to this process.

In terms of aligning with the existing priorities of stakeholder organisations, there was a tension within and across stakeholder bodies. While from the perspective of commissioners, providers and local authorities, innovation should serve the priorities and strategies of their organisations, there was an accompanying but dissonant perspective that one role of a Test Bed should be to challenge thinking and be "disruptive", echoed in the perspectives of the AHSN and the Test Bed itself.

6.6.1.2 Recruitment and termination of innovations

In contrast to the “project” style arrangements for the Test Bed *programme*, there was broad agreement that incorporating innovations to the work of a Test Bed should be continual and, at the level of individual innovations, gradual rather than a binary selection process.

It came through strongly from the Test Bed and from innovators that there needs to be much greater clarity in future about what it means for an innovator to be part of a Test Bed. Innovators had considered that being partners to the Test Bed brought with it a firm commitment that their innovation would be bought by the system and tested, with differing views on the support they would get from the Test Bed in terms of product development. However, it became clear that the NHS England prior selection process to identify innovations that Test Beds could partner with did not carry any weight within the procurement process of individual NHS organisations. This meant that NHS partners did not feel they could justifiably purchase innovations for testing without exploring the wider market. Clearer recognition that innovator partners were not guaranteed a financial return from engaging with the Test Bed and, separately, that Care City could not strongly influence commissioning or purchasing decisions would have saved innovators’ time and resources. The inception of a pooled innovation fund held by Care City eased this second concern to an extent. Also, some innovators came into the Test Bed thinking it was an opportunity to get help in product development, which clashed with the perspective of the Test Bed that (with the exception of HealthUnlocked) the innovations were and should be quite mature.

At a finer level, there lacked clarity regarding where the roles and responsibilities of the innovators end, where those of the system begin and, by implication, the roles and responsibilities of the Test Bed acting as a bridge between the two. There was a shared perspective among Test Bed and system partners that some innovators should do more background work on the characteristics and number of potential beneficiaries and a starting view as to the services within the health and social care system where innovations would best be deployed.

6.6.2 Testing of innovations

System stakeholders were generally aligned in the key components that they expected from piloting, e.g. using a robust methodology (such as Quality Improvement); involving appropriate stakeholders; examining and potentially changing pathway(s); establishing evidence of impact and capturing the implementation process to support uptake.

From an innovator perspective, the activities required of a Test Bed at this stage are specific to their own needs, and may involve a subset of the possible roles that a Test Bed could offer. In this worldview, a Test Bed would invest activity upfront to properly understand an innovator's key challenges given the stage of their product and the nature of their organisation, then consider what relevant, customised, support they are able to provide.

From a Test Bed perspective, there may be a need (if possible) to assess the nature and level of such support either during a recruitment phase or once recruited, weigh this against the potential benefit, and consider whether this is the best use of its resources.

This could incorporate forming an early view as to the extent to which an innovation would fit with, add to, replace or disrupt current work done by system partners and their staff (focusing on "work as done" rather than "work as imagined" [Blandford A, Furniss D, Vincent C. Patient safety and interactive medical devices: realigning work as imagined and work as done. Clinical Risk. 2014; 20(5):107–110. Available: http://journals.sagepub.com/doi/pdf/10.1177/1356262214556550]) and a realistic assessment of any challenges this presents to adoption. This might require greater upfront involvement from potential adopters, but this in itself could act as a test of genuine appetite for the innovation.

Partner NHS and Local Authority organisations had the perspective that the project status of the Test Bed led to an undue pressure on Care City to "make things work", undermining the sense that Care City was working in the interests of the local system rather than the narrower interests of the NHS England programme.

Care City and innovators in particular recognised the substantial amount of 'legwork' involved in piloting, e.g. training staff in the use of new technology, developing consent forms and SOPs, and generally keeping momentum going. However, there was a range of views, and perhaps some tension, regarding the extent to which a Test Bed entity ought to carry out the tasks themselves (on the basis that the system lacked either the capacity or capabilities to do so), or whether much of the legwork would need to become part of the system's business as usual in order for testing and adoption of innovation to be sustainable at scale.

A possible middle option emerged whereby a Test Bed would play a role in defining the activity (training, system change etc.) required alongside a technology to make it work in practice and play a supportive role in agreeing who takes responsibility for that activity, which may be a combination of the Test Bed, system and innovators. This could focus on activating capacity in the system where it exists, identifying where the responsibilities of innovators reasonably lie, and the Test Bed taking on the remaining necessary activity.

Many within the Test Bed were keen for the activity involved in piloting to be captured and, where possible, for this to be 'packaged' into templates and standardised processes so as to streamline the activity involved in future adoption either in other parts of the local system or nationally, or for other innovations (particularly similar types of technology or innovations deployed in a similar service). This chimed with the AHSN perspective that a Test Bed ought to use the wider innovation architecture to share products (e.g. IG contracts, blue prints, evaluation results) with adopters in other localities. However, to do this a Test Bed would need to devote time to robust methods of knowledge management and developing 'products', which would mean diverting some of its limited resources away from other roles.

6.6.3 Broader support for innovation

System stakeholders and Care City were aligned in considering that the role of a Test Bed extends beyond the recruitment and piloting of individual innovations, and that a Test Bed would also conduct activity towards:

> strengthening the system's readiness for innovation by supporting senior leaders to create a receptive culture, helping to build local confidence and capabilities in relation to innovation and inspiring others to innovate;
>
> providing consultancy and being the 'go to place' for advice about innovation locally (and on some topics nationally);
>
> generating inward investment and attracting innovators and research to the locality so as to foster innovation but also to promote social regeneration, a key priority for many of the system stakeholders.

These perspectives on the roles a Test Bed could take have implications for the staffing and expertise available within, or through, a Test Bed. Specifically, there was a view from innovators that a Test Bed should offer expertise on financial flows within the local health economy to enable clearer understanding as to where expenditure on their innovation and savings from their innovation would fall. This might also necessitate expertise in helping to develop and communicate risk and benefit sharing models, particularly where expenditure and savings do not fall within the budgetary boundaries of a single organisation. A perspective shared by several stakeholders was that the Test Bed should have expertise about how services work and how jobs are currently done, pointing towards a model of the Test Bed being able to draw on local expertise through temporary secondments, possibly as part of the service's commitment to testing innovation.

6.7 Learning from the innovations that were not adopted at appreciable scale

After several discussions, the CCG took a view that the upfront costs requested by **Health Navigator** made the scheme unaffordable in the current financial climate. Also, the CCG stated that it has plans to develop a similar coaching / navigator role in the future and this may have influenced their decision not to commission a commercial coaching service.

The view of the evaluation team is that Health Navigator may have faced some challenges specific to the nature of the innovation. The innovation on offer here was to use the CCG's own data in a novel way and then deliver health coaching, partly to help patients use CCG commissioned services more effectively. Some within the CCG might have felt that this was the sort of thing that could be done as effectively "in house", which would chime with the CCG having since developed non-clinical coaching / navigator roles since, although these are targeted at current high users rather than a cohort of users predicted to become high users.

Toward the end of September 2016, Care City were informed by parent company IXICO that, following a review of priorities by the IXICO board, they would be looking for a commercial healthcare partner to licence **MyBrainBook** rather than pursue the deployment of MyBrainBook directly themselves. No partner was found and Care City decided to disengage from MyBrainBook in early November 2016.

The implementation of JDR within NELFT's Rio system was significantly delayed, with this attributed to two factors. Locally, JDR's spin out from UCL proved slow and complicated, leading to uncertainty around the use of intellectual property built up by the project. Nationally, JDR's partners were unsure about supporting its roll-out and integration with hospital systems, amid uncertainty about whether a 'consent for contact' function was better provided as part of broader changes to digital infrastructure nationally. As a result, the integration of JDR within Rio could not be tested with patients during the life of the Test Bed. However, NELFT and JDR do still plan to deliver this functionality.

The local authorities expressed a number of concerns about the solution offered by **supportspace**. Specific concerns included a sense that the innovation was under-developed (with no active users of the product) compared to the initial pitch of this innovation and that the solution presupposed the availability of information that one local authority did not have. There was general unease that the feature of **supportspace** that would allow care

professionals to “rate” clients would breach professional duties of confidentiality. While the innovators had the view that the specification of the tool could be changed, and that such product development / refinement would be part of the Test Bed process, Care City decided to disengage from **supportspace** in November 2016.

The GPS device designed for use by people with Dementia prone to purposeful walking, **St Bernard** was perceived, after some internal testing by the Care City team, to have some technical deficiencies that made the team reluctant to actively support its adoption. Also, other, similar products were being used successfully within the Care City footprint and some surprise was expressed that this device was included in the NHS England list of innovations given the other devices available on the market.

As detailed in section 6.4 above**, Canary Care** was not adopted for testing at any appreciable scale by any of the 13 teams across health and social care that Care City engaged with, despite being widely recognised as a high quality product that professionals felt could be a valuable addition to the care and support offered to people by family and other informal carers. One reason for this combination of enthusiasm and lack of adoption seems to be a lack of shared understanding around the relevant workflows within health and social care and how they could or would need to change to incorporate the use of Canary Care and the review of the information it provides.

7. Conclusions and implications for scale and spread

We begin with comments relevant to the wider adoption of specific innovations tested by Care City before discussing the broader learning from the Test Bed with implications for scale and spread of innovation in health and social care and the operation of a future Test Bed.

7.1 Care City Test Bed innovations

Screening over 65s for risk of falling in community pharmacy and in primary care conducted by pharmacy assistants and health care assistants using **Kinesis QTUG™** was shown to be feasible. However, where there is limited availability of falls prevention programmes, screening in isolation of other innovation or service development is unlikely to bring benefits. The combination of falls risk screening in general practice using **Kinesis QTUG™** with a prescription to falls prevention exercises on the **Salaso** online platform is more promising. Our health economic modelling suggests that such a programme for over 65s could be a cost-effective use of NHS funds and that a programme restricted to over 75s could be cost-saving to the NHS. This finding comes with major caveats. For instance, because testing was not complete at the time of analysis, we had to make assumptions around the compliance of patients to the online exercise regime and the modelling should be revisited once compliance data become available.

The **HealthUnlocked** social prescribing tool has been shown to be feasible and acceptable to GPs, with steady use to generate emailed social prescriptions to resources designed to support patients in self-care, particularly in the areas of healthy eating, weight loss and getting active. Having the tool successfully embedded within one of the major GP information systems increases the prospect of this innovation being scaled relatively easily if it finds favour with GPs. The “open and click-through” rate of 48% was not out of line with expectations in ehealth interventions.

However, the scope of our evaluation did not extend to tracking subsequent patient use of the resources or, given the timescales, subsequent outcomes or service utilisation. A fuller, bespoke evaluation could explore issues around the accessibility (in terms of digital inclusion and language) of the intervention, attempt to have web-analytic mechanisms in place to track through usage at a more refined level and measure impact in terms of service utilisation and outcomes.

Screening for atrial fibrillation in community pharmacy without a dedicated onward referral process to facilitate diagnosis and appropriate anticoagulation is unlikely to bring benefits.

Dedicated screening clinics in primary care with health care assistants using **KardiaMobile™** among over 65s proved feasible and led to an increased level of AF diagnosis. It did not however seem to be associated with any increase in the proportion of diagnosed patients that were prescribed anticoagulants in a timely manner.

The combination of screening for atrial fibrillation in community pharmacy by pharmacy assistants using **KardiaMobile™** with onward referral to a dedicated clinic in secondary care was shown to be feasible, with secure information sharing between partners provided by Sonar. Our health economic analysis indicated that a programme of annual screening among over 65s using such a pathway is likely to be a cost effective use of NHS funds but, without a marked decrease in lifetime costs of anti-coagulation, would not be cost-saving. The innovative pathway is aligned with local and national policy initiatives around increasing use of community pharmacy as a setting for screening and health promotion and is designed to avoid increased demand in primary care.

We consider that these attributes would make it an attractive service for other localities to adopt. However, it should be noted that considerable work went into developing and refining the pathway, specifically engaging with clinicians in primary and secondary care to explain the rationale and understand and respond to their concerns.

As with many innovations, spread is likely to be reliant on sharing learning and local adaptation rather than simple roll-out. To this end, the development by Care City of resources (the service blueprint, standard operating procedures etc.) for sharing with other localities is particularly valuable. We note that Care City are exploring ways in which the pathway could be improved in terms of the decision making prior to and within clinics.

Our evaluation does not provide support for the other innovations that partnered with the Care City NHS Innovation Test Bed, although this doesn't constitute in all cases a negative assessment of their potential to contribute beneficially to health and social care systems.

A shared perspective among stakeholders was that several of the problems encountered in pursuing the adoption of these innovations were rooted in the initial selection process whereby the Test Bed chose the innovation partners it would work with. These problems included partnering with innovations that, while aligned to the overarching aspirations of the system, were not well aligned with the immediate priorities of the organisations, their financial context or the operational detail of the work that innovations were intended to enhance or alleviate.

Another problem acknowledged from several perspectives was that there was a lack of clarity at the outset concerning what it meant for an innovation to be in the Test Bed, with some unfounded expectations of guaranteed sales on the part of innovators, expectations of product maturity on the part of the system, and the support of senior system leaders not always transmitted to other parts of their organisations.

As examples, Health Navigator, despite having trial based evidence of generating savings in other health systems, struggled to secure upfront investment, with decision makers in the system feeling so financially constrained that “invest to save” was no longer considered an option.

There was also a (perhaps understandable given novel structures) lack of clarity around the roles and responsibilities of the Test Bed with respect to supporting the adoption of innovation. The roles taken on by Care City expanded over time to fill the gap between where innovators saw their responsibility ending and where services saw theirs beginning, with for example Test Bed staff training front-line staff and developing resources to support appropriate use of the innovations. These and other changes (for instance the inception of an innovation fund subscribed to by partner organisations to enable procurement of innovations for testing purposes) were departures from the original ambition to facilitate innovation on “business as usual” terms, albeit departures that were essential to Care City making progress as a “project”.

There is tension between the Test Bed as a project (with a degree of institutional investment in the success of particular innovations and the risk of being seen to serve an NHS England agenda rather than a regional agenda) and shared perspectives on what good would look like for an ongoing Test Bed.

There was a shared perspective that the process whereby innovations are incorporated to the work of a Test Bed would be better if continual and gradual. This points towards prospective innovations being subject to a number of filters and assessments prior to substantive testing. These would include, for example, an assessment against a periodically updated set of system priorities for innovation, an assessment of where in the system expenditure and savings would accrue, input from and shadowing of front-line professionals to understand how an innovation would fit with, add to, replace or disrupt current work as done. Expectations of the extent to which innovators should be in a position to address these questions at the outset and what support a Test Bed could offer innovators through this gradual process should be made explicit.

Indeed, the key recommendation emerging from both the substantive tests and the soft-system analysis is that Test Beds and innovators need to give very careful consideration to what changes would be required to patient pathways and other work flow for the potential benefits of innovation to be realised. This is especially relevant when there is a long chain of events required between the point of using an innovation and the accrual of improved outcomes and/or lower costs.

Within this process, a Test Bed may consider it valuable to take a portfolio approach, where the support they are prepared to offer an innovator is determined by the potential risk and benefits of that innovation and how working with that innovation augments the Test Bed as a whole. These considerations and the broader role that a Test Bed might take on in supporting organisations in innovation have implications for the skills available at or through a Test Bed, with access to expertise on financial flows within health and social care and access to insights from front-line staff considered particularly important.