Final report

February 2017

Innovating for Improvement

Smart Rehabilitation at Home before and after Lung Surgery

Heart of England NHS foundation Trust (HEFT)

The Health Foundation

About the project

Project title: Smart Rehabilitation at Home before and after Lung Surgery

Lead organisation: Heart of England NHS foundation Trust (HEFT)

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Part 1: Abstract

Pulmonary rehabilitation before and after Lung surgery is associated with a reduction in post-operative complications, enhanced recovery and improved quality of Life. The best way to deliver such rehabilitation has not yet been established. Currently COPD type pulmonary rehabilitation programmes running consisting of exercise training, self-management education, nutritional and smoking cessation supports are commonly used. In our unit we have demonstrated improvement in complications and hospital readmission rates with the use of this type of rehabilitation.
A cohort study running for 18 months tested the efficiency of the pulmonary rehabilitation classes. The attendance / compliance rates and waiting times for these classes were examined further in order to develop a more effective programme. Using the multi- disciplinary team and patient feedback the issues that occurred in the initial programme were addressed. Patients' motivation was good in the initial rehabilitation programme but there were delays getting patients to attend sessions prior to surgery. Only 48% patients re-joined the classes after surgery. There were multiple reasons for not attending such as; undertaking chemotherapy (37%), medically unfit (23%), personal choice (30%) and capacity issues (13%). From our research conducted it is evident that there is a need for an at home pulmonary rehabilitation service which can be provided at the patient's ease.
Whilst we have shown that a COPD type rehabilitation programme can be delivered effectively to surgery patients; there is limited evidence regarding whether COPD rehab can be delivered at home with an app. Therefore there is a need to know the viability and effectiveness of a bespoke app for lung surgery rehabilitation.

The aim of this study was to establish the feasibility of delivering a pulmonary rehabilitation service that can be delivered effectively at home at the convenience the patient through a tailored smart home device app. This App provided an innovative portable system suitable for the home-setting. It provided adaptive feedback not previously available. Healthcare staff could be able to utilise the data recorded for monitoring and therapy purposes. The app has been developed for an apple I pad using a Bluetooth pulse oximeter to measure the heart rate and O2 saturations during exercise. Patients could follow the step-by-step exercise instructions on the Ipad displaying patient heart rate, exercise time remaining in seconds, and gain useful feedback. We also wanted to provide an in-depth understanding of how patients have used the app and how it has contributed to their health and well-being. In addition, identify any unintended consequences for patients and their families to enable us as researchers to identify ways in which the app and its use can be improved.

Initial set up phase ran very efficiently, comprising of action plans for each month which include specific job roles for each individual member of the team. We had ensured effective communication through regular meetings and emails. Collaboration with various departments was key to the delivery of action points. The main challenges in the set up phase were recruiting staff to implement the distribution of the app to patients and to validate the data collected from the app. A part time Physiotherapist was recruited as part of the team to assist with the initial baseline sessions with the patients and training on usage of the app. At the early stage the app was not fully developed and needed improvement in regards to the feedback

questions and exercise videos. As the project lead; I had to manage the project on a day-to-day basis on behalf of the project sponsor. The main responsibilities were to set out the structure of the project, develop working plans to ensure project delivery, support and monitor the app development team. Another challenge that affected the progress of the project immensely was equipment failure. We found that the fully functioning oximeter and heart rate monitor with strap was not compatible with the app therefore an alternative oximeter was found.

The app seemed to have had very good feedback and from the early stages appeared to be doing what it is supposed to. The project had a good rhythm. I.e. design, development, testing, feedback and around through the same cycle again. It worked well with all team members. In terms of clinical measures, the app group performed well compared to the ROC group. The outpatient based pulmonary rehabilitation programme (ROC) is costed at £216 per patient whereas the Fit 4 Surgery app programme is costed at £178 per patient. The app seems comparable to running the pulmonary rehab classes therefore given that most patients loved using it, it has shown to be a viable alternative to pulmonary rehabilitation classes.

Part 2: Progress and outcomes

We recruited 40 patients overall to the project, there were 7 patients that had withdrawn from the project before using the app due to various reasons such as surgery being cancelled, having alternative treatments, attending pulmonary rehab classes or inability to complete the exercises. The project set out to evaluate the benefits of a smart device based rehabilitation programme in terms of clinical outcomes and patient acceptability and compliance. What follows is a discussion of the clinical outcomes.

Data was collected for both patient groups over the same time period. This allowed the project group to mitigate for system bias such as hospital operational decisions made in response to winter bed pressures. It was hoped that patients using the smart device app would experience benefits either better or comparable to patients following the outpatient pulmonary rehabilitation programme.

As such, the following clinical outcome measures were recorded for both patient groups:

- Pulmonary Complication (PPC) rate
- Inpatient length of stay
- Reduced ITU admissions
- ITU length of stay
- Length of high dependence (HDU) intervention
- 30 day hospital readmission rate due to surgical complication

As with the outpatient based pulmonary rehabilitation programme (ROC), the at home smart device (app) based lung rehabilitation programme aims to improve patient “fitness” for surgery, thus reducing post-surgical complications and enhancing recovery.

The two groups compare as follows:

	Smart device rehab (app) group	**Outpatient Pulmonary rehab (ROC) group**
Number of patients	32	47
PPC rate %	**9.4%**	**10.6%**
Hospital mean LoS (days)	4.4 days	4.8 days
Hospital mode LoS (days)	2 days	3 days

Unplanned ITU admission rate %	6.3%	0%
Unplanned ITU mean LoS (days)	1 day	0 days
HDU mean LoS (days)	2.8 days	2.2 days
HDU mode LoS (days)	1 day	2 day
Readmission rate %	21.9%	12.8%
Readmission mean LoS (days)	5.3 days	3 days
ITU readmission rate %	3.1%	0%
ITU mean readmission LoS (days)	5 days	0 days
Per patient cost of 1st inpatient episode beyond minimum intervention & LoS (this does not include app or ROC costs)	£947	£1202

Overall, the app based group performed well compared to the ROC group.

The key headline clinical measure is the post-operative pulmonary complication (PPC) rate. As can be observed the app based group had a lower PPC rate than the ROC group, 9.4% and 10.6% respectively.

The average hospital inpatient length of stay was slightly shorter for the ROC group that the app group 4.4 and 4.8 days respectively. However, the app group typically only remained in hospital for 2 days' vs 3 days for the ROC group.

Unplanned ITU admissions was one area where the app group performed noticeably worse than the ROC group. Whilst the app group had an ITU admission rate of 6.3% the length of stay was only 1 day. It should be noted that this was only two patients but this is an area that requires further monitoring.

When leaving theatre and returning to the ward, all patients are admitted to a HDU bed. As such, the HDU rate is not provided. What is off importance is the length of stay in HDU. Whilst we observe little difference between the two groups, on average the app group have stayed slightly longer than the ROC group with 2.8 and 2.2 days respectively. However, as with inpatient length of stay the app group typically stayed less time in HDU than the ROC group, 1 day vs 2 days respectively. Having

reviewed the data. one app patient stayed in HDU for 11 days thus skewed the data.

Finally, it can be observed that the app group had a noticeable higher three month readmission rate than the ROC group 121.9% and 12.8% respectively. The app group also had longer average length of staff once readmitted with 5.3 days vs 3 days. There was also a readmission to ITU for a patient on the app group. This gave a 3.1% readmission to ITU rate with a length of stay of 5 days.

In terms of clinical measures, the app group performed well compared to the ROC group.

Secondary outcomes
The Exercise capacity test had been changed to the Incremental shuttle walk test (ISWT). This test had been chosen instead of the 6-minute walk test as it has been shown to be more valid and replicable when assessing exercise tolerance in the patient group. The ISWT measured the distance the patient can walk until exertion.

The ISWT had been performed at first assessment prior to pre-operative rehabilitation, just after pre-operative rehabilitation before surgery and then after surgery at 4 weeks and 6 weeks' time point. This has been changed from the original time points mentioned in the original project aims as we felt it would be unfair for patients to complete an exercise capacity test just after they have had major lung surgery.

Quality of life had been measured using EORTC QLQ-C30 (version 3) and cancer specific EORTC QLQ - LC13 before surgery and after surgery at 4 to 6 week follow up and at 3 month follow-up by the project lead.

In addition interviews were conducted to assess acceptability and issues around compliance with the app as well how well the app matched their needs. Semi-structured qualitative patient interviews were undertaken after patients have finished using the app (4-6 weeks after surgery).Interviews were conducted by telephone in order to minimize the impact on patients following major surgery. An interview framework was developed using evidence from the use of pulmonary rehabilitation apps with other patient groups, and drawing on previous experience of running the rehabilitation study.

We also incorporated feedback questions into the app for the patients to complete after they had finished the exercise sessions. From discussions with the team measure of wellbeing tools were chosen but it was upon advice from the qualitative researcher and patient representative it was decided that measure of wellbeing tools tend to be rather too general e.g. integrating physical and psychological health; looking at self-perceived health; longevity; health behaviours; mental and physical illness; social connectedness; productivity and social and environmental factors. Completing these after every session was likely to be too onerous and wouldn't yield the kind of data we were interested in term of the patients' interaction with the app. Therefore the BORG scale of breathlessness was used instead as this is a subjective measure of exertion tool. It is a validated and simple to use measure that could be completed at the end of each session.

Alongside the patient feedback, audio notes were also collected from the app. This was a facility that was added to improve information gathered on the usage and compliance of the app. Patients were generally happy with the idea of using the app to complete the exercises at home. It was found that the intensity of the exercises needed to vary in order to satisfy the variety of patients that use the app as some may have a high physical activity level and others may not be as physically fit. Therefore, different versions of the exercises were recorded so that patients may increase or decrease the exercises if they wish to do so. In addition, from feedback it was evident that some patients were completing extra physical activities such as going for a short walk, so they were given the option in the app to input this data in.

In appendix 1 you can see an overview of the data collected from patients recruited in this studies that have had their surgeries. As you can see the age of the patient varies, the table specifies how many exercises sessions they completed, on average the duration of the exercises and the average BORG. The result we are most impressed with is the improvement in exercise capacity after using the app before the surgery. This indicates that usage of the app may have an impact on the conditioning of the patients.

Each patient was asked to complete an ISWT bfore they start rehab and just before surgery. As you can see from the appendix, out of the patients who attended both pre and post rehab ISWT appointments, 87 % improved their walk test results after completing exercises using the app. As the data is collected under a research environment by a very experienced research team, who abide by good clinical practice guidelines, the validity and reliability of the data collected is of a high standard.

Qualitative data

Semi-structured telephone interviews were undertaken with 13 patients by a qualified qualitative interviewer at University of Birmingham to avoid bias and also increase validity and reliability of the information collected. There were 7 females and 6 males that were interviewed. The aim was to explore the acceptability of and any issues around compliance with the app as well as how well the app matched patients' needs. They also explored how patients felt the app impacted upon their recovery and levels of health. Interviews were undertaken around 1-2 weeks after patients have finished using the app (approximately 4 weeks after surgery). Five patients who initially consented to be interviewed later decided that they did not wish to take part for health reasons (n=3); has lost their voice (n=1) or were no longer contactable.

All patients who had been referred for lung surgery were eligible for interview and interviews were be conducted until saturation was achieved (n=13). Interviews lasted on average around 20 minutes.

A framework for the patient interviews was developed in months 1-2 of the study set-up period, with reference to the literature and evidence from the use of pulmonary rehabilitation apps in other patient groups. It drew on previous experience of running the rehabilitation study (ROC – SHINE 2010). The framework was discussed with the Clinical Research Ambassador Group (CRAG) based within Heart of England NHS Foundation Trust. Input was also sought from our PPI representative who is a lung

cancer patient and also a public health researcher with extensive experience in qualitative methodology.

The following areas of interest were explored with participants:

- Motivation for using the app
- the effectiveness of staff communication and written communication about how to use the app e.g. did patients feel that the training and instruction were adequate
- the usability of the app
- impacts of the app upon perceived (and actual) levels of fitness
- any specific problems encountered using the app
- any factors that influenced their use of the app
- overall feedback (e.g. how the app influenced compliance with an exercise regime)
- what aspects of the app were particularly useful
- Recommendations they may wish to make to the research team (e.g. what may improve acceptability and compliance with the app).
- All interviews were digitally recorded and transcribed. The transcripts were analysed using content analysis to categorise and highlight the important messages from patients using the app.

Motivation for taking part in the study

There were six motivations for patients' participation in the study although the predominant reason was that taking part would help benefit others in the future. Other motivations included wanting to improve fitness levels and preparedness for surgery; to improve their recovery; to support the research team and staff at the hospital and as one patient stated 'it's common sense'.

Ease of use/instructions to use the app

All of the patients found the verbal and written communication relating to the app straightforward. They felt that the research and clinical team who were involved in the project fully explained how to use the app:

'I saw the consultant, then the nurse and the research team presented what they were doing and explained how to use it' (Pt 1)

Almost all the patients had some experience of using digital technologies to varying degrees. One patient had experience as a web developer and had been impressed with the app. Other patients with less experience and confidence also found it easy to use:

'It was exactly as it should be...simple to use, informative… you could get into it straight away' (Pt 3)

Positive aspects and features of the app

Patients reported a wide range of positive aspects of the app which included the following:

It was accessible and easy to use as you could use it in the comfort of your home. It enabled patients to set their own pace and decide how much they felt able to do on a given day. One patient found part of the app's appeal was the fact it was 'idiot proof'. Being able to compete with oneself was found to be helpful and motivational and two patients did the exercises with their partners. The simplicity of the app also meant

that the exercises were repeatable even after the app had been returned and one patient described the exercises as being instilled in in them. A number of patients found that being able to see their oxygen levels and heart rate via the oximeter was motivational and the variety of exercises was also welcomed. The novelty factor of using the app for exercise was appealing to some patients and even patients who had good levels if fitness prior to using the app found benefit in using it. The range and variety of exercises was also seen as positive.

Problems and tips for improvements

As is crucial to this feasibility study, we focused upon feedback from patients in terms of any problem they encountered with the app or if they had thoughts around any improvements that may make the app more acceptable. Despite the overall ease of use, patients identified a number of tips and areas that may improve patient experience and utility of using the app. Sometimes the app didn't record that an exercise had been undertaken which led to feelings of frustration and some patients experienced problems with the oximeter not recording oxygen levels. Three patients noticed that the batteries on the wristband ran out frequently. All these issues were fed back to the technical team and were rectified.

Two patients thought there could be a facility to record scores, to allow them to compete with themselves. This could work particularly well for competitive people. One patient thought the voice that was used on the app was a little monotonous and could be 'jigged up a bit', whilst another felt that the voice could be a little more motivating telling you 'come on…do another one [exercise]' [pt12].

Perceived impact upon fitness levels

Patients had various levels of fitness prior to surgery but overall, virtually all patients found benefit from using the app. Three patients found the upper body exercises helpful post-surgery. Some patients struggled to achieve similar activity levels post-surgery due to ongoing pain or post-surgery complications, but all patients understood the importance of keeping up with some level of activity.

In summary, this patients' experience of using the app were positive. Success seemed to be contingent upon both the ease of use, personal levels of motivation and health status.

Part 3: Cost impact

Funding for the lung cancer pathway is complicated. NHS England only commissions the thoracic surgery element of the lung cancer pathway with the remained of the pathway funded by CCG's. This does not include other treatment for lung cancer. But exactly what's interventions are included as part of the thoracic surgery tariff is unclear. As such, instead of attempting to understand and assign separate hospital, NHS England and CCG costs, a pragmatic evaluation of costs between the two groups has been undertaken in order to enable a comparison.

An evaluation of programme costs has been based on those clinical elements that have clear costs associated with them, regardless of whether they are included in tariff or not. These elements being typical hospital length of stay, ITU rate and typical length of stay and typical HDU length of stay. Readmission and ITU readmission costs were also calculated.

As such, a cost of £947 per app patient and £1202 per ROC patient was observed. A difference of £255 per patient in favour of the app group. The difference in costs between the two groups was a result of ROC patients typically staying one day longer in both HDU and hospital overall. It is doubtful that this is a cash releasing benefit to the trust or CCG's. At best, it represents an overall saving to the health economy, which is unlikely to be realised due to the nature of service level agreement (SLA) bulk contracts.

However some rehab regardless of modality is better than none, PPC and length of stay is reduced compared to the pulmonary rehab classes therefore the bed waiting list will go down. Even compared to patients who don't have any intervention (14.5% PPC rates) the app group does so much better (Agostini, 2010).

Variation in programme costs are calculated separately as this does represent a real cost saving to the trust. The outpatient based pulmonary rehabilitation programme (ROC) is costed at £216 per patient whereas the Fit 4 Surgery app programme is costed at £178 per patient. Costs of training staff have been placed into the Health foundation innovation for improvement programme by developing a detailed training film which can be given to staff to self- train on how to use the app.

Part 4: Learning from your project

This section is intended to summarise your learning from implementing your project. The project was delivered and achieved through the collaborative approach of pulling together a team of software designers, engineers, academics, thoracic surgeon, qualitative researchers, lung nurse specialist, patients and service improvement / project management consultant. This multi- disciplinary team worked really well and was the main positive to the project. The fracture of the medical illustration team due to the financial situation of the trust could have been detrimental to the project, the team were disbanded and therefore we had no technical support for this project. Luckily, any app developments had been completed by this time, the remaining team members were taught how to transfer data across from the app to the secure database and address any troubleshooting issues. Therefore new skills were developed by the project lead. Towards the end of the project the original medical illustration team became freelancers and carried on working on this project. This combination of technology and clinical skills also allowed for adequate testing to be performed and assurances in case of errors. It will also address barriers to data collection and governance issues.

Originally the app was supposed to send data back in real time. There were a number of roadblocks preventing this from happening regarding information governance and this had delayed recruitment of patients to test the app. Therefore to avoid any further delays, whilst we waited for approval from the Information Governance department the Ipads had the Wi-Fi capability switched off, to ensure data will not be sent back remotely. Temporarily, we collected the data from the app once the patient came back into the hospital for surgery and follow up appointments. Although, after 6 months we were able to switch on the remote capability of the app, and have the data sent back via the sims in the Ipads. This data consisted of compliance, duration, nature of exercises and physiological responses such as heart rate and O2 sats.

The app was also built using Apple's newest programming language and the medical illustration team often found themselves in unknown territory. The devices used were Apple iPads and from a user point of view that may have been a wise choice, for example ease of use, perhaps familiarity and generally simple and intuitive. However, the medical illustration team believed that Android could also have been a viable platform. From a developers viewpoint some of the work may have been more straightforward and the devices certainly would have been a fraction of the cost.

End-user acceptance was particularly poignant to the project as the innovation required adoption by both medical staff and patient. In order to address this issue staff were educated in training sessions as to the benefits and cost saving potential of such an application. It was important that this innovation was not seen as a direct replacement for current rehabilitation services but as an improvement and supplement. As training of medical staff was such an important aspect of this project, when combined with time taken to physically run the app, it was again, important to stress to staff what time benefits of using the system in the long-run was; in particular, the potential increase in patient motivation leading to higher compliance rates for rehabilitative tasks. From training sessions and hearing the benefits from

patients themselves, nursing staff quickly saw the benefit of the app and were happy to refer patients to the research team for pulmonary rehab at home. As the app was presented in several conferences, dissemination of the project reached other hospitals in Birmingham and therefore cancer specialist nurses from other trusts approached the research team to place some of their patients into the Fit 4 Surgery project.

Even though it was expected that therapists were required to motivate patients to use the app, it was found that some patients needed more motivation than others to use the app to complete the exercises on a regular basis. However, that the feedback provided from the app (i.e. heart rate, sats and summary progress charts) did ease them into the process and they overcame any initial resistance. The Shuttle walk test also provided them with a physical measurement to assess their progress. Many had also noted that their breathlessness had decreased when faced with the BORG scale. Although, in future the programme should be developed further to motivate patients to initiate exercising, using behavioural theories to increase self-efficacy particularly post-surgery and this is an area that this project could be improved.

Project management was guided by a hybrid of PRINCE2 and MSP' 'Benefits Realisation' approaches. A project initiation document was developed at the start of the project which helped vastly with ensuring correct data metrics were gathered, risks were identified, job roles and stakeholder benefits were identified. This ensured the project started off smoothly. Yet, the main risk of information governance issues were not identified in advance and caused a delay to recruitment of patients and in hindsight this is an area where we would look further into if we could do the project again. This is a lesson learnt for future projects, planning meetings with information governance before recruitment commences to guarantee a project is working within guidelines is essential. The model for improvement framework (http://www.ihi.org/resources/Pages/HowtoImprove/default.aspx) was used during implementation to test and modify the app and admin processes to include acceptability, usability, safety, reliability, robustness and the quality of data stream. This worked really well and ensured there was a constant stream of improvements to the app without causing disruption to the data gathering.

Given the one year timescale, the original ambitions of recruiting 50 patients were unrealistic. Given available resources of 8 iPads, even without the delay in recruitment the project would not have recruited 50 patients, although we would have got close. Due to financial constraints in the trust as there is an uncertainty of a merger of trusts in Birmingham, the team were unable to acquire more iPads to assist with the recruitment of patients to the project team.

The process of recruitment worked really well patients suitable for enrolment were identified from the Heart of England Foundation Trust Lung multi-disciplinary meeting or referred by the Lung cancer nurses. The team contacted the patient and arranged an appointment at which patients were issued with a mobile device and sensor with app installed. The patients were given instruction on how to use the device, the sensor and the apps functionality. They were also given an information pack on the importance of exercises, how to complete airway clearance breathing techniques and how to deal with breathlessness. This appointment typically took placed 2 to 3

weeks before surgery and their surgery was never delayed. Post-surgery, patients were asked to use the app on return home for a further 6 weeks. This was changed from the original application as it was revealed the patients preferred to keep the app for a bit longer when they found it easier to exercise post-surgery. Patients then had another appointment with the team at which all equipment was returned.

Part 5: Sustainability and spread

In order to sustain and improve the project we are aiming to apply for two grants in February and March (NIHR and Roy Castle Lung Cancer Foundation). We will be using the grants to explore patient experiences and looking into enhancing the variety of exercises to suit people's physical activity level. But we need to look into how the app and associated hardware might be funded in future if not part of a research grant. Would HEFT be able to pick up the cost of the surgical centre? The app is not covered by tariff so can the trust absorb the cost? We will need to ensure the cost is worth the clinical outcomes? All these questions can be answered by completing a large randomised trial. This trial could use supplementary model-based economic analyses to determine the short-term and long-term cost-effectiveness of patients using the app as compared to usual practise, respectively. The base case analysis will adopt the perspective of the NHS and Personal Social Services. Final outcomes will be expressed as cost per patient and cost per quality-adjusted life year gained. Sensitivity analyses will be undertaken to explore the uncertainty around the obtained results. Depending on the availability of data, additional analyses will be carried out from the patient's and society's perspectives. As a supplementary analysis, modelling will be carried out to extrapolate costs and effects beyond the end of the study.

Our other main challenge for this project would be spreading this innovation beyond the innovating for improvement award site. Currently, the research team is working on this project and deliver the app to the patients and will continue to do so. In order for this innovation to work, it must be implanted into daily clinical practice; we have two routes that we could use to maintain the benefits of the project beyond the programme; either have the Lung Cancer Nurses deliver the entire service alongside the appointments that they have with their patients and keep an eye on the patients through telephone follow up or they refer patients who they feel that would benefit from pulmonary rehabilitation at home to the Physiotherapy team. The Pulmonary Rehabilitation Physiotherapy team would then deliver the service to the patients directly, completing baseline sessions and providing assistance if needed. The Physiotherapy and Lung Cancer teams, at heartlands and other hospital sites are fully aware of the app and its potential therefore spreading this innovation beyond research will have support. This project has been driven from the trust board level allowing for the necessary support to create the environment to support spread/ adoption which will be enhanced by an active multilevel dissemination package.
To deal with the issue of equipment costs, we can reduce this by using cheaper versions of the iPad such as android devices. The technology team are looking into alternative versions of the sats probe such as using the Microsoft band watch which are cheaper and can provide the same metrics. The app is also going to be available to download so that patients could use their own devices at home to operate it this would save further equipment costs. Of course for those that don't have their own devices, they will be provided with an iPad and sats probe.

We have already started engaging with a team of Sports Psychologists who we may collaborate with for the next stage of the app testing to ensure patient experience, physical activity motivation and adherence is enhanced. Most of this work will be based on behavioural theory such as the Self- determination theory to promote choice and understanding to encourage autonomous physical activity. We have also

teamed together with students from the Polytechnic University in Milan who are currently creating an enhanced accelerometer that can detect the motion of physical activities at a higher level than present off the shelf versions. This will ensure that we can monitor patients' compliance to the exercises accurately. Furthermore, the design of the app has been advanced by a freelance technology team who will also be involved in providing the changes needed to further refine by personalisation prior to the commencement of a clinical trial in a broader surgical population. A national implementation strategy/framework will be developed to facilitate clinical adoption.

The technology team has already started:

- Creating a brand for the app
- Improved app design
- New web app designed for clinical dashboard so that clinicians will have access to patient app data.
- UI Complete for Web app
- New api designed
- New api completed

Over the past year the team has disseminated this project at several local, national and international conferences such as National Lung Cancer Nurses for forum, BTOG, ESTS and ERS. These have been via presentations of initial data and showcasing the app in networking seminars. At ESTS the team lead won an award for best presentation regarding the Fit 4 Surgery Project. The app has also been presented in hospital and local newspapers (see appendix).

Appendix 1: Resources and appendices

Table 1: Patient demographics, Comorbidities, Surgery details and lung function.

Patient	Age	Respiratory comorbidities	Incision	Procedure	FEV $_1$ % predicted
1	33	None	Thoracotomy	Upper lobectomy	74
2	68	None	VATS	Lower lobectomy	124
3	50	COPD	VATS	Wedge Resection	45
4	83	None	Thoracotomy	Upper lobectomy	70
5	62	Bronchiectasis	Thoracotomy	Bi-lobectomy (Middle and lower)	51
6	66	COPD	Thoracotomy	Pneumonectomy	65
7	76	None	VATS	Wedge Resection	56
8	55	COPD	VATS	Upper lobectomy	93
9	69	none	VATS	Upper lobectomy	76
10	76	COPD	Thoracotomy	Upper Lobectomy	120
11	61	COPD	Thoracotomy	Upper Lobectomy	49
12	69	none	VATS	Wedge Resection	123
13	72	Asthma	Thoracotomy	Upper Lobectomy	74
14	72	None	Thoracotomy	Upper Lobectomy	76
15	44	None	Thoracotomy	Frozen section of mass	71
16	65	Uncertain	VATS	Wedge Resection	88
17	53	COPD	VATS	Wedge Resection	74
18	50	None	Thoracotomy	Wedge Resection	77
19	60	COPD	Thoracotomy	Lower Lobectomy	72
20	36	Other	VATS	Wedge Resection	75

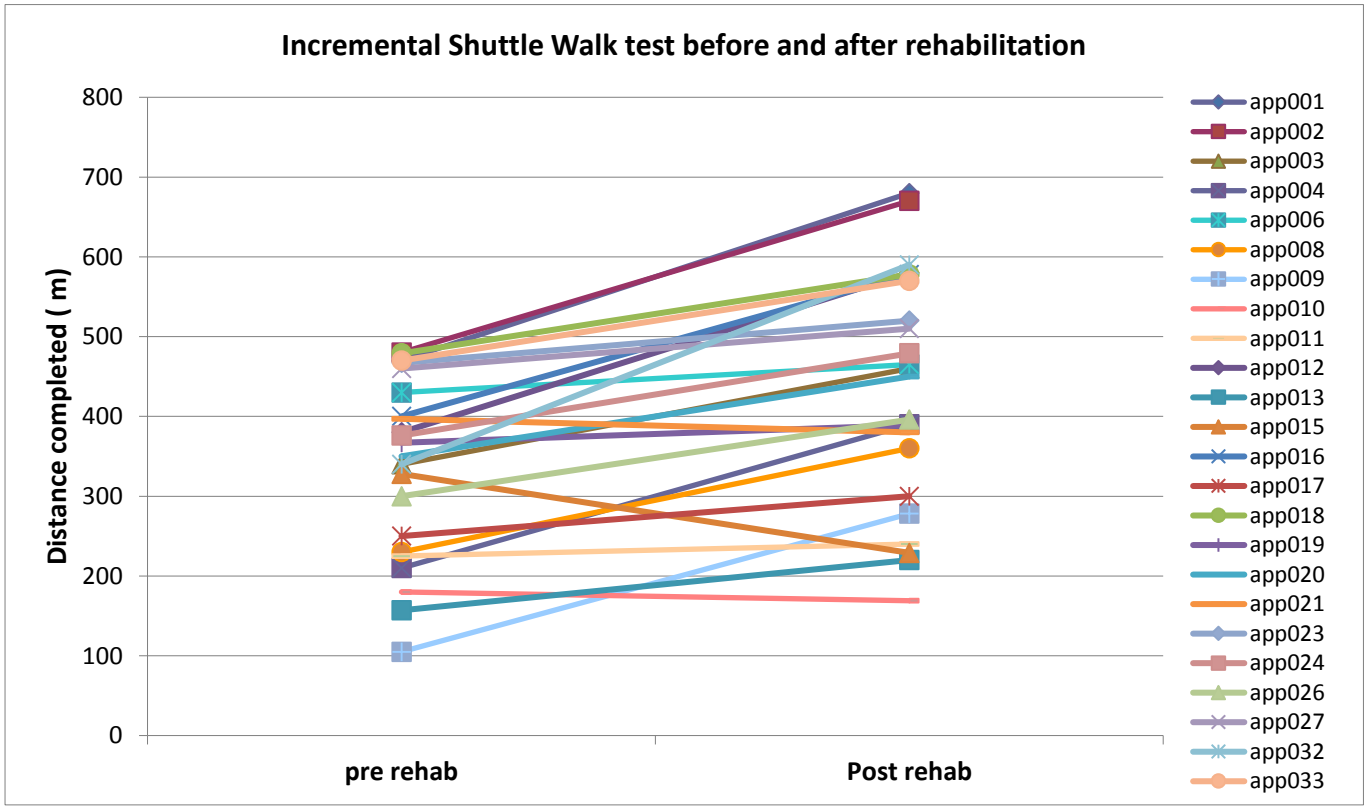
21	73	None	Thoracotomy	Upper lobectomy	74
22	66	COPD	VATS	Wedge Resection	124
23	76	None	VATS	Wedge Resection	45
24	56	None	Thoracotomy	Lower lobectomy	70
25	84	None	VATS	Upper Lobectomy	51
26	62	None	Thoracotomy	Wedge resection	65
27	53	COPD	VATS	Wedge Resection	56
28	61	Uncertain	VATS	Upper lobectomy	93
29	70	Bronchiectasis	VATS	Upper lobectomy	76
30	72	None	Thoracotomy	Upper Lobectomy	120
31	46	None	Thoracotomy	Upper Lobectomy	49
32	71	None	VATS	Wedge Resection	98
33	73	none	Thoracotomy	Upper Lobectomy	74

Table 2: Feasibility of recruiting patients in time for surgery, app usage and surgery complications

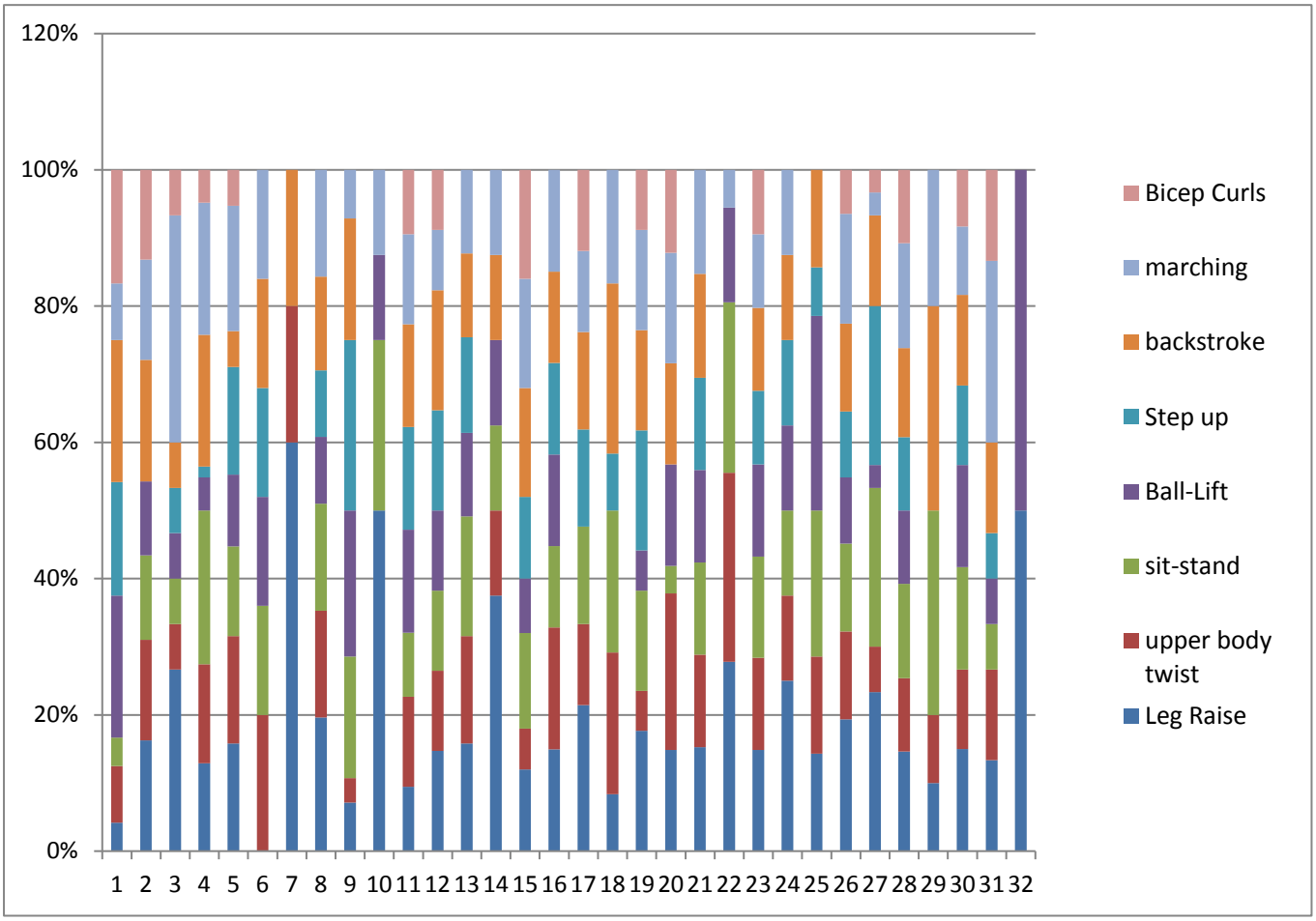
Patient No.	Screened to 1st rehab (days)	Rehab to surgery (days)	No of sessions	Total exercise time (mins)	Length of stay (days)	Unplanned ITU visit? (Y/N)	PPC? (Y/N) 4 or more +ve indicates PPC	Re-admission within 3 months? (Y/N)
1	21	21	6	78	4	N	N	N
2	36	36	22	646	8	N	N	N
3	24	24	6	46	2	N	N	N
4	21	21	15	252	8	N	Y	Y
5	32	32	18	283	7	N	N	N
6	15	15	8	160	3	N	N	N
7	7	49	1	6	3	N	N	N
8	13	13	8	156	3	N	N	N
9	19	19	13	123	7	N	N	N
10	30	30	4	22	16	Y	N	Y
11	17	17	12	361	7	N	N	N
12	7	7	5	98	1	N	N	N
13	24	24	8	261	9	Y	Y	Y
14	39	39	2	27.25	13	N	Y	N
15	18	18	12	221		-	-	-
16	12	12	13	339	2	N	N	N
17	24	24	7	201	3	N	N	Y
18	33	33	7	122	2	N	N	N
19	29	29	26	187	2	N	N	N
20	31	31	14	405	2	N	N	N
21	51	51	9	282	8	N	N	N
22	42	42	10	105	6	N	N	N
23	34	34	9	356	4	N	N	N
24	7	7	2	36.3	5	N	N	N
25	6	6	12	27	6	N	N	N
26	11	11	9	250	3	N	N	N
27	30	30	11	145	8	N	N	N
28	42	42	37	1226	6	N	N	N
29	24	24	7	74	4	N	N	recent surgery
30	30	30	15	267	7	N	N	recent surgery
31	8	8	4	6	2	N	N	recent surgery

32	8	8	1	3	4	N	N	recent surgery
33	9	31					Currently an inpatient	
Average	23	24	10	212	5			
SD	12	12	8	235	3			

Graph 1: Incremental shuttle test results pre and post rehabilitation before surgery. Note: 10 patients did not attend post rehab ISWT appointment due to various reasons.



Graph 2: The variation of the exercises performed in our patients before surgery. We are encouraging the patients to try all of the exercises and this is shown in the variation.



Ref: TW79

Date: November 2014

News Release

Trust lung cancer rehab programme wins national quality award

A successful programme that has changed the way lung cancer patients who have surgery are cared for has won a national award.

The thoracic team at Heart of England NHS Foundation Trust received the Healthcare Quality Improvement Partnership (HQIP) Quality Improvement Award in the effective dissemination of information category for good practice achieved through the rehabilitation for operated lung cancer (ROC) programme.

The multi-faceted ROC programme is designed to help lung cancer patients optimise their fitness prior to surgery and involves elements including pulmonary rehabilitation, smoking cessation support, dietary advice and patient education. These services are widely available but rarely utilised by the patient group. The team, which is formed of thoracic surgeons and specialist nurses, impressed judges with a DVD and app developed as a vital resource to educate and support this patient group during their rehabilitation.

Implementation of the ROC programme at the Trust has reduced the incidence of post-operative complications by seven percent, reduced the number of re-admissions due to surgical complications by nine percent and has been adopted by thoracic centres across the UK.

xx said: “I am absolutely delighted that we have won the Quality Improvement Award as it is fantastic recognition for the team which is committed to providing high quality patient care. Currently 5,000 patients in the UK undergo curative lung cancer surgery and 15 percent of patients develop complications. These complications can lead to an admission to intensive care, a longer hospital stay and even increased risk of death. Easy access to information

and support to help patients prepare for surgery better has improved patient care significantly. Patients can be required to attend exercise classes before surgery and the availability of the DVD means that they can still do some of these exercises if they are unable to attend a class. We've noticed a huge improvement in patient recovery and reduced length of stay since introducing the programme.

HQIP chief executive, Jane Ingham, said: "The HQIP Quality Improvement Awards received a record number of entries this year and standards were extremely high. Heart of England did extremely well in a strong field and I congratulate them on being worthy winners."

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- Ends -

Notes to editors:

Photo caption: Heart of England NHS Foundation Trust thoracic surgeon, Professor Babu Naidu and senior thoracic research nurse, Amy Kerr are presented with the HQIP Quality Improvement award by Vivienne Parry OBE.

- Are you on Twitter? To find out what is going on around our hospitals, and for latest news and updates follow us @heartofengland. Join our conversation today!
- Heart of England NHS Foundation Trust staff provides general and specialist hospital care across Heartlands Hospital, Solihull Hospitals, Good Hope Hospital and Birmingham Chest Clinic. The Trust also provides community health services across the borough of Solihull.
- The Trust employs more than 10,000 members of staff, making it one of the top five employers in the Midlands.

Issued by Nikki Boileau, communications officer at Heart of England NHS Foundation Trust. Contact: 0121 42 41668 or nikki.boileau@heartofengland.nhs.uk

http://www.suttoncoldfieldobserver.co.uk/heart-england-nhs-foundation-trust-runs-good-hope/story-27974932-detail/story.html

http://www.heartofengland.nhs.uk/new-mobile-app-could-transform-care-for-lung-surgery-patients/

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