The Future Challenges

Keeping Healthy at Home:

Moving to Better Health

West of England Academic Health Science Network

Sirona care & health

KiActiv®

South West Academic Health Science Network

The Future Challenges: Moving to Better Health

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Approvals

Project Partners	Role	Approval Received
West of England AHSN Senior Leadership Team	Sponsor	2nd March 2022
KiActiv®	Innovator	2nd February 2022
Sirona Care & Health	Host	15th February 2022
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The West of England AHSN, under their Office for Life Science commission, funded the Future Challenges programme to aid the adoption and spread of promising innovations. This real world validation project was delivered as a collaboration between all project partners. The project report has been co-written, with the data analysis and evaluation being conducted by the South West AHSN.

The project was undertaken during the Covid-19 pandemic, the delivery of the intervention and timescales were adjusted as necessary, to accommodate government guidance and lock downs.

Assurance rating

* This report can be used for context and background information	☐
** This report can help inform decision making, when considered with other information	☒
*** This report is the best available evidence to date	☐

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Contents

Executive summary

Background: The Future Challenges programme is a central part of the West of England Academic Health Science Network (AHSN)'s remit to assist industry, and work with the NHS to adopt and spread innovative products and services to benefit patients and to encourage economic growth in the UK. The programme identifies and articulates local healthcare challenges and connects healthcare professionals with SMEs to support the development of healthcare solutions. Following engagement with local experts across the West of England, a national call for innovative solutions under the theme of 'Keeping Healthy at Home' was launched and focused on two main areas: staying well and confident and staying connected and supported.

KiActiv®'s technology, KiActiv® Health was selected, along with Sirona Care and Health, previously Bristol Community Health, who were keen to trial the technology. Specialist evaluators, based within the South West Academic Health Science Network (AHSN), were also selected to assess the impact and effectiveness of this programme.

Innovation: The project evaluated KiActiv® Health, a personalised and guided online intervention that empowers participants to optimise physical activity within their everyday lives. KiActiv® Health provides an interactive personalised dashboard to display accurate physical activity data and is supported remotely by phone calls with a dedicated KiActiv® Mentor over a 12-week programme.

Purpose / objective: The 'Moving to Better Health' project was co-designed to explore whether KiActiv® Health could help people living with Chronic Obstructive Pulmonary Disease (COPD) by supporting them to understand and optimise their everyday physical activity, whilst evaluating its effectiveness and the potential for ongoing use in a real-world setting.

Sirona Care and Health typically receives around 1000-1200 referrals per annum for pulmonary rehabilitation (PR) for patients with COPD within the Bristol region. Prior to the Covid-19 pandemic, around 350 patients completed a course of PR each year. This project was initially designed to offer KiActiv® Health to patients that were otherwise unable to, or chose not to, undertake face-to-face PR. However, from March 2020, to provide a Covid-19 safe alternative, a remote PR programme was offered alongside other options, including KiActiv®, with clinicians determining the best offer with each patient.

Methodology: Between February 2020 and January 2021, adult patients referred to Sirona Care and Health with a confirmed diagnosis of COPD were introduced to KiActiv® Health. Interested patients were referred directly to KiActiv®, 80 patients contacted the innovator to find out more information or to enrol, 75 (94%) patients were recruited, and 52 (70%) patients completed the 12-week KiActiv® Health programme.

Data collection included qualitative and quantitative methods. Physical activity, across multiple dimensions (Non-Sedentary Time, Physical Activity Level (PAL) and Moderate or Higher Intensity Physical Activity (MVPA)), was assessed throughout the 12-week programme. Patients also completed validated outcome measure questionnaires and three single-item questions pre- and post- programme.

Data was also collected to establish patients' adherence and engagement, and, at the end of the programme, patients were asked whether their expectations of KiActiv® Health had been met and what had helped or hindered them to use the technology. Evaluators reviewed notes taken by the KiActiv® Mentors during sessions two to six, conducted one-to-one interviews with clinicians and respiratory team administrators, and reviewed the project team meeting minutes. Staff were asked about the barriers and enablers to engaging patients with KiActiv® Health, as well as how implementation of the project had been impacted by Covid-19.

Key findings:

- Patients with COPD experienced a statistically significant improvement in the PAM, EQ-5D VAS, and knowledge and confidence measures.
- Qualitative data revealed increasing interest and engagement in physical activity. Patients who were able to engage in more physical activity, reported improvements in overall fitness, mood and less pain.
- There were high levels of engagement. Patients wore the physical activity monitor for 80 of the 84 days (96%) and synced the device on 53 of the 84 days (63%).
- There was no clear upward or downward trend in any of the dimensions of physical activity. Analysis of the physical activity data showed a large variation, demonstrating that whilst some patients improved, some deteriorated, and others remained stable.

Some patients discussed periods of ill health as the reason for withdrawing. Patients who dropped out of the programme also frequently cited difficulties / confidence with technology. Covid-19 impacted patients differently, for example, some patients discussed how shielding limited their movement whereas others felt more able to recuperate due to furlough.

Staff acknowledged potential benefits to embedding KiActiv® Health in the PR pathway, including patients engaging with their data, shifts in patient language, feeling better able to actively manage the PR waiting list and valuing support after patients completed PR.

Lessons learned and conclusions: Successful patient recruitment was associated with staff knowledge and confidence in KiActiv® Health, and rapport with patients. However, digital exclusion can be a barrier to recruiting patients; a lack of technology was the most frequently cited reason from patients who declined to participate.

The project has shown that KiActiv® Health can be successfully introduced to patients at various points during the PR pathway. On average, patients wore the KiActiv® monitoring device more than would be expected from a similar population wearing simple physical activity monitors, and a majority attended all of the KiActiv® mentoring sessions.

Given the impact of Covid-19 on the delivery of PR, the virtual nature of KiActiv® Health enabled patients with COPD to continue engaging in discussions around physical activity at a time when face-to-face PR was not available. The single group evaluation design means that causality cannot be attributed to KiActiv® Health directly.

However, qualitative data does support the hypothesis that KiActiv® Health is having a positive effect on patients' physical activity behaviour and cognitions.

Recommendations: KiActiv® Health can have a positive impact for patients with COPD. Further analysis of individual physical activity profiles over time, taking into account environmental factors may help to understand the impact of these factors on the COPD population. An analysis of the uptake of virtual or face-to-face PR by patients who completed the KiActiv® Health programme would also be useful to understand its potential impact. A more detailed cost-benefit study is needed to support the business case for the use of KiActiv® in COPD and other respiratory conditions. However, with previous studies demonstrating that greater patient activation is associated with lower healthcare utilisation and costs (Greene et al., 2015; Bu & Fancourt, 2021), it is promising to find that patients significantly improved their activation after completing the KiActiv® Health programme.

Background

The Future Challenges programme

The West of England Academic Health Science Network (AHSN) has a remit to assist industry, particularly small to medium sized enterprises (SMEs), to work with the NHS to adopt and spread innovative products and services to benefit patients and to encourage economic growth in the UK.

The Future Challenges programme is a central part of the West of England AHSN's remit to support innovation in health and care, delivered as part of the commission from the Office of Life Sciences to aid the adoption and spread of promising innovations. The aim of the programme is to identify and articulate local healthcare challenges and develop a system where healthcare professionals can connect with SMEs to stimulate engagement and partnership in supporting the development of healthcare solutions.

This national call for innovative solutions and offer of funding is part of the wider West of England AHSN innovation work, which aims to support the NHS to identify companies to partner with to deliver these solutions. The programme aims to actively nurture an innovation ecosystem around health and care, removing obstacles and bringing diverse groups together to maximise new ways of working.

The West of England AHSN refers to 'challenges' as a means of articulating clinical or healthcare system needs and then describing it in such a way that companies can respond with concepts for development or solutions which could meet that need. This process also frames areas of need as a 'what if?' question, to help innovators think about problems more openly and creatively. An example used for this theme was, 'what if we had the technology, knowledge and confidence to manage our own condition?'

The West of England AHSN engaged with a broad range of local expert networks, representatives from health service providers and commissioners, voluntary organisations and university researchers from across the West of England AHSNs member organisations to identify areas of need around which we could focus our challenges. This resulted in the identification of two initial themes:

- Young People and Mental Health Resilience
- Keeping Healthy at Home

The national call for innovative solutions under the theme of Keeping Healthy at Home, focused on two main areas: staying well and confident, and staying connected and supported.

The Moving to Better Health project

In June 2019, KiActiv®'s[1] technology, KiActiv® Health was chosen from a wide range of submissions by an expert panel. A further call then went out across our NHS membership for expressions of interest in hosting a trial and evaluation of the chosen technology. Sirona Care and Health, previously Bristol Community Health, was keen to trial KiActiv® Health. In parallel to this, specialist evaluators based within the South West AHSN were also identified, via separate tender, to assess the impact and effectiveness of this programme.

The West of England AHSN utilised a co-design-based approach with the innovator, NHS organisation host and evaluator to design and plan a project to explore the potential value of the innovation within the identified patient cohort and evaluate its effectiveness and the potential for ongoing use in a real-world setting. The resultant project, **Moving to Better Health** was designed to explore whether KiActiv® Health could help people living with Chronic Obstructive Pulmonary Disease (COPD) to improve the self-management of their condition, by supporting them to understand and improve their everyday physical activity.

A key criterion for innovations to be selected for inclusion in the Future Challenges programme was evidence of success elsewhere, perhaps in another clinical area. KiActiv® Health is currently in use across a number of locations to support people with type 2 diabetes and other long-term conditions to increase their physical activity levels. However, this was the first time it has been evaluated within this patient group.

[1] KiActiv® is the trading name of Ki Performance Lifestyle Limited

The Future Challenges programme has been a great opportunity for the West of England AHSN to build collaborative relationships between the NHS and SMEs, bringing innovation into practice to potentially solve needs within the health and care community.

Host organisation

Bristol Community Health originally hosted the project. In April 2020, after the project had started, the community contract with BNSSG CCG changed to a new provider, Sirona. Services transitioned from Bristol Community Health to Sirona, with the clinical teams involved transitioning to the new organisation. Sirona Care and Health serves a larger population than Bristol Community Health with teams operating out of different localities, with different management and IT systems.

Host organisation challenges

A contract change with the commissioner in April 2020 necessitated some adjustments to the project during the early stages of the project. The respiratory workforce in Sirona Care and Health was larger than the original provider and there were differences in how care was delivered. In addition, during the spring/summer of 2020 three key clinicians and the original clinical lead for the project left Sirona. The presence of a core team of staff at Sirona, both clinical and administration has been crucial in maintaining a focus on the Moving to Better Health project against the backdrop of an organisational merger.

The value of physical activity in COPD

The main factors that increase risk of illness and disease are smoking, high blood pressure, obesity, physical inactivity, alcohol and poor diet. The value of exercise and physical activity has been extensively evidenced and is the underpinning principle of improved health outcomes following participation in a PR plan. PR utilises prescribed exercise training to increase aerobic fitness (measured during a six-minute walk test) and increase muscle strength. Health education focuses on maximising the increased physical capability to reduce sedentary time and partake in exercise. Sedentary time has been identified as an important marker for health outcomes and is an independent predictor of mortality in COPD (Furlanetto et al., 2016). There is a growing evidence base that addressing sedentary time post exacerbation is as valuable as commencing traditional exercise (Orme et al., 2018). It has been identified that persons with moderate to severe COPD have significantly lower time engaged in physical activity than age-matched controls (Bernard et al., 2018).

KiActiv® intervention

The innovator selected to work on this project was KiActiv®. Their technology KiActiv® Health is a digital therapy which aims to empower people with long term conditions, and those on rehabilitation pathways, to self-care at home, using their personal everyday physical activity. It utilises a personalised, mentor-guided digital service which aims to empower individuals to make sustainable behaviour change in the context of their health, capacity and environment.

The KiActiv® Health service is available 24/7 and requires no visits to clinics or gyms. It can provide an accessible option for those who are unable, or have chosen not to take up PR, who previously may have received limited continuing support.

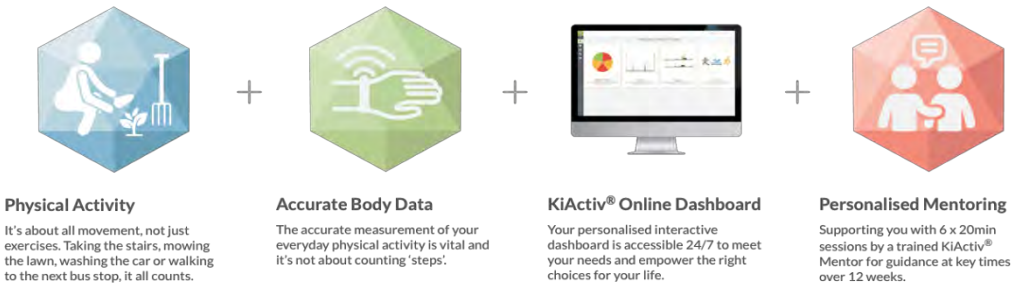
Although the benefits of physical activity are evidenced, for many people living with COPD, physical activity is something that is often dreaded or feared, and there is a common misconception that for physical activity to be valuable it must be vigorous, or exercise based. As such, understanding that physical activity is more than just exercise and sport, and that 'every move matters', is vital for empowering effective self-management.

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure, and as such it is important that we account for all of the movement in our lifestyles, and not just exercise. KiActiv®'s unique approach evaluates physical activity across multiple dimensions that are independently important to health, using a patented method of data analysis. Much like the multiple aspects of diet known to be important, physical activity is a heterogeneous behaviour, which can't be accurately reflected in a single metric.

Research has demonstrated that personalised multidimensional physical activity profiles are crucial to providing an accurate and comprehensive understanding of an individual's physical activity (Thompson et al., 2015; Thompson & Batterham, 2013). Importantly, this overcomes the danger of developing a false picture of one's physical activities and moves away from this idea that exercise is the only type of movement beneficial to our health.

The KiActiv® service aims to expand the therapy window, from just one to two hours of exercise per week, to include all ~112 hours of a waking week and provides a personalised understanding of the value of movement in daily routines, and how to find opportunities to move more. For individuals living with COPD, focusing on movements they enjoy or feel comfortable with, and learning how to pace themselves, can help alleviate fear and deliver the numerous benefits of physical activity and promote self-care. Staying physically active can take a variety of forms, from small, everyday changes, such as walking an extra bus stop or taking the stairs instead of the lift, to the structured exercise in PR programmes.

The focus of KiActiv® is on empowering individuals to make the right choices for their health and to create new habits relating to their physical activity that benefit them now and in the future. The KiActiv® approach to behaviour change is underpinned by Self-Determination Theory (Deci & Ryan, 2000; Ryan & Deci, 2000; Williams et al., 1998), which suggests that sustainable behaviour change relies on people internalising the value of the behaviour, knowing how to change, and being supported to have authentic self-choice in doing so. It focuses on the fulfilment of peoples' need for autonomy, competence and relatedness, as drivers for initiating and maintaining changes in behaviour. Across the 12-week programme, KiActiv® Health aims to support these needs and enable people to make self-endorsed behaviour change, which through the emphasis on personal understanding and intrinsic value are sustainable in the long-term.



KiActiv®'s proprietary technology evaluates minute-by-minute physical activity data from a validated wearable monitor, cleanses the data, and displays it in the user's personalised online dashboard, available 24/7 to provide meaningful and actionable feedback. A trained, dedicated KiActiv® Mentor supports patients throughout the 12-week programme at six key time points. The Mentor calls aim to help patients build an understanding of the value of their daily activities and the confidence to plan, monitor and improve, without compulsion or prescription. At the end of the 12-weeks, the patients retain access to their personal dashboard and activity monitor, enabling them to continue their self-management using the technology, if desired.

Patient recruitment to the project

Standard care pathway

Sirona Care and Health typically receives around 1000-1200 referrals annually, from primary and secondary care to PR of patients with COPD within the Bristol region. Prior to the Covid-19 pandemic, Sirona Care and Health offered these patients the traditional PR course, which is a face-to-face gym based six-week intervention, including a supervised programme of exercise training, health education and strategies for managing breathlessness techniques. However, for reasons that often centre on logistics, confidence or wellbeing (Sahin & Naz, 2018), it is reported by that around only 350 patients annually complete a course of PR.

Project care pathway and target population

The frequency of attendance required for PR, the group-based consultation style, and physical burden of attendance means that for many, PR is not an accessible treatment option. This project was designed to provide KiActiv® Health as an alternative offer to those patients that were unable to, or chose not to, undertake face-to-face PR. KiActiv® sought to provide an additional option for patients who were not able to access PR, with the aims of reducing sedentary time and increasing time spent being physically active. However, it was acknowledged from the outset that this intervention did not provide education about their condition or prescribed exercise, as provided by PR. Patients who participated in KiActiv® were encouraged to self-refer to PR at the end of the 12-week programme, as both interventions seek to modify differing clinical outcomes, all of which are important for patients with COPD.

Recruitment process

Patients were recruited signposting them to KiActiv® for enrolment onto the programme via personalised conversations and letters. During the rolling recruitment period (January 2020 – December 2020) the clinical team identified appropriate COPD patients from the Sirona Care and Health caseload, who had either:

1. Declined to attend a routinely offered opt-in session for PR
2. Attended the routinely offered opt-in session but subsequently decided not to enrol in PR
3. Dropped out of PR after one to two sessions
4. Declined to take part in PR ('legacy' patients) dating back to December 2019

From March 2020, due to the global Covid-19 pandemic, opt-in sessions and PR ceased and for the remainder of the project, face-to-face care was not delivered. Therefore, the original recruitment process was no longer tenable, and the target population changed, as no-one was able to attend face-to-face opt-in sessions and PR.

Impact of Covid-19 on recruitment process and referral rates

From this point onwards, Sirona Care and Health needed to change their PR offering to provide Covid-19 safe alternatives. They designed a remote PR programme, which clinicians offered to their patients alongside other options, including KiActiv®. Sirona Care and Health ensured that all patients were offered the same menu of clinically appropriate resources irrespective of whom they interacted with during their care pathway. The project therefore had to adapt and instead of offering KiActiv® only to patients who were unable to, or chose not to, undertake face-to-face PR, KiActiv® was offered, alongside other options, to all patients on the waiting list to complete PR.

From mid-March 2020, all recruitment to the project and signposting to KiActiv® from Sirona Care and Health was provided over the telephone, video call or via letter. Each new referral to the Sirona Care and Health respiratory service was provided with a letter informing them of the cessation of face-to-face PR and signposting to the available options, including KiActiv®. A follow-up phone call to promote the options available was also attempted by the administration team.

The clinical team reported that 60% of patients had a virtual clinical assessment during this time. For patients that were referred to PR and who did not wish to take up an assessment with a healthcare professional, the administrative team was their only contact. It was therefore essential that the administrative workforce was fully briefed on the alternative offers for patients, including KiActiv®. This administrative role has been central in coordinating communication to the patients across the newly expanded Sirona Care and Health workforce.

During the pandemic and this project, there was a noticeable decrease in the number of referrals to the respiratory team across BNSSG; from the pre-Covid-19 level of approximately 2,000 patients per year (Bristol - 1,400; North Somerset- 600) to 713 patients between the 16 March 2020 and 31 March 2021, which overlapped with the recruitment phase for this project. This equates to around a third of what a normal year would look like (figures are not available for South Gloucestershire).

Evaluation

Evaluation scope

The South West AHSN was commissioned to undertake this real-world evaluation in 2019. The evaluation was co-designed by the West of England AHSN, South West AHSN, KiActiv® and the clinical teams in Sirona. A detailed logic model (Appendix A) was developed by the project team to visualise how KiActiv® Health produced its intended outcomes. This was then translated into the evaluation questions described below. The original aim of the project was to provide an alternative to rehabilitation for people with COPD who do not take up or drop out of face-to-face PR. Due to Covid-19 and the cancellation of all face-to-face PR. This aim shifted to one in which KiActiv® Health was offered to new referrals who were on the waiting list for PR and to those who had completed virtual PR. The evaluation aimed to answer the following questions:

- To what extent do patients with COPD engage with KiActiv® Health?
- Does the KiActiv® Health programme lead to:
    - Changes in physical activity?
    - An increase in knowledge, skills, and confidence in managing their COPD and engaging in physical activity?
    - A reduction in COPD symptoms?
    - Patients intending to participate in PR in the future?
- Are patients' expectations of KiActiv® Health met?
- What are the barriers and enablers to using KiActiv® Health from the patient and staff perspective?
- How has Covid-19 affected the implementation of KiActiv® Health?

Methods

Between February 2020 and January 2021, adult patients referred to Sirona Care and Health with a confirmed diagnosis of COPD were introduced to KiActiv® Health by either a clinician or a Respiratory Team Administrator. This also included back dated patient referrals from December 2019 and January 2020. Patients were provided with written information and were asked to enrol directly with the innovator by phone, email, or online sign-up. Patients who responded were then contacted by KiActiv®, who checked that they were eligible to participate and then completed the enrolment process. The physical activity monitor was then sent to the patient and a start date arranged. The programme began with a set-up call with a KiActiv® Mentor. Data collection combined qualitative and quantitative methods.

In response to poor recruitment rates and the Covid-19 pandemic, changes and adaptations were made to the service and the method by which patients were recruited to KiActiv® Health. Appendix B shows a timeline of how the service and recruitment altered between March 2020 and August 2020. Following these adaptations, a standardised PR pathway was established, which included when KiActiv® Health should be introduced to patients (Appendix C). From August 2020, patients were offered KiActiv® Health via three routes (i) when they were first referred to Sirona Care and Health and placed on the waiting list for PR, (ii) if virtual PR was not suitable for the patient or they refused to participate and (iii) when the patient had completed virtual PR.

Quantitative data

Objectively measured physical activity

Physical activity, across multiple dimensions, was directly and continuously assessed using a validated physical activity monitor throughout the 12-week programme (Figure 1).

- **Non-sedentary time:** the amount of time (mins) spent engaging in non-sedentary activity per day. Sedentary behaviour included any waking behaviour characterised by an energy expenditure of <1.8 metabolic equivalents (METs), while in a sitting or lying posture (Swinnen et al., 2014).
- **Physical activity level (PAL):** a standard objective method of expressing total daily energy expenditure in multiples of resting metabolic rate.
- **Moderate or higher intensity physical activity (MVPA):** the amount of time (mins) spent engaging in MVPA, defined as anything that made the individual burn more than three times the number of calories they burn at rest per day (≥3 METs) (Haskell et al., 2007).
- **Moderate bouts:** the amount of time (mins) spent in MVPA (see previous definition) of sustained bouts of 10-mins or longer.

Figure 1: The multiple dimensions of physical activity

Demographic characteristics

At baseline, patients were asked to provide their age, sex, and home postcode to establish deprivation decile (Ministry of Housing, Communities & Local Government, 2019), whether they had attended PR before, and height and weight in order to calculate body mass index (BMI). Grade on the Medical Research Council (MRC) dyspnoea scale (Fletcher, 1960) and ethnicity was obtained by Sirona Care and Health staff through EMIS records.

Self-report questionnaires

Patients were asked to complete a questionnaire at the start and end of the 12-week KiActiv® Health programme. The questionnaire included:

- The Patient Activation Measure (PAM) (Hibbard et al., 2004), which total scores can range between 0-100. The four levels of activation are defined as:
    - Level 1 (0-47.0): Individuals tend to be passive and feel overwhelmed by managing their own health. They may not understand their role in the care process.
    - Level 2 (47.1-55.1): Individuals may lack the knowledge and confidence to manage their health.
    - Level 3 (55.2-72.4): Individuals appear to be taking action but may still lack the confidence and skill to support their behaviours.
    - Level 4 (72.5-100): Individuals have adopted many of the behaviours needed to support their health but may not be able to maintain them in the face of life stressors.
- The COPD Assessment Test (CAT) (Jones et al., 2009), which quantifies the impact of COPD on a patient's health across eight symptoms. The CAT has a range score of 0 to 40, with low scores representing better health. A reduction of two points or more on the scale is deemed clinically meaningful (Kon et al., 2014).
- The Visual Analogue Scale (VAS) from the EuroQol five-dimension (EQ-5D) questionnaire (Rabin et al., 2001), which is a measure of overall health. The VAS ranges from 0 (the worst health you can imagine) to 100 (the best health you can imagine).
- Three single-item questions, all on a 4-point Likert scale from strongly agree to strongly disagree:
    - I understand how the different activities I undertake in my daily life contribute to my physical activity levels.
    - I know how to take appropriate steps to improve my physical activity levels.
    - I feel confident in my ability to perform physical activity.

Adherence and engagement

The following data was collected to establish patients' adherence and engagement with KiActiv® Health:

- Total number of days that a patient wore the physical activity monitor.
- Total number of complete days that a patient wore the physical activity monitor. A complete day was defined as the monitor being worn for at least 80% of an assumed 16-hour waking day (i.e., wear time ≥768 mins).
- Total number of days on which the patient synced their data from the device to the KiActiv® online dashboard.
- Total number of days on which the patient visited the KiActiv® online dashboard.
- Total number of days on which the patient tagged their activity on the KiActiv® online dashboard.
- Number of patients logging into the KiActiv® online dashboard or syncing data at one month, three months and six months post intervention.

Qualitative data

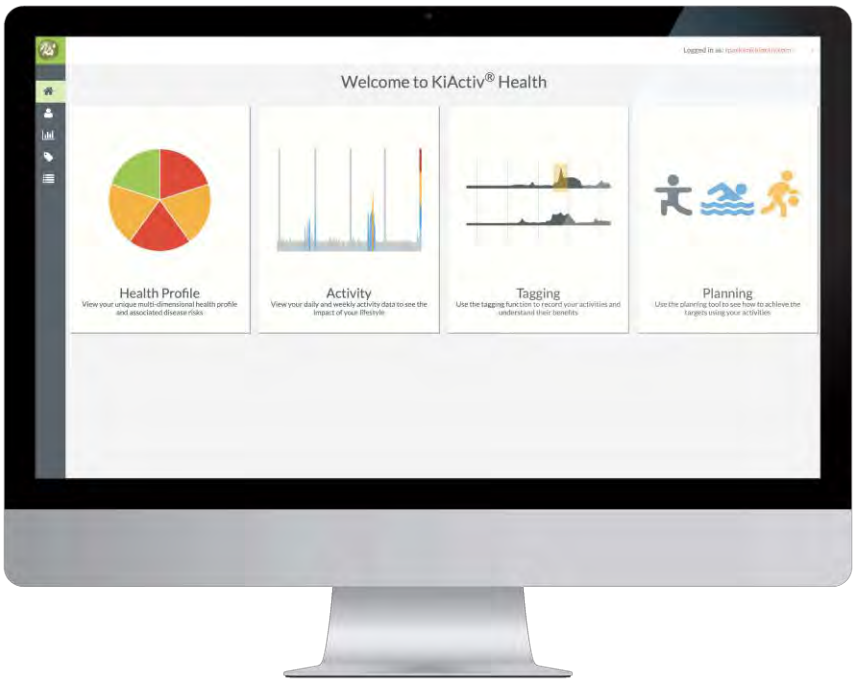
- At the end of the programme patients were asked whether their expectations of KiActiv® Health had been met and what had helped or hindered them to use the technology.
- The evaluators reviewed the notes taken by the KiActiv® Mentors during sessions two to six.
- The evaluators talked one-to-one with the clinicians who delivered face-to-face and virtual PR and to the administrators who were responsible for contacting patients about the services that were available to them, including KiActiv® Health. Staff were asked about the barriers and enablers to engaging patients with KiActiv® Health, as well as how implementation of the project had been impacted by Covid-19.
- The evaluators also reviewed the project team meeting minutes.

Analysis

The analysis techniques used depended on the type of data collected:

- Qualitative data were analysed using the theoretical domains framework for behaviour change (Cane et al., 2012) or thematic analysis (Braun & Clarke, 2006).
- Wilcoxon's signed rank tests or paired *t* tests were used to analyse changes in the self-report questionnaires and single-item questions over time.

- Objective physical activity data was analysed using multiple (maximum of 12) seven-day profiles. For non-sedentary time, PAL and MVPA a patient required a minimum of four complete days to calculate a daily average for that seven-day period. Moderate bouts are treated as a weekly total and therefore required seven complete days to be included in the analysis. To account for any missing data (i.e. not having all twelve seven-day profiles for every patient), linear mixed modelling was used. The dependent variables included non-sedentary time (mins/day), MVPA (mins/day), moderate bouts (mins/week), and PAL. The fixed effects were week, sex, deprivation decile, with age and BMI adjusted for as covariates. Estimated marginal means and 95% confidence intervals (CIs) were calculated and comparisons between the fixed factors were made using post-hoc Bonferonni adjusted tests. Linear mixed modelling was also used for sub-group analyses of each dimension of PA for patients who had complete MRC data.



Results

A total of 80 patients contacted the innovator to find out more information or to enrol during the recruitment period, 75 (94%) patients were recruited, and 52 (70%) patients completed the KiActiv® Health programme (Figure 2).

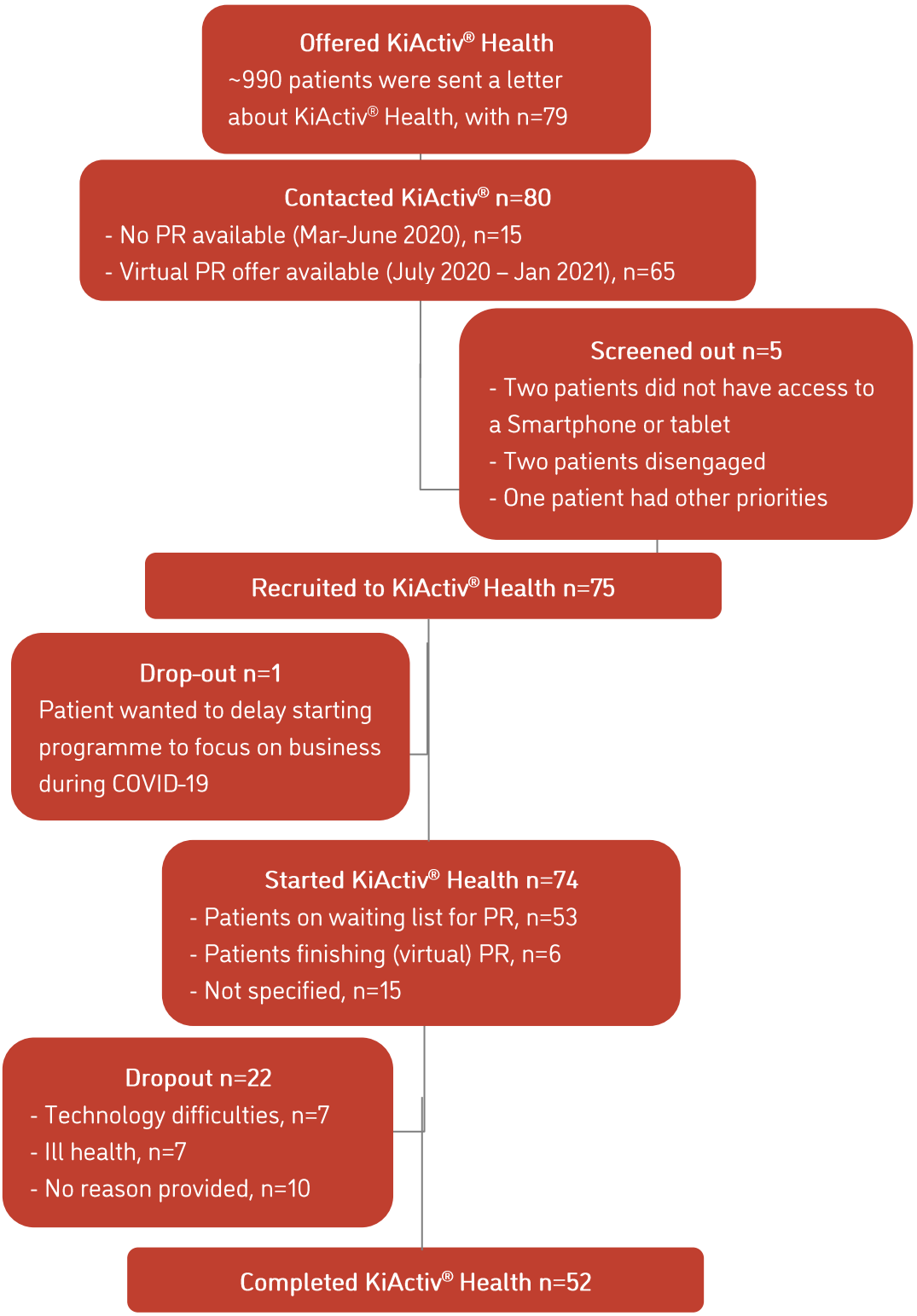


Figure 2. KiActiv® Health participation rates

Notes from sessions with the KiActiv® Mentors were analysed to determine the reasons for patients withdrawing from KiActiv® Health. Often, they did not provide a clear reason, but some patients did discuss periods of ill health and issues with using the technology in the sessions prior to withdrawing. Patients were contacted by a Sirona Care and Health clinician if they dropped out of KiActiv® Health, to understand their reasons. The most frequently cited reasons were difficulties using the technology, including syncing the device and navigating the dashboard, as well as confidence in using the technology.

Patient characteristics

The 74 patients who started the programme were on average 67 years old (SD=11), 50% were female and their average BMI was classified as overweight (mean BMI = 29; SD=7; Table 1), a sample representative of the wider COPD population.

Table 1. Patient characteristics

	n	%
Sex		
Male	37	50
Female	37	50
Age (yrs)		
18-30	0	0
31-40	1	1
41-50	4	5
51-60	17	23
61-70	25	34
71-80	23	31
81-90	4	5
Deprivation decile by postcode (1=most deprived, 10=least deprived)		
1	11	15
2	5	7
3	8	11
4	5	7
5	9	12
6	5	7
7	17	23
8	8	11
9	3	4
10	3	4

BMI ($kg \cdot m^{-2}$)		
Underweight (<18.5)	3	4
Healthy weight (18.5-24.9)	19	28
Overweight (25.0-29.9)	18	26
Obese (30-34.9)	20	29
Severely obese (35.0-39.9)	4	6
Morbidly obese (≥40.0)	5	7
Attended PR before		
Yes	17	23
No	37	50
Not specified	20	27
Ethnicity		
White – British	8	11
White – Other	1	1
Not specified	65	88
MRC grade	1	1
Grade 1	6	8
Grade 2	18	24
Grade 3	17	23
Grade 4	2	3
Grade 5	30	41
Not specified		

Adherence

On average, patients who completed KiActiv® Health wore the physical activity monitor for 80 of the 84 days (96%) and 77 (91%) of these days were regarded as complete. Syncing of the device occurred on 53 of the 84 days (63%). Patients visited the KiActiv® online dashboard on 23 days (30%) and on 13 of these days (17%) patients also tagged their activities. Forty-two patients (81%) received all five KiActiv® mentoring sessions, plus the set-up call.

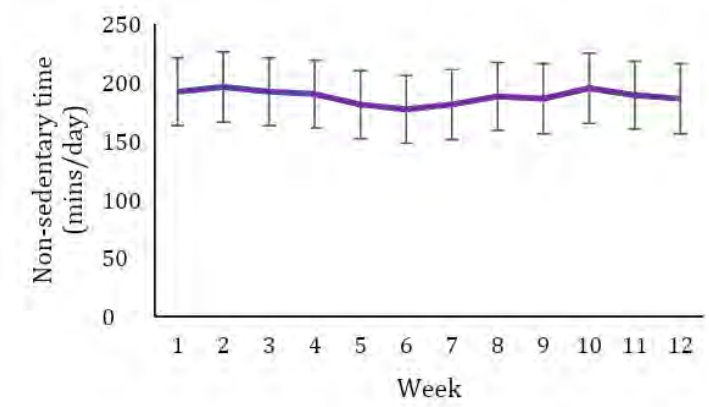
Findings of a recent systematic review estimates that between 40% and 86% of people adhere to wearing their activity monitoring device (Marin et al., 2018). This evaluation indicates that KiActiv® Health is able to engage and retain patients in wearing a device throughout the programme and at a level greater than physical activity monitoring devices alone. This could indicate the added value of the personalised mentor sessions and interactive online dashboard.

Of the 52 patients in this evaluation, 48 (92%) interacted with the technology beyond the initial 12-week period either by visiting their personal online dashboard or syncing their physical activity monitor.

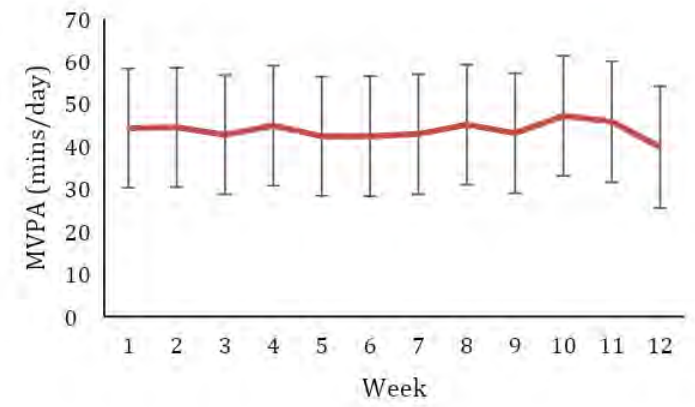
At the time of data analysis (April 2021), the number of patients still using KiActiv® Health, despite no longer receiving mentor calls remained good, with a decline to 27% after six months (Table 2).

Table 2. Patient engagement after intervention period

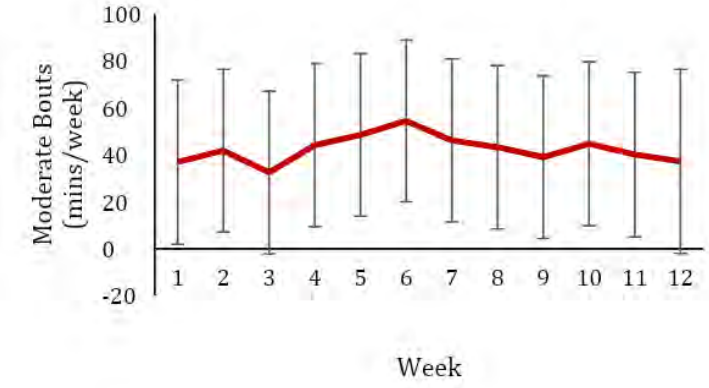
Time since end of intervention	Number of patients who had reached this stage	Number of patients still using KiActiv®	% still using KiActiv®
One month	52	37	71%
Three months	28	13	46%
Six months	11	3	27%



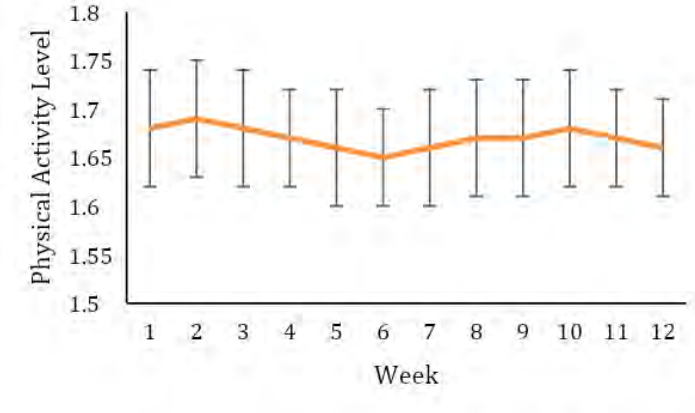
a) Non-sedentary time



b) Moderate-to-vigorous physical activity



c) Moderate bouts of physical activity



d) Physical activity level

Figure 3. Multiple dimensions of physical activity during KiActiv® Health

Objective physical activity data

Individual's physical activity data across the 12-week programme showed variation across the cohort with many people changing their physical activity levels, but at different points in time and in different dimensions. This variation is also highlighted in the results of the linear mixed models. Figure 3 shows the estimated marginal means and the 95% CIs across the multiple dimensions of physical activity for patients who completed the 12-week KiActiv® Health programme. Visual inspection of the grouped figures shows that there was significant overlap in the CIs indicating that there were no significant changes in non-sedentary time, MVPA, moderate bouts or PAL across the 12-week period. Sub-group analysis by MRC (Grade 1-3 and Grade 4-5) found no significant changes in non-sedentary time, MVPA, moderate bouts or PAL across the 12-week period found for patients in either group.

Patient impact

Analysis of the quantitative data collected at the start and on completion of KiActiv® Health indicated that patients with COPD experienced a statistically significant improvement in the PAM, EQ-5D VAS, knowledge in how to improve their physical activity levels and confidence in performing physical activity (Table 3).

Table 3. Change in patient-reported outcomes from baseline to post-intervention

	Pre	Post	*p*
	n (%)	n (%)	
Understanding (n=35)			0.17
Strongly Agree	16 (46%)	21 (60%)	
Agree	19 (54%)	14 (40%)	
Disagree	0 (0%)	0 (0%)	
Strongly Disagree	0 (0%)	0 (0%)	
Knowledge (n=35)			< 0.01
Strongly Agree	5 (14%)	16 (46%)	
Agree	22 (63%)	18 (51%)	
Disagree	8 (23%)	1 (3%)	
Strongly Disagree	0 (0%)	0 (0%)	
Confidence (n=35)			< 0.02
Strongly Agree	2 (6%)	9 (26%)	
Agree	20 (57%)	17 (49%)	
Disagree	13 (37%)	9 (26%)	
Strongly Disagree	0 (0%)	0 (0%)	

PAM Level (n=29)[2]			< 0.01
Level 4	2 (7%)	3 (10%)	
Level 3	13 (45%)	19 (66%)	
Level 2	6 (21%)	5 (17%)	
Level 1	8 (28%)	2 (7%)	
	Mean (SD)	Mean (SD)	
PAM score (n=29)	55.5 (11.6)	61.7 (8.7)	< 0.01
Health status (n=42)	54.0 (18.7)	64.2 (22.3)	0.02
CAT score (n=32)	21.3 (6.9)	20.3 (7.6)	0.40

When looking at changes in these self-report measures on an individual basis, a majority of patients remained stable or improved (Table 4).

Table 4. Individual changes in self-report measures

	Improved n (%)	Stable n (%)	Deteriorated n (%)
PAM Level	12 (41%)	15 (52%)	2 (7%)
Understanding	9 (26%)	22 (63%)	4 (11%)
Knowledge	18 (51%)	15 (43%)	2 (6%)
Confidence	14 (40%)	17 (49%)	4 (11%)
Health status	26 (62%)	6 (14%)	10 (24%)
CAT score	13 (31%)	9 (28%)	13 (31%

Analysis of the qualitative data from both the questionnaires and KiActiv® Mentor session notes indicated a picture of increasing interest and engagement in physical activity. Whether that was through more traditional forms of exercise, or through making changes and choices in their everyday lives to move more or reduce sedentary behaviour. Patients attributed these changes to the KiActiv® programme.

Patients described making conscious choices to break-up everyday activities like taking the bins out or taking multiple trips to the supermarket in order to walk for longer and further, purposefully breaking up what would otherwise be sedentary periods and pushing themselves a little further each time.

[2] Level 1 (0.0-47.0) low activation suggesting that the person does not yet understand their role in healthcare; Level 2 (47.1-55.1) indicating that the person does not yet have the knowledge and confidence to take action; Level 3 (55.2-72.4) indicating that the person is beginning to engage in positive health behaviours; Level 4 (72.5-100) indicating that the person is proactive and engaged in recommended health behaviours (Greene et al., 2015).

'It's made me try to push myself to do more.'

'It's made me do more things.'

'I'm moving more and better than I was before. Perhaps because I'm doing this, I'm pushing myself and I'm walking a little bit further than I used to walk.'

'I've been consciously doing a bit more. If I've got a spare five minutes, it's more about what can I do than sitting on the sofa.'

Patients exhibited a clear shift in their perceptions of what constituted physical activity and what activities contributed towards energy expenditure. Many started with a focus on traditional forms of exercise but, over time, through the support given by the mentors and the ability to self-monitor and tag behaviour, patients were able to appreciate the broader scope of activities that they were engaging in, and how beneficial these can be. Patients reframed their lifestyles from being sedentary, to one in which their everyday activities made them active, giving them a sense of achievement. This made movement feel more attainable and encouraged patients to think about how they could move more within the context of their day-to-day life.

'...it's shown me I move more than I thought I did.'

'It has made me realise that doing simple things I would have thought of as non-active are actually active.'

'You've made it feel like I don't have to run a marathon to get activity.'

'It takes the pressure off me saying to myself that I should be going to the gym, in actual fact I should be doing a bit more activity than I am.'

Those who were able to engage in more physical activity, whether that was through formal exercise or increasing their everyday movement, reported improvements in their overall fitness enabling them to do more. This led to less breathlessness and less pain and as a consequence less medication. Patients also reported improvements in their mood, both through the immediate enjoyment of moving more in the moment and when that led them outside, but also lifting depression more broadly.

'My breathing has improved quite a lot.'

'The good thing about [KiActiv® Health] at the moment is that I haven't been on the nebuliser for weeks and weeks. I'm quite pleased with that. I haven't touched my emergency pack for a long time.'

'I feel better when I move more. The more I move, the better I feel.'

'It's got me more active and probably more positive that I'm not on the way out, I had given up.'

Using KiActiv® Health also triggered some patients to initiate other changes that they would not have otherwise considered, in order to improve their health and well-being. These included purchasing adaptive aids to help them move more, utilising stop smoking services and joining virtual exercise groups.

Staff also acknowledge a range of benefits to embedding KiActiv® Health in the PR pathway for patients and the service. These included the ability of patients to engage with their own data and a shift in language that suggested patients were normalising everyday movement and physical activity, feeling more autonomous and able to self-manage. Staff also felt better able to actively manage the waiting list for PR and valued the ongoing support around physical activity after patients completed PR.

What has enabled change in these outcomes?

Patients appreciated the support and encouragement of the KiActiv® Mentors. These regular sessions incentivised patients to move more over the course of the programme, as a consequence of feeling externally monitored and held to account. The technology, including the monitor and dashboard also enabled improvements in well-being, cognitions and physical activity. The accuracy of the monitoring device in comparison to step-based wearables was noted and wearing the KiActiv® monitor acted as a prompt and reminder to move more.

'You remember it's there on your wrist and it's making you think about things, whether I just sit there or whether I get up and do something. It's down to KiActiv that I get up and do something most days.'

The visualisations found within the dashboard motivated patients, enabling them to understand the relationship between their behaviour and outcomes. Specifically in relation to how everyday movements and the activities they enjoyed constituted physical activity and contributed towards their calorie burn.

'It's Eureka going on here. What I can do is look at my activities that give me a good result and I can then work out the best efficient ways in which I can burn my calories.'

'It's given me an incentive, a good kick up the backside to get yourself moving because I can see what I have and haven't done.'

'The pie charts, the different aspects of activity, have been really useful……I can see how [the planning tool] can be used. I like the graphs; they are quite stark and that's quite motivating. I like the tagging.'

The mentor session notes revealed the benefits of the dashboard visualisations and mentor support providing patients with an opportunity to develop and specify goals, both in relation to physical activity and the outcomes they wanted to achieve. Behavioural goals included engaging in and increasing the frequency or intensity of more traditional forms of exercise, such as the gym, aerobics, running, walking and cycling, as well activities like dancing and yoga. Others spoke about establishing a routine and setting a goal to break up sedentary periods, by integrating basic moves into their everyday lives, such as standing up and moving at periodic intervals, if they led a more sedentary lifestyle. There was also recognition that pacing was important and some patients aimed to pace their activity in order to ensure they did not 'crash'. Some had a clear understanding that they would never be able or want to engage in vigorous bouts of activity, appreciating the ability of KiActiv® to support a more tailored approach to their goals. As well as behavioural goals, patients also defined goals in terms of the positive outcomes they hoped to achieve by moving more. Seeing improvements in these outcomes encouraged use of KiActiv® Health and physical activity. These included, weight loss and weight gain, burning more calories as displayed in the dashboard and protecting themselves against the risks of contracting and fighting Covid-19.

These goals were often discussed within the context of specific action plans or implementation intentions. Patients planned the performance of their desired behaviours providing detail about context, frequency, intensity or duration of the activity. Examples include aiming to do 15-minutes each on a bike and treadmill every other day, walking up and down the garden when the weather is good and, if the weather is good, going for a long walk and if not, going up and down the stairs more often. Planning was not easy for everyone, with some patients unable to plan ahead due to a lack of routine and consistency in their week.

Future intention to attend PR was also strong. Data from the final follow-up questionnaires indicated that 36 patients (86% of those who were asked) would definitely or probably attend PR in the future. Of the patients who had said they would attend PR in the future, 21 (68% of those asked) had not attended PR previously. Furthermore, 29 patients (69% of those who were asked) reported that their expectations of the programme had been met or exceeded.

'It's given me a tool that I can use in my own way in the future. I'm pretty optimistic that this is going to be the key to me getting where I want to be and staying there.'

Impact of Covid-19

It is important to acknowledge the impact of Covid-19 on patients, given that the project was delivered during the first year of the global pandemic. In the current evaluation, patients described how engagement in physical activity was more difficult due to the guidance on shielding for people defined as extremely vulnerable. Patients spoke about how Covid-19 had stopped them leaving the house entirely, remaining housebound for much of their 12-week programme and hence limiting their movement and increasing

their sedentary time. This is supported by the findings of Stockwell et al. (2021) who found that physical activity decreased, and sedentary behaviour increased in the general population during the pandemic, including those with medical conditions. Although other research indicates that 81% of COPD patients have managed to keep active during the pandemic (Philip et al., 2020) it is unclear if this included a decrease in activity from pre-pandemic levels. In this evaluation, some patients were able to shift their focus to everyday activities in their house or garden. Shielding also allowed some patients to relax and recuperate due to being furloughed, with some noting a significant reduction in chest infections and improved breathlessness due to fewer social interactions and exposure to atmospheric pollution. Given that KiActiv® Health is an entirely virtual intervention Covid-19 did not impact significantly on the delivery of the programme.

Discussion

Are patients with COPD willing to use KiActiv® Health?

Although we do not have precise data on how many patients with COPD were offered KiActiv® Health, it can be estimated that approximately 990 were sent an invitation letter and only 8% contacted the innovator to participate. This may have been associated with the recent restrictions in place due to the Covid-19 pandemic and as an overload of information when being invited to participate - along with issues with the online capture equation being off-putting to patients. This does, however, indicate a low uptake rate that could challenge future spread and adoption.

However, those patients who did participate were recruited across the whole of the PR pathway. This included those on the waiting list for PR, in order to prepare patients and begin their journey towards increased physical activity, and on completion of their PR programme, providing additional external motivation after completing either face-to-face or virtual PR.
A significant number of participants were recruited from areas of high deprivation, which suggests that the programme could contribute positively towards addressing the known socio-economic gradient in physical activity (Cavill & Rutter, 2017).

The primary barriers to recruitment largely related to a lack of appropriate technology and lack of confidence in the use of digital technology. So, despite the range in demographic characteristics of patients in this evaluation, the widespread use of KiActiv® Health may still be limited by a 'digital divide'. Once on the KiActiv® Health programme, patients were engaged and unlikely to drop out. Patients wore the KiActiv® monitoring device more than a standard physical activity monitor (Marin et al., 2018) and a majority attended all of the KiActiv® mentoring sessions. In-between sessions, patients visited the online dashboard every three to four days and tagged their data on every other occasion. These retention rates are much higher than those reported for other digital interventions that aim to promote physical activity in COPD (Bentley et al., 2020) and suggest that patients valued the KiActiv® Health programme.

What is the impact of KiActiv® Health on patients with COPD?

The analysis revealed that across all patients, physical activity levels appeared to remain stable across the 12-week programme. Although the wide confidence intervals indicated that patients' physical activity levels could improve, deteriorate or remain stable. At the very least, stability in light of the fact that patients with COPD were advised to remain at home due to Covid-19 and physical activity levels in the general population (Stockwell et al., 2021) and for those with other medical conditions (Vetrovsky et al., 2020) reduced significantly during the pandemic, is an achievement. This data suggests that KiActiv® Health was able to prevent deterioration in a group who might have otherwise been expected to have declined, especially for patients with MRC grades of 4 or 5 whose health is more likely to deteriorate.

Despite no clear trend in the physical activity data, participation in KiActiv® Health was associated with significant improvements in patients' ability to self-manage, their knowledge in how to improve their physical activity levels, confidence in performing physical activity and their overall health status. Given that in increased knowledge, confidence (Hartman et al 2013) and ability to self-manage act as predictors of improvements in physical activity, this could indicate that KiActiv®, given more time, could have had a more sustained and stable impact on physical activity in this cohort. Qualitative findings, from patients and staff, also support the hypothesis that KiActiv® Health is having a positive effect on some patient's physical activity behaviour and cognitions and was valued by those who participate. The results demonstrated that patients used KiActiv® Health beyond the 12-week programme, but it would be interesting to conduct an evaluation with a longer follow-up period, alongside an assessment of whether this engagement leads to positive changes on clinical outcomes and healthcare usage.

The weather was reported to be a significant limiting factor in a patient's ability to engage in physical activity. This included the impact of both hot, cold, wet and windy weather on breathlessness. These findings support the broader literature demonstrating a link between the weather and physical activity in people with COPD (Alahmari et al., 2015; Shea et al., 2017; Hartman et al., 2013) and weather being a barrier to engaging in other COPD physical activity interventions (O'Shea et al. 2007). Unsurprising given that this more extreme weather is associated with more frequent exacerbations in patients with COPD (Gayle et al., 2020). Hartman et al. (2013) suggest that to overcome these barriers, the possible influences of weather on adherence to regular physical activity should be openly discussed with the patient. This could include talking about backup activities in case of poor weather, such as how best to remain physically active at home. Given the impact of weather on physical activity, future research could benefit from collecting objective data on temperature, humidity, wind speed and daylight hours, alongside objectively collected physical activity data, in order to quantify and control for these effects.

Given the impact of Covid-19 on the delivery of PR, the virtual nature of KiActiv® Health enabled patients with COPD to continue engaging in discussions around physical activity, at a time when face-to-face PR was not available and was transitioning to virtual delivery. During the pandemic, patients with COPD have experienced a significant reduction in exacerbations and hospitalisations (González et al., 2021) as a

consequence of the isolation from others and avoiding air pollution. This evaluation shows that KiActiv® Health is an effective option for many patients and reduces the need for face-to-face interaction which may also offer a benefit beyond the pandemic.

These changes were driven by a number of active behaviour change techniques found within the KiActiv® Health programme. Patients set individualised goals that related to the physical activity they wanted to engage in and the outcomes they hoped to achieve. These goals were sometimes in the context of detailed action plans, encouraging embedded and sustained behaviour change. The support offered during mentor sessions, together with the visualisations found within the dashboard, allowed patients to understand the relationship between their everyday movement and their physical activity data, giving them a better understanding of what constituted physical activity. For some, there was a shift in the perception of themselves from a sedentary to active person, motivating them further.

Together these techniques led to statistically significant improvements in knowledge and confidence to self-manage and greater understanding, awareness and confidence in their ability to perform moderate physical activity. Improvements that are similar to those found after PR (Barber et al., 2019; McNamara et al., 2019).

A majority of the patients in this evaluation were on the waiting list either for face-to-face or virtual PR and it is encouraging that 86% remained interested in attending PR after completion of the KiActiv® Health programme.
Given that interventions to increase uptake of PR have so far had a limited effect (Early et al., 2018) and long waiting lists and travelling distance are associated with poor engagement with PR (Cox et al., 2017), KiActiv® Health could be a potential route to increasing uptake.

What learning can we take from this project in order to spread KiActiv® Health?

Staff familiarity and confidence in KiActiv® Health was important for recruitment of patients to the programme. Ensuring staff have sufficient knowledge about KiActiv® Health, including the physical activity monitor, dashboard and mentor sessions is vital. Staff spoke about needing a 'working knowledge of the technology' to give them the confidence to endorse it to their patients. When staff recognised the benefits to patients of joining KiActiv® Health, they were more motivated to engage patients in talks around recruitment.

Digital exclusion can be a barrier to recruiting patients to KiActiv® Health, with a lack of technology, or lack of confidence, being the most frequently cited reason for patients declining to participate. This included older patients who did not have a smart phone or Bluetooth® and younger patients who did not have a laptop or tablet. For patients who did possess the technology, a lack of digital literacy was reported by some, particularly older patients, who felt they lacked the confidence and skills to engage in the programme. Although this is recognised as a barrier to adopting digital health technology in people with

COPD (Slevin et al., 2019), fewer were unable to participate in KiActiv® due to these reasons than for virtual PR delivered during the pandemic (Lound et al., 2021). Linking in with local initiatives that aim to increase digital inclusivity through the distribution of devices and improving digital literacy could overcome these issues.

Recruitment resources and methods play an important part in uptake and retention. The project team recognised that it was important that all patient-facing materials are clear about the benefits of physical activity for people with COPD and how participation in KiActiv® Health operates alongside virtual and face-to-face PR. This could be in the form of patient stories from those who have been through the programme and benefitted. The invitation should be personalised to the patient, and either from a senior member of staff, or from someone the patient has already interacted with. In this project, rapport and trust in the staff and service made patients feel more confident about engaging with KiActiv® Health. It is also recommended that if information is being sent in the post it helps to send this alone, as patients can experience information overload if sent with other documents. In order to ensure that the recruitment process is aligned with the needs and expectations of people with COPD, patient and public involvement (PPI) in how this is undertaken can be beneficial to both enrolment and retention (Crocker et al., 2018).

Future implementation of KiActiv® Health should consider tailoring recruitment materials to address the potential barriers to engaging in KiActiv® Health and physical activity more broadly, in order to maximise uptake and engagement, aided by PPI.

This could include making the benefits of physical activity for people with COPD more explicit and providing more information on how the programme integrates or compliments PR. This could be achieved through the use of patient stories, which are powerful tools that enable patients to see the impact of an intervention for someone like them. This evaluation has shown the importance of a personalised recruitment process that invites patients from a known and trusted staff member. However, ensuring staff are sufficiently knowledgeable about KiActiv® Health is vital to them being able to show enthusiasm for the innovation. Future implementation should consider embedding clinical champions or super users, who could be staff or patients, who could be given devices and trained to facilitate shared learning between staff and patients, to allow their enthusiasm for the innovation to spread. Given the complex relationship between physical activity and weather conditions for people with COPD, future evaluations of KiActiv® Health in this population would benefit from considering how the mentor sessions could be tailored to address this barrier, and how daylight hours, temperature, humidity and wind speed data could be incorporated into analysis of changes in physical activity.

Limitations

The single group evaluation design means that causality cannot be attributed to KiActiv® Health directly. In the absence of a control group, changes between the start and end of the KiActiv® Health programme might be due to other external environmental or social factors, such as the weather, or Covid-19 lockdown

status. Limited data was available on ethnicity, so the cohort cannot be fully described, and is unable to determine whether those who participated were representative of patients eligible for PR. Reference has already been made to possible digital exclusion, but other factors, such as selection bias, might also be significant.

Potential for the future and next steps

The Moving to Better Health project is an example of a successful multi-partner, real-world evaluation, that has provided an opportunity for a sample of people with COPD to experience the KiActiv® Health innovation.

The results from this evaluation indicate that the use of KiActiv® in this way can have a positive impact for patients with COPD. This project has identified a number of areas that would benefit from further exploration.

- Further analysis of individual physical activity profiles over time, taking into account environmental factors such as pollution levels and weather conditions, to understand the impact of these factors on the COPD population.
- Analysis of the uptake of virtual or face-to-face PR by patients who completed the 12-week KiActiv® Health programme would also be useful to understand its potential impact.
- The West of England AHSN industry and innovation team will continue to support KiActiv® to further explore opportunities for the product in COPD and other clinical areas.

This project has provided an opportunity to demonstrate effective collaborative working across NHS organisations and industry, resulting in key learnings for future partnerships.

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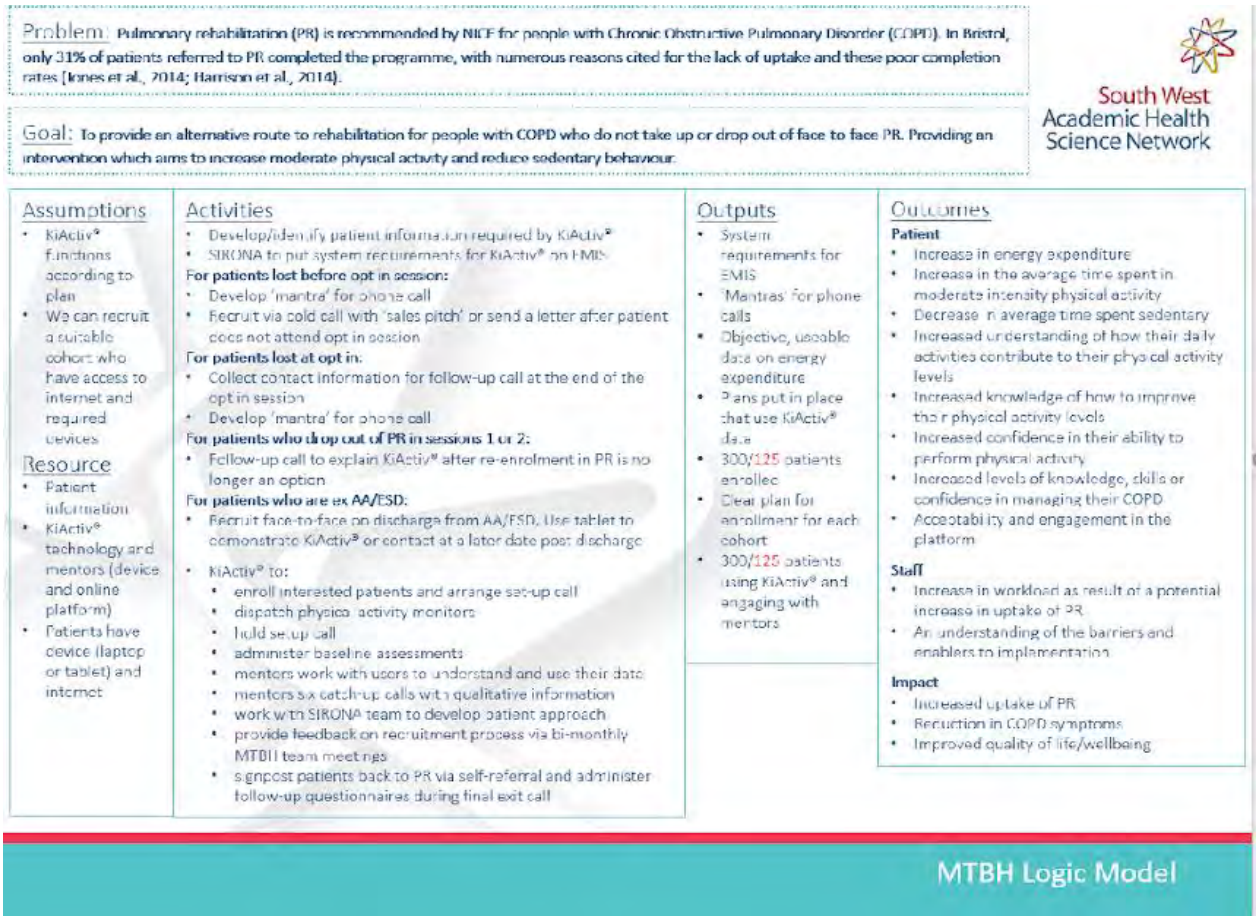
Appendices

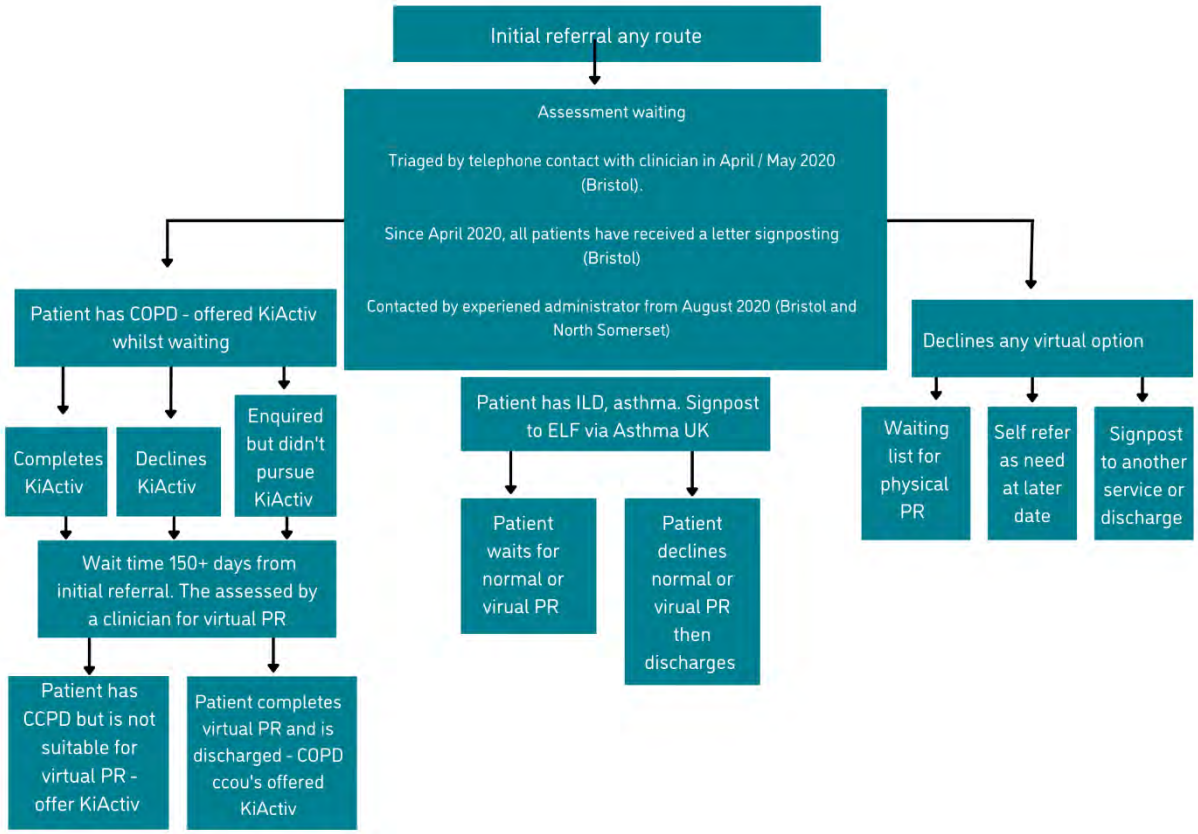
Appendix A. Moving to Better Health logic model



Appendix B. Adaptions to Sirona Care and Health services and recruitment to KiActiv® Health

March 2020	Face-to-face PR was postponed following NHSE guidance. All patients with COPD in Bristol, including those who were already attending PR, about to start and those on the waiting list, were contacted by phone or letter to inform them that PR was postponed until further notice. KiActiv® Health was offered as an alternative route to rehabilitation along with myCOPD, an NHS approved self-management app.
March-June 2020	COPD patients were classed as 'vulnerable' due to the pandemic and began shielding.
April 2020	Referrals from GPs for PR decreased significantly from 25-30 per month to two referrals in April 2020.
April-May 2020	All new patient referrals for PR were offered KiActiv® Health by clinicians during telephone triage.
May-July 2020	All new patient referrals for PR were sent a letter offering KiActiv® Health along with information about myCOPD. The two clinicians who had been assigned to contact patients by phone were signed off sick and then left their roles, so patients did not receive a phone call during this period.
July 2020	Remote PR was set up by the clinical team in Bristol and is now offered to all patients in Bristol, South Gloucestershire and North Somerset, alongside KiActiv® Health and myCOPD. Recommendations about the most appropriate route to rehabilitation is facilitated through a discussion with a clinician. Patients are also informed that they are able to take part in the KiActiv® Health programme whilst they are on the waiting list to begin remote PR. All "legacy" patients (dating back to December 2019) in North Somerset and South Gloucestershire were contacted by an administrator by phone (two attempts) with a letter to follow up offering KiActiv® Health.
August 2020 – January 2021	New referrals in Bristol and North Somerset are being contacted by an experienced administrator or a member of support staff (two attempts) with a letter to follow-up, offering KiActiv® whilst they are on the waiting list for remote PR which is >150 days. Patients in South Gloucestershire do not have a waiting list, but were offered KiActiv® if they chose not to take up remote PR.

Appendix C. PR referral flow chart for patients in Bristol, North Somerset and South Gloucestershire



The Future Challenges

Keeping Healthy at Home:

Moving to Better Health

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