Final report

August 2016

Innovating for Improvement

Implementation of the TRAK intervention to enable e-rehab for knee conditions: a web-based intervention suite to support self-management in rehabilitation

Cardiff and Vale University Health Board

The Health Foundation

Project title:

Implementation of the TRAK intervention to enable e-rehab for knee conditions: a web-based intervention suite to support self-management in rehabilitation

Lead organisation:

Cardiff and Vale University Health Board

Partner organisation:

Cardiff University

Project lead/s:

Dr Kate Button

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Part 1: Abstract

Musculoskeletal conditions are extremely common, accounting for 30% of GP consultations (Briggs 2012). Amongst these, knee conditions are the most common and can significantly affect mobility and quality of life (Arthritis Research 2013). Physiotherapy is often recommended to help these patients. However, growing demand for long-term condition management means new approaches are needed. A team at Cardiff and Vale University Health Board (C&V UHB) developed TRAK – an application suite that provides a patient-focused approach to sharing information and exercise prescription. The web-based app provides patients with information about the nature of their condition together with a self-care plan, which provides practical information on rehabilitation exercises. The app allows patients to keep a diary of exercise activities and also features an interactive tool that helps them assess their recovery progress over the course of rehabilitation. The usability and acceptability of TRAK has already been tested with both patients and clinicians and feedback has been positive (Spasic et al .2015). The aim of the current project was to implement TRAK as an intervention into routine health care practice and evaluate the impact of implementation on the patient, clinician and organisation. The study design used was a participatory action research with an embedded cohort study. This innovative project blended treatment components that are known to support self-care with an online platform, which has been fully integrated into the clinical environment

There were 3 phases to the intervention:

- **Set-up phase**: to integrate TRAK into the IT infrastructure within C&V UHB and recruit and train a group of 15 physiotherapists as clinical participants in the study

- **Phase 1 (initial implementation):** to test the TRAK app with the group of 15 physiotherapists and patients, allowing them to familiarise with the app and use the findings to suggest/make changes to improve its usability and clinical utility

- **Phase 2 (wider implementation):** to implement the intervention more widely into clinical practice and evaluate longer term use and impact on patient care and service change. The recruited physiotherapists were asked to either (1) use TRAK as part of treating 50 patients, or (2) use conventional physiotherapy care on 50 patients (control group)

Successes

- TRAK was successfully integrated into the NHS IT infrastructure and embedded into the physiotherapy out-patient service within Cardiff and Vale UHB. This is the first example of an e-Health intervention to support co-production of personal care plans for knee conditions.

- Preliminary findings indicate improvement in symptoms and physical activity over time for individuals using TRAK.

- A team of clinicians from across 6 physiotherapy departments in C&V UHB volunteered to use TRAK. They demonstrated a change in practice as they became more familiar with TRAK.

- TRAK has spread beyond C&V UHB and has been implemented at Homerton University Hospital by Emma Dunphy, in a project funded by NIHR under the HENCEL/CLAHRC fellowship programme.

Challenges and Solutions

- Ensuring that TRAK meets NHS Information governance requirements, so that no patient identifiable data was stored in the TRAK database, whilst maintaining TRAK functionality.

- Both patients and clinicians found TRAK easy to use, but clinicians initially experienced the additional challenge of integrating TRAK into a model of supported self-care. Additional training on supported self-care was provided before the start of phase 2.

Outcomes

To measure impact, we collected a range of outcomes including:

- a survey about initial TRAK implementation,

- interview data that broadly evaluated patient and clinician opinions about change of practice, approaches to self-care, experience of TRAK and future needs,

- a health resource use questionnaire (Cooke et al. 2009),

- patient rated outcome measures assessing knee related symptoms, function, quality of life, pain and sport (Knee Osteoarthritis Outcome Score, Roos et al. 1998),

- self-efficacy (6 item self-efficacy scale, Lorig et al. 2001),

- physical activity (International Physical Activity Questionnaire, Craig et al. 2003), and

- TRAK use data

Project Impact and learning

- TRAK is transferrable to other institutions and can be expanded for use in other healthcare settings such as primary care.

- The initial findings suggest a shift in working practice by physiotherapists who reported better engagement and outcomes using TRAK with older adults. Physiotherapists indicated that TRAK was appropriate for a wider audience than anticipated.

- TRAK was used by physiotherapists and patients almost exclusively to co-produce personalised exercise plans. The videos were of therapeutic benefit to remind patients of their personal exercise plan and correct technique. There was poor engagement with the email contact with the physiotherapist.

- Both patients and clinicians found TRAK easy to use.

- There was good engagement by patients, 32 out of 48 patients (67%) accessed TRAK outside of the clinical environment.

- Patients struggled to progress their exercises over time. Addressing this shortfall may improve long term self-management.

- A training package to help clinicians develop the skills required to integrate TRAK into a supported self-care framework will be used in future spread of TRAK.

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Part 2: Progress and outcomes

Course of the intervention

There were 3 phases to the study: set-up phase, phase 1 and phase 2.

Set-up phase

To comply with the information governance of the Health Informatics Service, the original TRAK app had to be re-implemented and hosted within the NHS firewall. Figure 1 displays the screenshot of the home page of TRAK. The final version is accessible at this URL: http://trakphysio.org.uk/Home

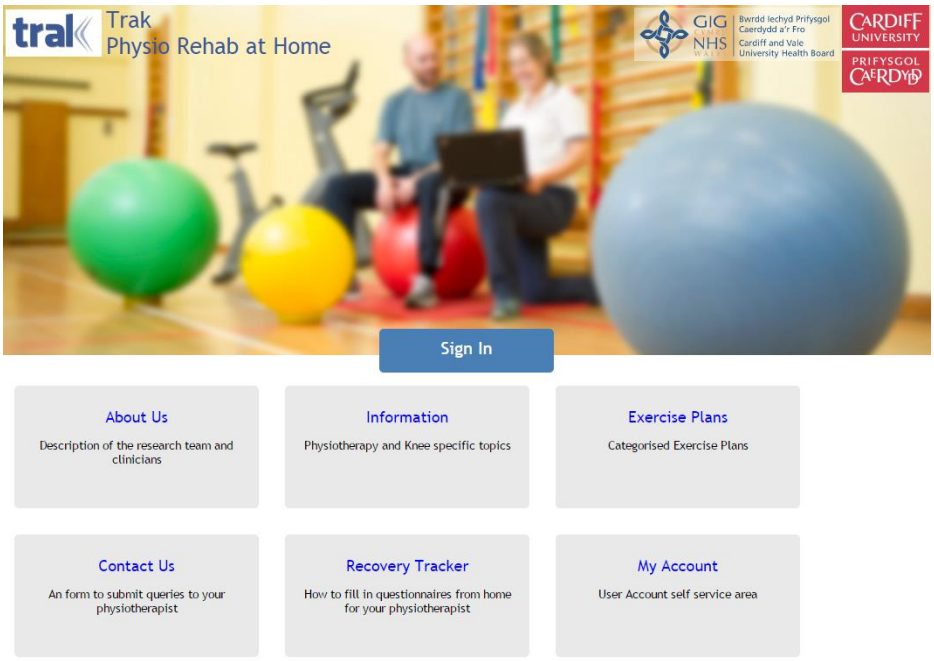

Figure 1. Screenshot of the new version of the TRAK app

The original functionality was extended to support exercise prescription. The screenshots in Figures 2a & 2b shows how to set up and later access a personalised exercise plan.

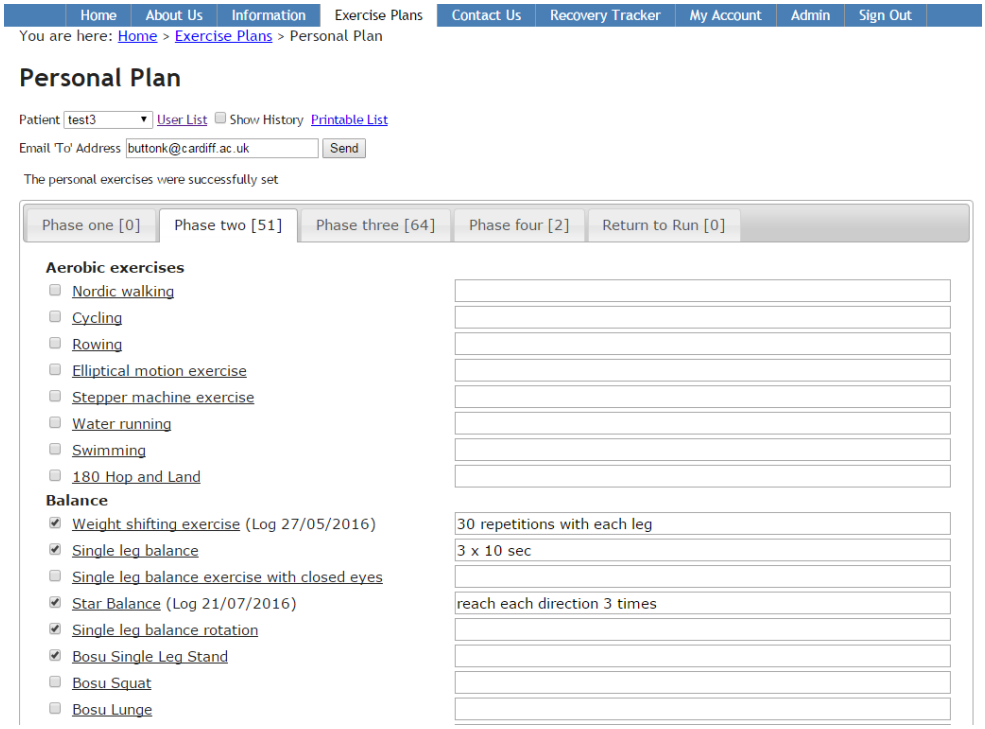

Figure 2a. Clinician's view: Setting up a personalised exercise plan

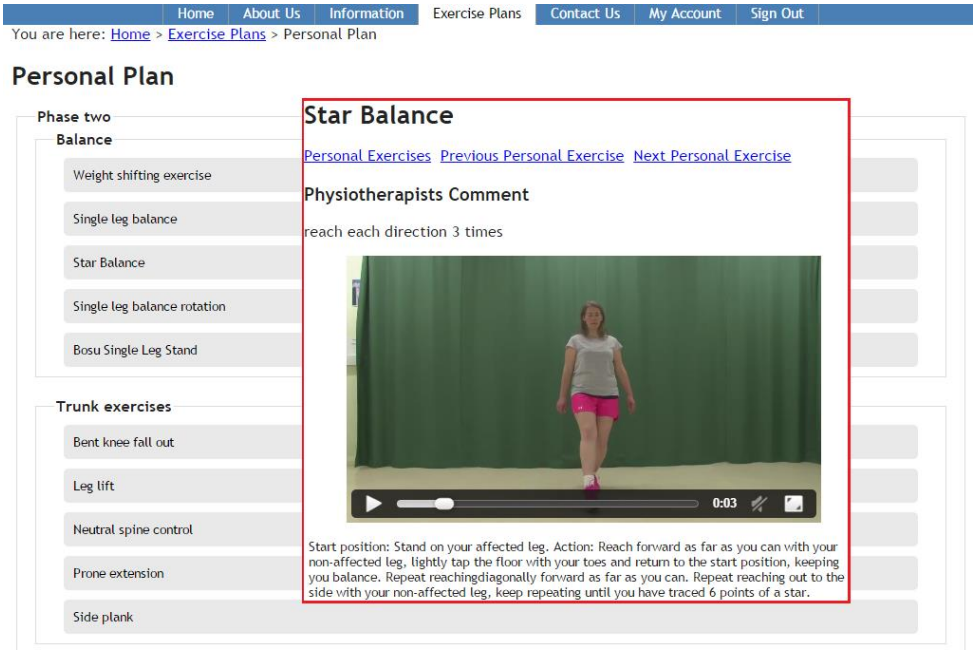

Figure 2b. Patient's view: Accessing personalised exercise plan

Once fully integrated within the C&V UHB IT infrastructure, we recruited 15 physiotherapists to participate in the study. They were recruited from 6 physiotherapy departments. A separate training session was organised at each department to explain the aims of the study and demonstrate the functionality of the TRAK app. Once they have consented to participate, a clinician user account for the TRAK app was created for each physiotherapist.

Phase 1

The group of 15 physiotherapists recruited during the set-up phase deployed TRAK on a small pilot scale in their clinical practice. They recruited a total of 16 patients (6 male, 10 female, mean age 39 years) that matched the selection criteria for the study:

Inclusion:

- Adults ages 18 years and above.
- Have a knee condition, which is chronic, acute and/or post-surgical.
- Attend C&V UHB for treatment of the knee condition.
- Able to read and write English.
- Able to give written informed consent themselves.
- Have access to the Internet at home.
- Deemed appropriate for an exercise supported self-management approach.

Exclusion:

- Complications associated with knee injury or surgery such as deep vein thrombosis or infection.

Both types of users, i.e. clinicians and patients, were asked to use TRAK app for 4 weeks as part of the rehabilitation process. When recruiting patients, the Principal Investigator (PI) attended the initial consultation to explain the aims of the study to the patient and obtain their consent for participation. The consultation would then proceed involving the interaction between the physiotherapist and the patient. As part of the new intervention, the physiotherapist would demonstrate the functionality of the TRAK app in addition to normal clinical practice. The physiotherapist would also use TRAK app to prescribe a personalised exercise plan. The patient was given a user account to access TRAK from home as part of their treatment. At the conclusion of the initial consultation the physiotherapist and patient were asked to complete a survey about their first impressions about using TRAK in clinical practice. The patient also completed the Knee Osteoarthritis Outcome Score (KOOS) to establish a baseline for their knee condition (Roos et al 1998).

After 2 weeks into their treatment, patients were emailed to obtain midway feedback on using TRAK app as part of their self-care. The response rate was 50%. Having used TRAK for at least 4 weeks, both patients and clinicians were interviewed separately in relation to the following main topics: TRAK app itself, its implementation in clinical practice, self-care and future research. In addition, patients were asked about the current status of their knee condition, whereas physiotherapists were asked about appropriateness of using TRAK intervention across different patient populations.

Phase 2

As part of the wider implementation of TRAK within clinical practice, the physiotherapists originally participating in Phase 1 were approached to participate in

Phase 2. Eight of these were available to participate. In addition, we recruited three new physiotherapists. Based on the experience from Phase 1, we modified the training to emphasise the self-care aspect of the intervention. All 11 physiotherapists have undergone such training. A total of 49 new patients (one withdrew) were recruited to participate in the TRAK intervention. A total of 14 patients were recruited as part of the control group to have the standard physiotherapy care. The recruitment followed the same approach as in Phase 1. Both types of users, i.e. physiotherapists and patients, were again asked to use TRAK app as part of the rehabilitation process, this time for 12 weeks. At the start and the end of this period we collected the following patient rated outcome measures (PROMs) from the patients: KOOS subscales, self-efficacy 6-item scale (Lorig et al. 2001), EQ-5D-5L (EuroQol 1990), Health Resource Use (Cooke et al. 2009) and the international Physical Activity and Activity Questionnaire (IPAQ) (Craig 2003). As for physiotherapists, they were interviewed after 12 weeks similarly to previous interviews in Phase 1. The flow chart for the recruitment for Phase 2 is detailed in Figure 3.

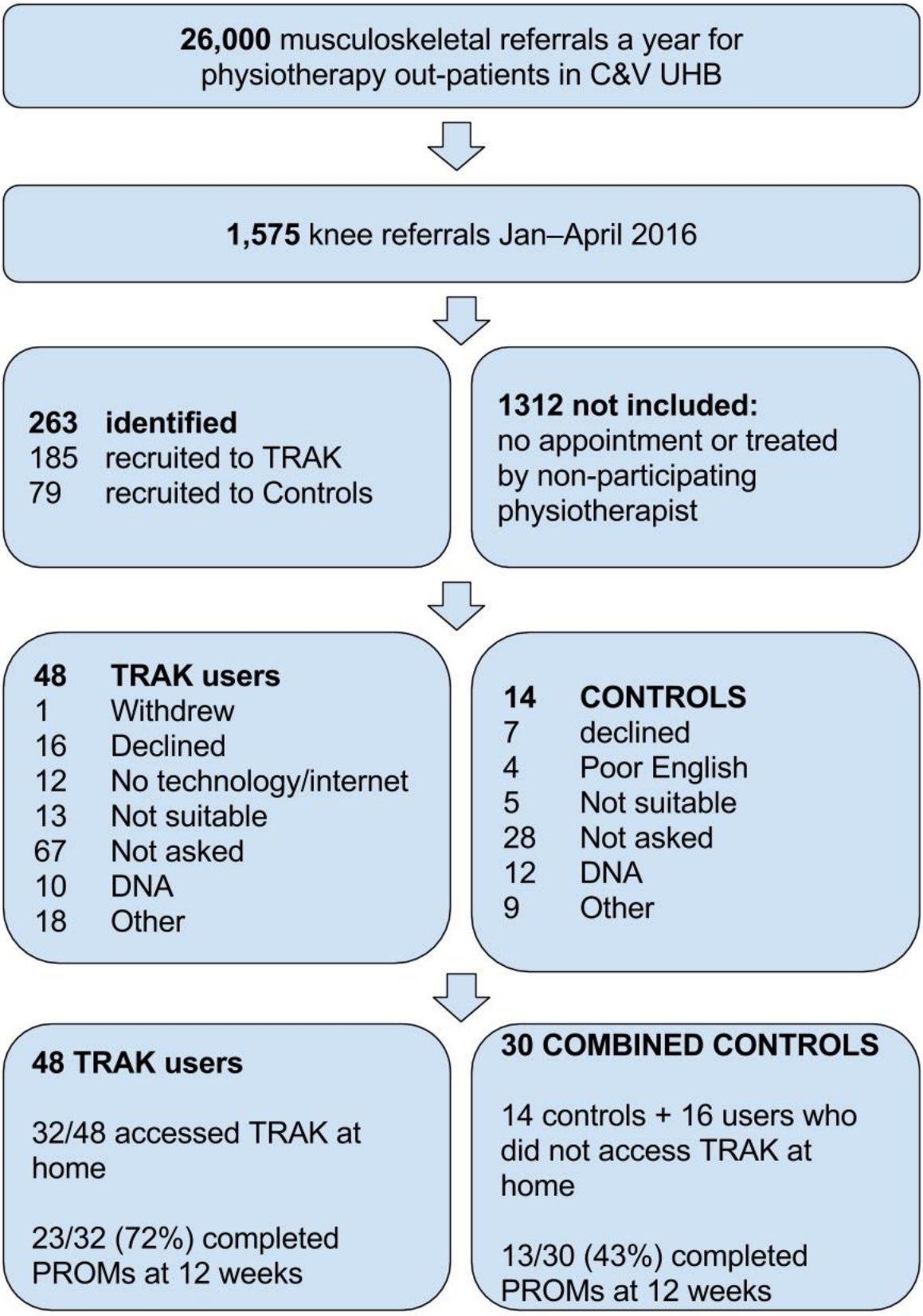

Figure 3. Recruitment flow chart for Phase 2

Data collection & analysis

The timing of data collection for each outcome measure and for each phase of the study is detailed in Figure 4. Table 1 summarises and describes each type of data collected and Table 2 the type of analysis performed on each set of data.

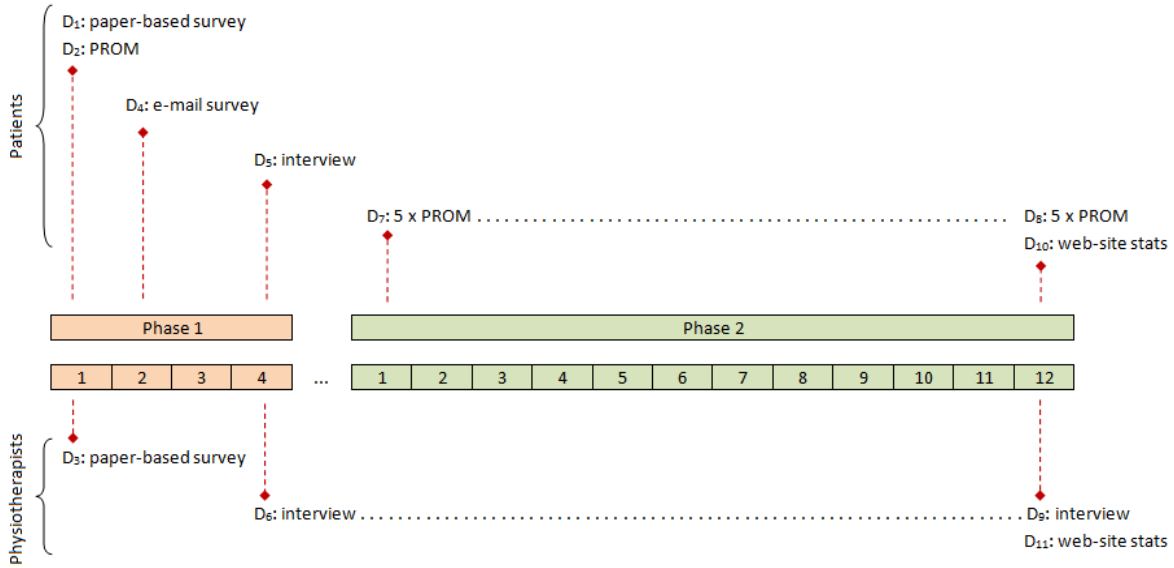

Figure 4: Timing of data collection for all outcomes measures

Table 1: Summary of data collected

Dataset	Type	Source	Sample Size	Description
D_1	survey	patient	16	Paper-based survey summarised in a spreadsheet.
D_2	PROM	patient	16	Knee Osteoarthritis Outcome Score (KOOS): 5 subscales measuring pain, symptoms, activities of daily living (ADL), sport and quality of life (QoL). A higher score means fewer symptoms.
D_3	survey	physio	15	Paper-based survey summarised in a spreadsheet.
D_4	survey	patient	8	E-mail survey summarised in a spreadsheet.
D_5	interview	patient	15	Interviews recorded (audio only) and transcribed.
D_6	interview	physio	15	Interviews recorded (audio only) and transcribed.
D_7	PROM	patient	48+14 (32+30)	KOOS, self-efficacy 6-item scale, Health resource use and International Physical Activity Questionnaire (IPAQ) which measures weekly physical activity in terms of MET's (multiples of resting metabolic energy cost) and activity category of low, moderate and high activity.
D_8	PROM	patient	48+14 (32+30)	The same PROMs as above to measure the change.
D_9	interview	physio	6	Interviews recorded (audio only) and transcribed.
D_{10}	stats	patient	48	Web-site use stats.
D_{11}	stats	physio	6	Web-site use stats.

Table 2: A summary of the data analysis performed on each dataset

Analysis	Dataset(s)
Summary	D_1, D_2, D_3
Thematic analysis	D_4, D_5, D_6, D_9
Statistical analysis (paired t-test, independent t-tests and Chi square). For there to be a statistically significant difference between baseline and follow-up p needs to be less than 0.05 ($p<0.05$).	D_7, D_8, D_{10}, D_{11}

Summary of results

D1: paper-based survey (patients phase 1)

Having had the initial consultation, which included the training, the patients felt confident about using TRAK at home. They did not offer any additional information, so the findings are not presented in any further details in this report.

D2: KOOS scores (patients phase 1)

The KOOS scores for phase 1 patients participants are presented in Table 3. Each subscale is scored out of 100 and a high score means fewer symptoms.

Table 3: Summary of KOOS scores for phase 1 participants

KOOS Pain	KOOS symptoms	KOOS activity of daily living	KOOS sport	KOOS quality of Life
61	60	68	37	40

D3: paper-based survey (physiotherapists phase 1)

After the initial patient consultation the physiotherapists were asked a series of questions about TRAK. The questions and main findings are presented in Table 4.

Table 4. Summary of physiotherapy survey post initial consultation

Question	Main findings
How did you introduce the TRAK into the patient consultation?	TRAK was introduced in two different ways: 1. Going through the functionality together with the patient 2. Letting the patient browse independently TRAK was predominantly used for exercise prescription and support.
How did you train the patient to use TRAK?	Demonstration by the physio on a desktop computer or an iPad.
What would you do differently in the future when introducing a patient to TRAK?	Two major themes were identified: 1. Improve their own proficiency in using TRAK 2. Allow patient time to explore TRAK prior to appointment
What would make it easier to incorporate TRAK into treatment?	Two major factors were identified: 1. More time 2. Access to appropriate devices (e.g. computers, iPads, printers) The time issue occurred because the clinicians simply added TRAK to their usual consultation. Change in clinical practice is required to make better use of TRAK, which should than save the actual time for consultation. As for access to devices, as part of the policy of NHS efficiency, NHS has been challenged to go paperless by 2018.

D4: e-mail survey (patients phase 1)

The content of the patient emails was analysed to identify themes. These themes and patient quote are presented in Table 5.

Table 5: Themes extracted from the patient emails

Theme	Definition	Patient Quotes
Exercise technique	Proper exercise execution	*I think seeing the exercises online enables you to do them correctly.*
Exercise progression	Varying exercises to optimise health outcomes	*The different levels for the exercises and strength building programmes are great. You can pace yourself and do as much or as little as you want and move on to other exercises between physio sessions.*
Communication	Sharing healthcare information	*It feels like the next best thing to actually being with the physiotherapist.*
Information content	The amount of information conveyed	*The TRAK website works well as it includes a lot of information.*
Information accessibility	Making information easy to access and use	*My immediate reaction is that there's lots of useful information here, but its access is far too laborious and it needs massively simplifying for quick and easy reference.*
Personalisation	Tailoring treatment to individual patients	*My personalized exercise programme does not state how many repetitions/ times a day that they have to be done.*

D5: interview (patients on completion of phase 1)

The patients were audio recorded and the transcripts were transcribed. Two reviewers independently annotated the transcripts and met to agree on themes. The findings of the thematic analysis and patient quotes are presented in Table 6.

Table 6: Thematic analysis of patient interviews at the end of phase 1

Theme	Definition	Patient Quotes
Digital divide	Access to and use of ICT	*Obviously there could be one or two barriers with people if they are not sort of computer literate. And then you have people who don't have access to Internet.*
Usability	Ease of use and learnability	*I would say if you have the skills required to do online shopping that would be more than sufficient.*
User requirements	What the users expect TRAK to be able to do	*The main thing I've been looking at is how to plan my sessions. Rather than just doing it on a week by week basis, I could forward plan and goal plan.*
Change management	Incorporating TRAK into clinical practice	*Need to go through TRAK with physio first for guidance and direction, to gain confidence and understanding.*

		I am able to see how the exercises are meant to look like and how I'm meant to be doing them, but it doesn't give indication of making them harder or easier.
Self-care	Supporting patients to take responsibility for their rehab	*I think it meets all my needs. TRAK tells me what to do, shows me what to do and I do it.*

D6: interview (physiotherapists on completion of phase 1)

The themes and quotes from the physiotherapist interviews conducted at the end of phase 1 are summarised in Table 7.

Table 7: Thematic analysis of physiotherapist interviews at the end of phase 1

Theme	Definition	Physiotherapist Quotes
Digital divide	Access to and use of ICT	*... whether they are good with technology and they want to access technology.*
Usability	Ease of use and learnability	*Training-wise I can't really see any… It doesn't take much. You just look at it like a website and you will pick it up straight away.*
User requirements	What the users expect TRAK to be able to do	*If there's some sort of catalogue or some sort of picture thing that you can flick through quickly and say "right I can give him phase two, number two, two c, two b".*
Change management	Incorporating TRAK into clinical practice	*I think initially it was more that I wasn't too confident with it, I didn't know what the exercises were on it, so it is a case of planning of what I was going to do with the patient, having some time before they came in to prep myself with TRAK so then I can go confidently "right, here you are, this is your phase, these are your exercises"*
Self-care	Supporting patients to take responsibility for their rehab	*Gives them the ability to take control of their rehab. When they come in they get reliant on us.*

D9: interview (physiotherapists phase 2)

The physiotherapists were interviewed again at the end of phase 2. The themes and quotes from their interviews are presented in Table 8.

Table 8: Thematic analysis of physiotherapist interviews at the end of phase 2

Theme	Definition	Physiotherapist Quotes
Digital divide	Access to and use of ICT	*That really surprised me actually. A lot of the older generation thought it was really, really good.*
Usability	Ease of use and learnability	*It's really self-explanatory when you are actually on it, and obviously most of the people have enough IT skills to navigate around the website.*
User requirements	What the users expect TRAK to be able to do	*I think it was really good when we could quite quickly put together the patient programs, you can personalize it.*
Change management	Incorporating TRAK into clinical practice	*I found it very useful because previously I used to draw out pictures … whereas to have those videos and pictures available and also together, I found that quite good and saves me time*
Self-care	Supporting patients to have the confidence to manage their own condition	*I had one patient. We were going to look at the next assessment, which she had to cancel so by the time I'd seen her next she already utilized the site which was great and before I had the chance to give her any information or exercises, she already had a look at it and came to me with suggestions of what exercises she might do.*

Patient Rated Outcomes: Statistical analysis D7, D8, D10, D11

We collected baseline data on 48 TRAK users and 14 controls who received usual care. Of the 48 TRAK-users; 32/48 logged onto TRAK outside of their face-to-face physiotherapy appointment and 16/48 participants never accessed TRAK. Therefore, due to the small number of 14 control participants we combined this group with the 16 individuals that did not access TRAK, to form a combined 'natural' control group of 30 individuals. After twelve weeks we contacted all participants to complete the follow-up patient rated outcome measures, we have received responses from 23/32 TRAK users (72% response rate) and 13/30 combined controls (43% response rate) (Figure 3).

Data for the baseline and follow-up is presented in Table 8. At baseline there were no statistically significant differences ($p>0.05$) between the TRAK-user and combined natural control group, i.e. the groups were matched for; age, gender, KOOS scores (pain, symptoms, activity of daily living, sport and quality of life), self-efficacy and physical activity (METS).

Between baseline measurement and 12-week follow-up the TRAK user group did demonstrate a statistically significant improvement in their KOOS scores (pain, symptoms, ADL and QoL) and physical activity (METS) ($p<0.05$) (Table 9). The natural control group did not demonstrate a statistically significant improvement ($p>0.05$). Neither group demonstrated an improvement in KOOS sport or self-efficacy over time ($p>0.05$). There was no statistical difference in the number of physiotherapy attendances ($p>0.05$).

We did not perform a statistical analysis comparing groups at follow-up because of the unequal group sizes (small number in the control group) and because our control group was made up of a combination of those that had not accessed TRAK and individuals that were allotted as controls i.e. contamination of the control group.

Table 9. Mean, standard deviation (SD) and frequencies for outcome variables for the TRAK user group and natural control group at baseline and 12 week follow-up. *significant difference ($p<0.05$) between baseline and follow-up for TRAK users

Variable	**TRAK users *baseline***	**TRAK users *follow-up***	**Natural control *baseline***	**Natural control *follow-up***
Mean Age years (SD)	49.4 (18.2)		41.7 (21.5)	
Gender (frequency)	Females 19, Males 12		Females 20, Males 10	
Physiotherapy attendances (SD)		5.58 (2.87)		4.95 (2.42)
Mean KOOS pain (SD)	57.21 (21.56)	68.68* (16.32)	61.8 (20.21)	67.69 (21.68)
Mean KOOS symptoms (SD)	53.03 (19.68)	61.64* (21.38)	62.03 (16.71)	68.77 (19.27)
Mean KOOS ADL (SD)	66.17 (24.22)	74.33* (20.09)	67.80 (22.94)	73.85 (23.53)
Mean KOOS sport (SD)	45.42 (30.25)	47.04 (26.27)	48.39 (31.42)	50.00 (28.28)
Mean KOOS Qol (SD)	38.69 (19.11)	53.88* (20.83)	40.87 (19.91)	50.08 (21.12)
Mean Self-efficacy (SD)	7.07 (1.88)	7.65 (1.88)	6.37 (1.88)	7.08 (1.89)
Mean Physical activity MET (SD)	1954.48 (2362.79)	3238.71* (2649.06)	3124.78 (2348.47)	2954.46 (3370.94)
Physical activity levels (frequency)	LOW: 13 MOD: 8 HIGH: 5	LOW: 5 MOD: 8 HIGH: 11	LOW: 7 MOD: 14 HIGH: 7	LOW: 3 MOD: 7 HIGH: 3

D11 TRAK Use (physiotherapists)

A total of 60 different exercises were prescribed in personal exercise plans (Table 9). The most frequently used exercises were those from phase 1 for strengthening (straight leg raise and static quads), balance (single leg balance) and functional/ neuromuscular control (mini squat).

Physiotherapists did not prescribe a personal plan for 3 TRAK users, personal plans were given to 29 TRAK users, 18 of these were not updated over time, 6 plans were updated once and 5 plans were updated twice.

Table 10. Summary of exercises used in the personal plan

EXERCISE name	**Phase**	**Frequency of use**	**EXERCISE**	**Phase**	**Frequency of use**
CATEGORY: Flexibility			**CATEGORY: Balance**		
Knee flexion	1	7	Weight shifting	1	6
Knee extension	1	6	Single leg balance	1	10
Prone knee extension	1	2	Single leg balance eyes closed	1	2
Prone knee hangs	1	1	Star balance	2	2
Knee flexion overpressure	1	2	**CATEGORY: Aerobic exercises**		
Hamstring stretch	1-3	3	cycling	1-3	8
Quadriceps stretch	1-3	3	rowing	1-3	2
Gluteal stretch	1-3	1	Elliptical motion exercise	1-3	2
Gastrocnemius stretch	1-3	5	Stepper machine	2-3	1
Soleus stretch	1-3	2			
CATEGORY: Functional and neuromuscular control			**CATEGORY: Strength**		
walking	1	3	Static quad	1	7
Wall squats	1	8	Single leg raise	1	15
Forward stepping	1	5	Inner range quads	1	14
Backward stepping	1	3	Knee extension sitting	1	6
Basic squat	2	11	Hamstring curl lying	1	3
Mini squat	2	6	Straight leg hip abduction	1	4
Single leg squats	2	2	Knee extension with weight	1	1
Sprint squat	2	1	Sit to stand	1	2
Step ups	2	9	Bridging	2	9
Step downs	2	4	Bridging one leg	2	3
Forward lunges	2	5	Clam	2	8
Lunge on step	2	1	Heel raise	2	3
Backward lunges	2	1	Hamstring curl standing	2	4

Forward lunge with weights	2	1	Resisted hip abduction	2-3	2
Single leg squat to chair	2	1	Hip abduction resistance machine	2-3	1
Single leg bridge	2	3	Leg press	2-3	5
Squats with weights	2	2	Knee flexion resistance machine	2-3	1
Jump down steps	3	1	Knee extension resistance machine	2-3	1
Jump up steps	3	1			
Squat jumping	3	1			
Vertical hopping	3	1			
Jump and one leg land	3	1			

Summary

The interview findings suggest that over time the physiotherapists identified benefits of using TRAK for patient care, found it easy to use and did change their practice as they became more familiar with TRAK. Within the self-care theme it seems that physiotherapists did not think holistically about self-care, i.e. not all principles were integrated into patient care and possibly regarded these skills as something that a patient either has or does not have. Physiotherapists did not make use of the email facility to coach or remotely support patients. Therefore, supporting behaviour change related to self-care is an area for development and future research.

Patients also found TRAK easy to use and identified how it supported their treatment, e.g. planning, goal setting, motivating. Patients liked the personalisation of exercises and both patients and clinicians reported the therapeutic benefits of the exercise videos. Patients did report needing assistance with selection and progression of exercise.

We have found early but weak evidence that the TRAK user group had an improvement in KOOS scores and physical activity over time. This was not found for the combined natural control group. This finding needs to be interpreted with caution. It may be unrelated to TRAK usage and may reflect a more motivated and rehabilitation engaged group of participants in the TRAK use group. To fully evaluate effectiveness of TRAK this needs to be explored in a randomised control trial with a larger sample.

Overall usage of TRAK by the physiotherapists appeared to decline over the course of treatment, as less than half the personal plans were progressed and the most frequently used exercises were from early rehabilitation. Most patients were given a personal plan which met with the patient reported requirements.

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Part 3: Cost impact

Estimated cost of the existing service

The average cost of physiotherapy is based on the treatment being delivered by a physiotherapist at the mid-point of the Agenda for Change band 6 pay scale. The yearly cost of this is £39,941, plus an extra 10% (£3,994) for overhead costs so the total cost is £43,935 per annum. Based on a physiotherapist working 45 weeks of the year, 37.5 hours a week, 7.5 hours a day; the cost of a 45 minute assessment is £20 and a 30 min follow-up appointment is £13. A recent local audit of patients following anterior cruciate ligament reconstruction found that patients had an average of 7 individual treatments. The total cost of this course of treatment is £99. For osteoarthritis the recommended number of supervised sessions is 12, which would cost £138.

What we found

We monitored the actual number of treatment sessions delivered to the TRAK intervention and usual care control throughout the study. We found that the number of face-to-face treatment sessions was similar for TRAK (6 face-to-face at a cost of £85) and the natural control group (5 face-to-face at a cost of £72). Based on statistical analysis there was no significant difference in the number of treatment sessions received between the two treatment groups. In addition, the expected cost associated with providing 'online support' was negligible due to low usage of the "Contact us" feature. However, this may increase once TRAK becomes fully integrated into clinical practice.

By implementing TRAK we have not demonstrated a reduction in the number of face-to-face contacts compared to those receiving ‘usual care’, but the number of attendances has not risen (and is less than we would have expected based on a local audit and the literature). This is reassuring, because in phase 1, physiotherapists reported requiring ‘extra time’ to use TRAK within a treatment session. In phase 2, we have found that as their familiarity increased and the functionality of TRAK improved, the physiotherapists speeded up and in some cases using TRAK was reported to save them time. Consequently, it is clear that although physiotherapists reported that TRAK was easy to use, integration into clinical practice poses additional challenges and learning needs. Therefore, in any future implementation it is essential that a training package is developed, that not only increases physiotherapist familiarity and confidence with using TRAK, but also supports them with the integration of TRAK into clinical practice, i.e. into a supported self-care/ patient centred care model for eHealth. We believe that equivalent to half a day of training is required for this, the cost of which is estimated to be £91. Such training sessions are already cost into the service, which would then not require an extra cost specifically for TRAK. We anticipate that with better training, there is

potential for the number of face-to-face treatments to reduce in the future.

These costs are based on the assumption that the basic IT infrastructure, including access to an Internet-enabled device and a secure Internet connection, is already provided. Our experience with the pilot study shows that using a tablet computer fits best into the existing clinical practice. Such devices are not yet used routinely within the NHS, so they would need to be cost separately. The cost of a 10'' Android tablet ranges between £150 and £220. This is equivalent to the cost of 14 face-to-face contacts. In the future by reducing the average number of visits to 4 (from 6), this would reduce the cost of treatment from £85 to £59. This cost would be offset by after an online intervention with a maximum of 7 patients.

By scaling TRAK up beyond the implementation study, there are potentially large financial benefits for the physiotherapy service. In C&V UHB the number of patients referred for physiotherapy out-patient treatment each year for a musculoskeletal condition is 26,000. It is estimated that 21% (approx. 5,500) of these referrals are related to the knee. Therefore, C&V UHB stands to potentially save on treatment costs in the future. Furthermore, TRAK could be applied to musculoskeletal conditions in other body regions, which would free up additional time and resources.

Additional investment would be required to maintain TRAK and implement additional functionality identified from user feedback including both patients and clinicians. This cost is not likely to exceed £2,000 per annum. Aspects of functionality that patients and clinicians want improvement on include an exercise search function, thumbnail image beside each video and creation of a video playlist.

Limitations

One limitation of the calculation is that some of the face-to-face physiotherapy was delivered in a group setting with a physiotherapist and a physiotherapy technician (£13.21 per hour). We have calculated that attendance at one group session costs £6.80 per session. This is based on an allocation of 10 minutes of physiotherapist (£4.30) and physiotherapist technician (£2.20) per patient.

Secondly, we collected additional data in our health resource use questionnaire about visits to the GP, hospital Consultants and Emergency unit attendances. We crossed referenced a sample of the self-report health resource use data against the hospital database and found that the self-report was a lot lower. We now plan to check all participants against the hospital database before reporting this data.

Finally, in our original plan we stated that in phase 2, TRAK participants would receive a maximum of 2 face to face contacts with the equivalent of 1 more face to face required for remote email contact. Based on the findings of phase 1 we were not able to enforce this because:

- Supported self-care does not necessarily mean less care.

- Clinicians needed more time than anticipated to increase familiarity and confidence in the benefit of TRAK.

Part 4: Learning from your project

The aim of this project was to assess the impact of implementation of the TRAK intervention on the organisation, on the service users (both patients and clinicians) and on health outcomes. We achieved this aim with significant contributions from the NHS IT service, clinicians and patient volunteers. To our knowledge this is the first e-health supported self-care intervention for musuloskeletal conditions that has been successfully integrated into NHS IT infrastructure and embedded into routine patient care to co-produce personalised treatment plans.

The PI ensured the buy-in from the clinicians by actively engaging them both individually and in group sessions. She provided bespoke training for the clinicians and individual support when they used TRAK with patients for the first time. In turn, the clinicians ensured the buy-in from the patients. The team leaders and managers within the C&V UHB allowed free access to clinicians. This can be attributed to the fact that the PI is a clinician herself and a staff member who has developed good rapport with other staff members and has already established a good track record in clinic-based research.

Two policies in particular have helped implement this project:

- Informed health and care – A digital health and social care strategy for Wales http://gov.wales/docs/dhss/publications/151215reporten.pdf

- The Management of Chronic Conditions in Wales – An Update http://audit.wales/system/files/publications/chronic-conditions-2014-english.pdf

These policies highlight the need for 3 key requirements that are embedded within TRAK: supported self-management approach, physical activity and use of digital technology in healthcare.

Challenges

In our Initial plan we were aiming for patients to receive a maximum of 2 face-to-face contacts in phase 2 of TRAK implementation. This was not feasible, firstly because self-care does not necessarily mean less care (especially early on in treatment), secondly this seemed too big a change in practice for the participating physiotherapists, i.e. they required more time than anticipated to become familiar and integrate TRAK. After phase 1 physiotherapists were still gaining familiarity with TRAK and reported that they required more time in a treatment session to use.

Therefore, we felt that it would not be appropriate to reduce the contact time to 2 appointments in phase 2.

Findings from the patient and clinician interviews suggest that more could be done to integrate principles of self-care not just through the functionality of TRAK but also through the structure of the face-to-face consultations between the physiotherapist and patients. Ways this can be achieved are as follows:

- The TRAK information resource: This needs to be less wordy and more interactive, i.e. the patient asks what they want to know and TRAK provides that with an answer. For the patient the experience would feel similar to interacting with a real physiotherapist remotely. This is something that we are working on outside of the current project.

- TRAK personalised exercise plans: These need to automatically update based on the patient's physical activity needs, level of exertion and pain. This will make the exercise program relevant to the individual's current requirements.

- Remote support and coaching: The email functionality of TRAK could be upgraded to allow a two-way conversation between the patient and physiotherapist. Issues related to this are storage of patient identifiable data that would need to be overcome, which is why email was used in the current project.

- Physiotherapist training to include the following: time to become familiar with the content of TRAK, understand TRAK functionality and how this meets with the principles of self-care, presentation of patient feedback and experiences of using TRAK, using tools to support patients create their own exercise plans and progressions over time (skill development), workshops to deconstruct (and then reconstruct) the traditional script or structure of the consultation to incorporate eHealth tools, e.g. using TRAK together for information seeking, exercise prescription/ techniques, signposting, goal setting, remote monitoring and coaching (email), monitoring exercise logs etc. and addressing issues around risk adversity such as patient safety around exercise selection. This should facilitate thin integration of TRAK rather than it being used as an adjunct to treatment.

There were challenges related to transferring of the TRAK app itself into the NHS. Team building across two organisations (C&V UHB and Cardiff University) took time to reach an agreed understanding of what could be achieved. Access to the NHS's technical infrastructure was not straightforward for a research assistant based in Cardiff University. In addition, the NHS information governance, which provides the legal framework governing the use of personal confidential data in healthcare, had to be adhered to. It took time to ensure that all parties were satisfied with its interpretation and compliance within TRAK. This has constrained the NHS IT team in

terms of the IT solutions they could offer. Nonetheless, the TRAK app was successfully migrated into the NHS in time for it to be implemented into clinical practice.

Another challenge for the project was physiotherapy staff rotation, which makes it difficult to retain the originally recruited clinicians over the course of a study. A potential solution to this problem is to fund a smaller team of dedicated clinicians throughout the project.

Physiotherapists did not ask all of the potential participants if they would be willing to participate often without providing a reason for this (Figure 3). The research process was reported by physiotherapists as a barrier to them using TRAK. Since finishing recruitment for the study, physiotherapists have reported that it is easier to use TRAK now that patients don't need to be consented.

It proved difficult to recruit and retain patients in the control group as they had nothing to gain by participating. In the future, we would allow for a natural control group to develop simply from those who did not participate in the intervention.

All aspects of our projects should be replicable in other online interventions. Physiotherapists have continued to use TRAK beyond this project. In future projects better usage statistics are required beyond those collected in this study.

Successes

Overall this project has been highly successful. We have been able to integrate TRAK, an eHealth tool for supported self-management into routine patient care. This does require a change in practice by physiotherapists, which requires time and training. In addition, some skill development is required to ensure a blended approach to physiotherapy consultations in this out-patient setting, to combine face-to-face contact and use of TRAK alongside applying principles of self-care. We have identified that an appropriate training package is required to support this process and facilitate future spread of TRAK.

Both patients and physiotherapists reported that TRAK was easy to use and based on their reported experience it appears that TRAK does provide added value to supporting self-care. Finally, we have generated some limited evidence that use of TRAK may enhance patient treatment outcome.

Part 5: Sustainability and spread

The aim of original project was to implement TRAK intervention within a single physiotherapy department at C&V UHB. Following the end of this project, TRAK will remain in use across six departments at C&V UHB.

Spread

Since the start of the project, Homerton University Hospital started using TRAK for rehabilitation of patients with ACL reconstruction. This is part of Emma Dunphy's NIHR-funded project under the HENCEL/CLAHRC fellowship programme.

Spread of TRAK to primary care. Upon an unsolicited request to C&V UHB NHS IT, from primary care MSK lead, Rebecca Walberg, for an online resource for MSK treatment, we presented TRAK intervention. We have had meetings to discuss ways in which TRAK can be integrated into services within primary care. A further meeting including Public Health Wales has been arranged for early September. We plan to apply for further funding from to integrate TRAK into primary care. We will investigate to what extent this will reduce referrals to secondary care and repeat visits to the GP.

While producing videos for knee rehabilitation exercises, we used this opportunity to film exercises for rehabilitation of hip, ankle and lower back conditions. These are ready to be added to the TRAK app as part of widening its clinical applicability.

Training & engagement

As part of our strategy to engage physiotherapists beyond C&V UHB, we presented a poster at a conference in Cardiff organised by the Chartered Society of Physiotherapy in Wales. The conference was an opportunity to celebrate physiotherapy practice in Wales, network with colleagues and enhance professional development. At poster presentation we ran demos of TRAK on an iPad and handed out login details to use test TRAK on their own. The presentation won a runner up award for the best poster.

We were invited to present at the Royal Society of Medicine's Sport Injuries and Sports Orthopaedics Conference in London. As part of our presentation on biomechanical compensations and optimisation of the rehabilitation pathway, we discussed the progress of implementation of the TRAK intervention. The presentation was well received by attending clinicians and sparked a fruitful discussion on rehabilitation requirements for patients following ACL reconstruction. Given a high interest in ACL injuries and associated length of recovery and amount of treatment needed, we extended the information resources on TRAK with a dedicated area for ACL rehabilitation.

At Cardiff University, we organized a workshop on "Integrating supported self-care into clinical practice". The workshop was targeted at all healthcare professionals that are involved in managing services or delivering interventions that support individuals to self-manage their condition. A total of 50 people attended from 15 organisations (healthcare, academic, policy) including patient representatives. Emma Dunphy from Homerton University Hospital gave a presentation on using TRAK for rehabilitation of patients with ACL reconstruction. The presentation included a demo session where attendees were given iPads and login details to explore TRAK online. We received the following feedback from patients:

"One very exciting project to me was the TRAK project using physiotherapy at home, on the computer, or iPad. I thought of the exciting application this could be in enhancing pulmonary rehabilitation for lung sufferers like myself. As you are aware Pulmonary rehabilitation is costly to the NHS. And there is often a long waiting list to go onto a Pulmonary rehabilitation course. Using this application I can see that many aspects of pulmonary rehabilitation, including breathing exercises could be implemented, allowing the patient to exercise safely at home."

"There were a couple off presentations like TRAK that sparked more interest. On this particular talk I thought the physio exercises were very good and most seemed manageable. A video sequence would be useful, easier and therefore more likely to be used."

Following the lessons learnt from this project as outline in Part 4 of this report, we are in the process of developing a training package on how to properly integrate TRAK into clinical practice. This will be made available via a youtube video to maximise the reach.

Kate Button has been invited to present at the 6th Early Recovery after Surgery Conference in Cardiff on 4th November 2016. She has been specifically asked to present the TRAK project and the outcomes from this study.

Finally we plan to write this project up for publication, we are aiming to submit the manuscript to Osteoarthritis and Cartilage, Impact Factor 4.535.Research

Our early evidence of effectiveness from this project needs to be tested on a larger scale as part of a randomized control trial (RCT). We partnered with the South East Wales Trials Unit (SEWTU) to apply for NIHR research-led funding to conduct a RCT using a cluster design. We are already in the process of planning the application including the RCT design and sample size.

Following the feedback from this study, we also want to further improve TRAK functionality. We will apply for a PhD studentship from Arthritis Research UK to develop a computational model of a personalised responsive exercise plan (PREP) to optimise health outcomes. This will be based on correlating variables from exercise prescription to patient reported outcomes and use the findings to

automatically adjust the exercise plan as part of exercise progression.