Original Paper

What is the feasibility of patients using an online forum for reporting progress when engaging with a six-week exercise programme for knee conditioning?

ABSTRACT

Background: The use of e-health and web-based resources for patients with knee pain is expanding. Padlet is an online noticeboard that can facilitate patient interaction by posting virtual ‘sticky notes'.

Objective: The primary aim of this study was to determine feasibility of patients on a six-week, knee-exercise programme using Padlet as an online forum for self-reporting on outcome progression.

Methods: Undergraduate manual therapy students were recruited as part of a six week study into knee conditioning. Participants were encouraged to post maximum effort readings from quadriceps and gluteal home exercises captured from standard bathroom scales on a bespoke Padlet. Experience and progression reporting were encouraged. Posted data were analysed for association between engagement, entry frequency and participant characteristics. Individual data facilitated single subject, multiple baseline analysis using statistical process control. Experiential narrative was analysed thematically.

Results: Nineteen participants were recruited (47% female); ages ranged from 19 to 53. Twelve individuals (63%) opted to engage with the forum (range: 4 - 40 entries), with 5 (42%) reporting across all six weeks. Gender did not influence reporting (OR 0.761, CI 0.06-6.93). No significant difference manifested between BMI and engagement (*P*=.46); age and entry frequency did not correlate (r^2=0.054, CI -0.42 to 0.51, *P*=.83). Statistically significant conditioning profiles arose in single subjects. Themes of pain, mitigation and response were inducted from the experiences posted.

Conclusions: Patients will engage with an online forum for reporting progress when undertaking exercise programmes. In contrast to related literature, no significant association was found with reporting and gender, age or BMI. Individual posted data allowed multiple baseline analysis and experiential induction from participants. Conditioning responses were evident on visual inspection. The importance of individualised visual data to patients and the role of forums in monitoring patients’ progress in symptomatic knee-pain populations need further consideration.

Keywords
eHealth; Social media; Exercise therapy; Rehabilitation

Introduction

The use of web-based resources and eHealth applications for patients with knee pain is an area of expansion [1,2]. EHealth is considered to encompass technology delivered through computer, hand-held tablet or smartphone that support patients and practitioners in decision making, coping strategies, treatment approaches or functional improvement [3]. There are a range of knee conditions such as osteoarthritis (OA), arthroplasty and cruciate ligament tears that are being informed by patient decision aids, electronic patient reported outcomes and biofeedback software [4–6]. Positive effects are noted across a range of conditions including knee OA but further work is required on determining suitable interactions between patients and these eHealth measures [7,73].

The cost of developing and delivering eHealth resources is considered to be offset by the ease of patient accessibility [8]. The lack of quality studies and the heterogeneous nature of conditions supported by eHealth prevent full unequivocal endorsement of the cost-effectiveness of technology driven approaches [9,10]. The expedient delivery and low cost development afforded by Web 2.0 applications may facilitate further access to eHealth [11] and wider health information technology [71] including patient-reported health records [72]. The Web 2.0 platform has been seen to increase participation through social media and the sharing of experience due to the ease of posting materials such as video files and online forums [12]. This latest generation of internet development is seen as providing a collaborative medium for knowledge generation and dissemination [13]. This aligns to the potential interactive nature of eHealth programmes that has been reported to facilitate healthcare engagement [14].

Educational research and pedagogic practice have been fruitful areas of exploration around Web 2.0 applications [15]. The option to motivate learners in ever more expansive ways of engagement adds to the wider participation aspirations of higher education [16]. There are a range of tools that allow for students to engage in learning and feedback in the Web 2.0 toolset that may have applicability in eHealth [15,17,18]. These tools have been deployed to support chronic conditions in older adults with regards to education and self-management; the pedagogue/student relationship transformed to clinician/patient with the shared aim of empowerment [19]. The exposure to the range of eHealth has been seen to bridge gender and age differences but there is a suggestion that gender influences engagement with Web 2.0 applications [20]. Online social interaction has also been explored with respect to weight management facilitated through discussion boards; attrition rates are reportedly high in this area and little change is noted in body mass index (BMI) as a common outcome measure [21]. High BMI has been seen to be associated with higher attrition rates.

Padlet is a Web 2.0 online noticeboard that can be used to facilitate participant interaction by posting of multimedia files as virtual ‘sticky notes’ with mediation by an administrator [22]. The scope for using this resource as an eHealth application has been investigated with some success in terms of engaging surgeons or clinicians to discuss cases in a forum setting [11]. The initial disadvantages described around mobile access have been addressed with the latest software release [23]. There is potential that this platform could facilitate an online health community (OHC); OHCs can be used to share patient and clinical experiences while disseminating expert-moderated knowledge [24]. These communities have the potential to allow patients to report progress and responses that are normally qualitative in nature [25]. With the range of biofeedback devices now available, the sharing of quantitative data to monitor patient progress and motivation via Web 2.0 applications has potential to influence compliance [26]. The use of the Padlet Web 2.0 platform to facilitate a patient-led, clinician-moderated, online forum around knee conditioning exercises with biofeedback data has not been explored. The potential to use this type of forum for participant-specific, primary data gathering is also an area requiring further investigation.

The aim of this study was to determine the feasibility of patients engaging with an online forum to report progress using biofeedback as part of a six-week exercise programme to improve knee function.

The primary objective was to facilitate a moderated, online community and explore participant characteristics that reportedly influence engagement, with a view to answer the following research question:
Is there a difference in reporting progress in an online forum based on gender, age and BMI?

A secondary objective was to ascertain if sufficient individual data was reported in order to complete a multiple baseline case study for participants in the study. A tertiary objective was to establish if sufficient qualitative data was posted to allow induction of descriptive themes.

Methods

Design

Mixed-methods: Quasi-experimental feasibility study with an integrated single case, multiple baseline, ABCD analysis and descriptive thematic summary.

Participants

As part of a parallel study into the effects of biofeedback on knee function, participants were recruited from current year 1 to 4 undergraduate students on the Osteopathy programme at the European School of Osteopathy and Year 2 undergraduates on the Sports Therapy programme at the University of Kent. Recruitment took place from August 2016 to January 2017 and student participants were invited to take part in the study via email and notices placed around campus. The following criteria were applied:

Inclusion Criteria: Male and female adult students were able to take part in this study if they had daily access to bathroom scales, permitted receipt of reminders via text message and had online access via any suitable device.

Exclusion Criteria: Participants were excluded from taking part if they were suffering with bilateral knee or hip pain, undertook recurrent high intensity physical training or had an underlying metabolic disorder or neuromuscular condition.

Online Forum Development

The Padlet Web 2.0 application (Padlet Co, Sunnyvale, CA, USA) was used to develop the forum for posting of participant data; the Padlet platform facilitates multiple users sharing information and resources in a discrete environment. From the main site page (https://padlet.com), accessed via a personalised user and password, the '+make a Padlet' option was selected and a freeform option for the forum was selected as demonstrated in Figure1.

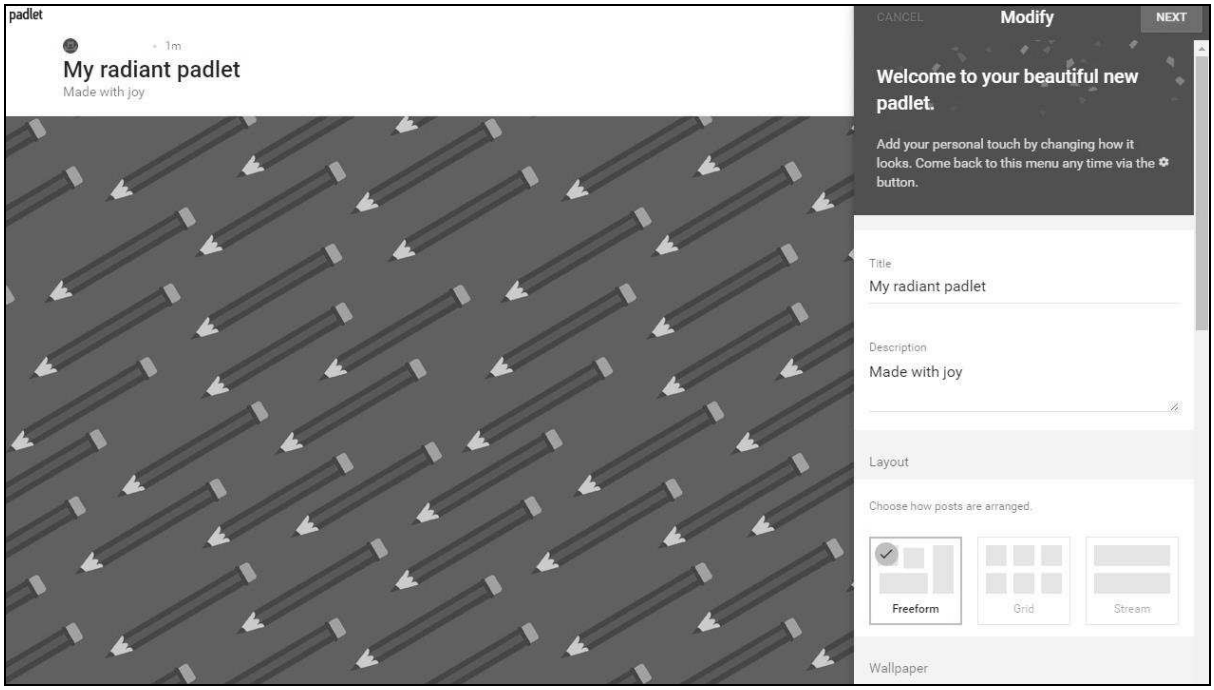

*Figure1. Creation page for Padlet*Wallpaper is indicative and themes can be customised.*

As users were encouraged to share information and experience, the posts were not anonymised but oversight of the activity was conducted by the lead researchers on the study (PB, KH). A code of conduct was posted on the webpage in order to ensure acceptable standards of behaviour were adopted. The details of this can be viewed in Figure2. Padlet also operates its own policy for reporting and removing inappropriate content in addition to user-defined practice available on their web-site.

> The use of this moderated forum is to: provide information to study participants; allow a medium for recording progress; facilitate sharing of experiences during the course of the study. The exchanges should remain respectful and courteous at all times. Banter is encouraged but the study moderators policing activity will ensure any offensive or inappropriate comments or images are removed.
> Participants that persist in posting such material will be asked to withdraw from the study.

Figure2. Textbox - code of conduct displayed on Padlet.

Procedure

The following characteristic data was collected at baseline: Height (cm), weight (kg), waist circumference (cm), body mass index (BMI, kg/m^2), activity levels (11-point NRS), age and gender. Participants were inducted into a knee programme consisting of staged repetitions of a seated clamshell exercise (an adaption from Distefano et al. [27]) and short-arc quadriceps extension (Figure3.). The clamshell required participants to abduct the hip, contracting gluteals as hard as possible against the resistance of bathroom scales supported against a wall. The short arc quadriceps exercise required the participant to begin with a flexed knee over a foam roller (or equivalent bolster support) resting on bathroom scales positioned on a stable surface. The exercise was completed by contracting the quadriceps to

extend the leg through the shortened range, registering contraction force on the scales beneath the roller. Both required a 5 second contraction and 2 second relaxation phase.

Figure3. Seated clamshell and short-arc quadriceps exercise.

Both exercises were repeated in sets of 12 and on both legs with a 60 second relaxation phase between sets. The progression phases are depicted in Table1.

Weeks 1 and 2	Maintain 2 sets of 12 repetitions every other day	Phase A
Weeks 3 and 4	Maintain 3 sets of 12 repetitions every other day	Phase B
Week 5	Maintain 4 sets of 12 repetitions every other day	Phase C
Week 6	Maintain 5 sets of 12 repetitions every other day	Phase D

Table1. Exercise progression details for participants.

Participants were sent text reminders on the days they were required to perform the exercises. The text messages included a hyperlink to the bespoke Padlet forum with instructions detailing their exercise and video guidance materials. Participants were also requested to post readings of their maximum effort in kilograms, obtained from the bathroom scales, onto the online forum after each exercise session.

Outcome measures

The primary outcome measure was the number of recorded entries detailing progression with the exercise schedule. A secondary outcome measure was the maximum voluntary contraction reading as captured from the bathroom scales from each exercise session. This was provided by the participants over all stages of engagement within the study.

Ethics

The study protocol was submitted to and approved by the Research Ethics Committees of the European School of Osteopathy and the School of Sport and Exercise Sciences, University of Kent as part of a larger study exploring the use of biofeedback in a knee conditioning programme.

Statistical analysis

The Padlet postings were exported to a spreadsheet and aligned to participant baseline data. Summary and inferential statistics were calculated using Excel version 16 (Microsoft Corporation, Redmond, WA, USA) and Analyse-it version 4.65.3 (Analyse-it Software, Ltd., Leeds, UK). The numbers of recorded entries and BMI were assessed for distribution and equality of variance; gender group relationships and differences in reporting were explored using odds ratios (OR) (with 95% confidence intervals (CI)) and the Mann-Whitney U test. Physical characteristics (BMI) and reporting differences were also explored using Student's t-test. Correlation between age and recording of entries was explored using Spearman's test; statistical significance was set at $P<.05$. Entries entered against one date were

considered a single entry so multiple data added under a single date was only counted once. Discrete nominal values were derived from this in terms of binary (Y/N) indication of engagement with the forum to allow proportional analysis of association.

The staged recordings of maximum voluntary isometric contractions were extracted from the forum recorded entries and three consistent datasets were analysed using a multiple baseline [28], ABCD case study [29] approach aligned to four (1 baseline and 3 progressive) stages of exercise . A statistical process control (SPC) visual analysis [30] was applied to the resultant line graphs with means and standard deviations (SD) calculated from Phase A baseline data. Statistical significance was regarded as two consecutive data points outside +/- 2 SD in Phases B, C or D. Linear trend lines were added to indicate direction of individual progress. Finally, open forum comments were analysed within a descriptive thematic framework and summarised in relation to the source participants.

Results

Baseline characteristics

Nineteen participants were recruited and their baseline characteristics are depicted in Table2. The group was 47.37% female and age ranged from 19 to 53 with a BMI between 16.63 and 33.83; eight individuals (42%) were over the desired 25 kg/m^2.

Gender M/F	Age	Height	Weight	BMI	Activity Rating	Waist*	Padlet Entries*
10/9	32.79 (10.78)	173.47 (10.06)	75.65 (16.20)	25.02 (4.39)	4.42 (1.30)	84 (12.7)	**8 (16)**

Table2: *Summary of baseline characteristics; proportions and means (SD) are described.*
**Median (Interquartile range)*

Primary outcome measure

Twelve individuals (63%) opted to engage with the Padlet forum with entry frequency ranging from 4 through to 40. Follow-up on the 7 who did not report outcomes elicited 4 replies; time constraints (n=3) and technophobia (n=1) were cited as reasons for non-response. All individuals that initially reported outcomes went on to complete the exercise programme regardless of dropout from the forum. The depiction of the finalised notice board entries can be viewed in Figure4.

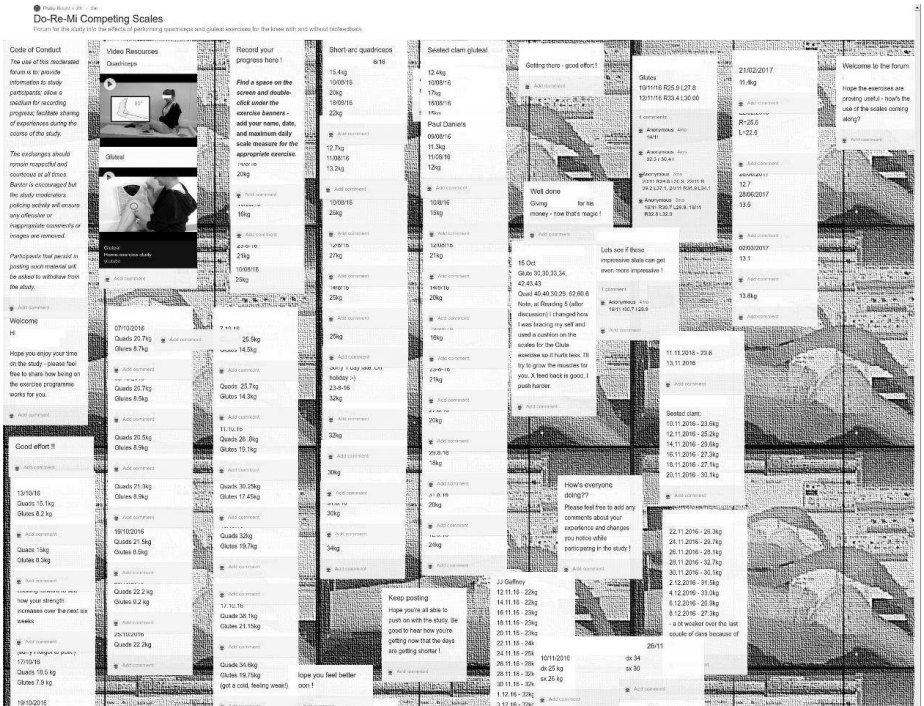

Figure4. Bespoke Padlet forum with participant and moderator posts.

Inferential analysis of the influences on reporting by gender and age showed no statistical significance. The odds for male and female responders demonstrate that gender was not a factor in this sample for engaging with the forum activity (OR 0.761, CI 0.06 to 6.93). There was no significant difference between genders and entry frequency (*P*=.97) or BMI and engagement (*P*=.46). Age and entry frequency also showed no significant correlation (R^2=0.054, CI -0.42 to 0.51, *P*=.83).

Secondary outcome measure

Consistent data was reported across all six weeks of the study by 5 of the 12 participants that engaged with the forum (58% attrition rate); three were selected for statistical process control analysis due to their staggered recruitment dates. The multiple baseline analysis demonstrates the training effects of participants undertaking the staged exercises and the duration of their engagement with the short arc extension quadriceps exercise.

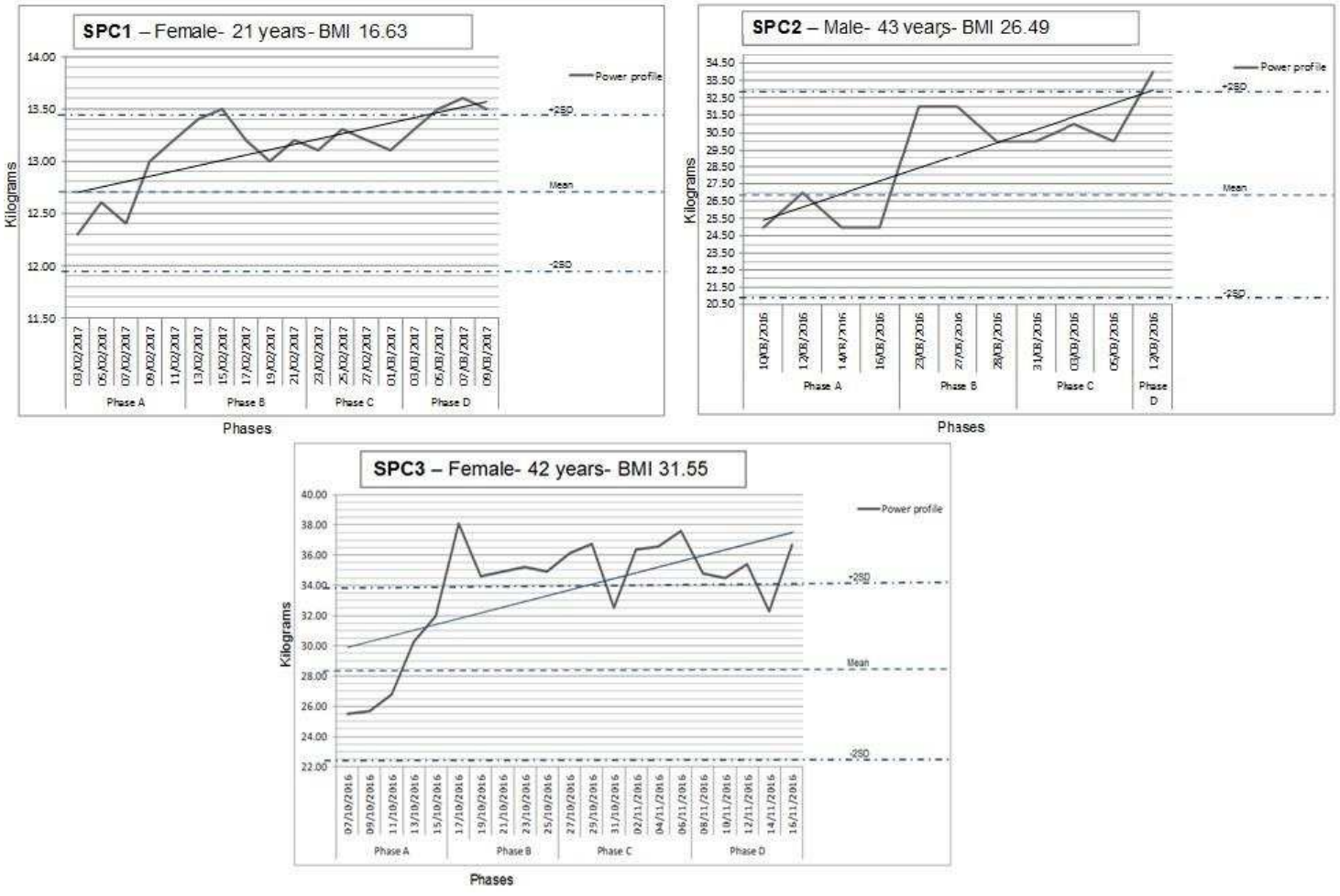

Figure5. Multiple baseline analyses of single participant data with statistical thresholds and linear trendlines.

A progressive conditioning response is demonstrated in Figure5 with the three line graphs; significant events are depicted in two of the three SPC analyses. SPC1 incurs two

consecutive data points outside the upper 2SD threshold at the end of Phase D; SPC3 demonstrates a range of significant improvements in reported muscle strength during Phase B and D of the study.

Qualitative data

Six participants (50%) provided limited commentary during their engagement with the online forum; exemplar is represented in Table3 and demonstrates themes of pain (p), mitigation (m) and response (r). These participants were representative of the gender (40% female) and age (mean 31) of this study's demographic.

Participant	Quote (theme)
Female 22yrs	Been getting more hypermobile in the last few days, which shows in the results (m).
Male 41yrs	Feedback is good, I push harder (r).
	I changed how I was bracing myself and used a cushion on the scales for the glute exercise so it hurts less (m,p).
Female 21yrs	Get a cold, feeling weak, but the exercises are fine (m).
Male 42yrs	A bit weaker over the last couple of days because of flu (m).
Male 29yrs	I had an injury while climbing.....it's painful (p).

Table3. Illustrative quotes from online forum

The individuals provided reflection on their experiences and progress in response to the exercises (Female, 22). The mitigating effects of pain were commonly reported in response to perceived decline in performance and reporting (Male, 29). A stoic sense of perseverance was interpreted from the commentary with an adaptation of technical approach where required (Female, 21; Male, 41).

Discussion

The primary aim of this study was to determine the feasibility of patients using an online forum for reporting progress when engaging with a six-week exercise programme for managing knee pain. No statistically significant difference was found in reporting progress based on gender, age or BMI. It was possible to use individuals' posted progress data to complete a multiple baseline case study for a selection of participants in the study. Participants were willing to engage in limited discussion posts during their progression on the programme.

Posting to the forum was initially at a moderate level and attrition rates were comparable with other studies exploring engagement with online discussion boards. The 58% reported in this current study is in the range of the 12 studies exceeding the 20% attrition rate within the review of Williams et al. [21]. Within the scope of behavioural change in eHealth, the range of 41-84% attrition is reported in large RCTs [28]. The consistency of participants' reports within the current study, facilitating individualised progression data, may be indicative of the stable core user remnant that prevails after initial early dropouts [29]. Further exploration of the benefits of self-reporting with the incentive of producing individual activity profiles is warranted, particularly within the scope of affordable technology and activity tracking [30].

Exercise adherence has been identified as a major contributor to exercise efficacy [31]. Participants that made initial engagement with recording their outcomes online, committed to the six week programme irrespective of report attrition. The access to the video instructions through the forum may have influenced this behaviour as these media have been seen to improve exercise adherence [32,33]. The growth in interactive video technology may facilitate this further; real-time remote motion capture of patients, tracking and analysing movement, with feedback relayed direct from a therapist may be the panacea in this field [34]. There are implications for these type of systems in terms of sensitivity of personal data

[35] and developing suitably secure software architecture is an ongoing challenge within the Web 2.0 milieu [36,37]. The integration of body sensor network information into this Cloud-Computing platform and the volume of wearable devices (FitBit, MOOV, Nike+) that can contribute to these biofeedback networks elicits a complex array of data [38]. This potentially lacks meaning or context for patients; the findings of this current study demonstrate a simple solution to this complexity.

Age and social media engagement have been reported as conflicting characteristics in studies engaging eHealth with usage mediated by generation. While engagement activity profiles may differ, the Over-65s are comparable to the Under-30s in terms of the proportions reporting the use of the Internet for health-related information (53 and 56% respectively) [39]. The age range in this current study crossed Generation X and Y but lacked engagement with Senior Citizens. The Over-65s are motivated to engage with eHealth and increased Internet use as a vital connection with the wider world, offsetting age-related functional changes [40] and physical inactivity [41]. Age was not seen as predictive of engagement in this study but there is a suggestion that socio-economic status is an overt influence on Internet use in relation to subjective health [42]. The sample in this study were drawn from undergraduate cohorts but the 19-53 age span indicate funding sources and social status could not be directly inferred and was not sought at the time of participation.

Gender and BMI may indicate a barrier to IT use in adolescents and practitioners [43,44, 47] but reported disparities in adoption of internet-based health correspond more with lower income, educational attainment, ethnic background and those for whom English is not their native language [45]. Gender and BMI influence on engagement was equivocal in terms of the odds reported in this current study; the student sample here may be more consumer-driven, aligned to recent shifts in UK Higher Education with strong emphasis on student choice and experience and less on gender-based decisions [46]. The shifting engagement in this study's student participants may be tempered by self-determination and personal preference. Electronic media use has been reported as a risk factor for higher BMI, particularly within the adolescent female population [47]. Conversely, targeted eHealth solutions for weight management in young women suffer from poor uptake and user satisfaction ratings [48]. Activity and diet modification via specialised applications may offer an improved engagement profile around personal weight-management in adults [49, 50]. Similarly perceived pressures reported by other healthcare undergraduates [51] may be applicable to the current study and mitigated engagement. Time availability and pressures of course deadlines are also reported as inhibitors to activity related eHealth [52]. The potential addictive impact of technology and reduced academic performance reported in other studies [53] may have been seen as prohibitive in this study's sample. Exploration of technology reliance and side-effects on prolonged eHealth use is a conflicting relationship that warrants further exploration.

The provision of individualised single case data fed back to patients contributes to the ideal of personalized, preventive health-care planning [54]. The ability for patients to report on their own progress with clinical home-based outcomes has been reported as vital to integrated electronic medical records [55]. The biofeedback information in this study could provide further complementary data to wearable devices [38,56]; this potentially negotiates the pathway between consumer mass-adoption and practitioner caution in this developing area [57]. This current study demonstrates that patients can have direct access to personal analytics and potentially aid in the management of ongoing conditions. The growing demand to use single case analyses to inform effect size and meta-evidence [58–60] demands that 'Big Data' from individual patients be used more constructively, particularly the patient-accessible visual analytics afforded within these designs [61].

This study's sample reported experiences around pain, mitigation and responsiveness and this was within a recruitment strategy of asymptomatic participants. Subjective and objective

pain measures have been widely explored in knee condition sufferers [62,63]. Qualitative data intimates that patients' outcomes and pain management should be considered on an individual basis [64] with online forums providing the validation, support and resources as required [25]. The sample in this current study described mitigating effects of pain in relation to the exercise task-orientation. This contrasts with young symptomatic individuals that report the burden of MSK pain on quality of life and future prospects; the need for digital technologies to provide accessible, evidence-based resources is seen as vital in connecting these people with support from peers and health professionals [65]. The individuals in the current study were potentially engaging from a sense of duty and felt compelled to offer mitigation when compliance wavered. There is suggestion that compelling pain management programmes may only arise with a population that perceives the need for individualised care, particularly if that population feels disenfranchised [66].

Limitations of this study include selection bias with a convenience sample of undergraduate students. Only those prepared to commit to the programme were included indicating that participants had an underlying motivation towards exercise. All participants were asymptomatic implicating the diversity in compliance; attrition could be further mitigated with a motivated symptomatic patient population. The extension to engage with the Over-65s in future studies would allow the development of this type of OHC in condition-specific scenarios. Socio-economic status was not captured by this study and this is seen as a key influence on access and engagement in the field of eHealth; such barriers to engagement have to be explored further. This study was able to demonstrate that a low-cost solution to developing an OHC is feasible and that individualised, patient-centric data can be produced from reporting biofeedback data on an online forum. Future research should look to investigate discordance between attitudes to technology-assisted healthcare, the importance of individualised visual data to patients and the role of forums in monitoring patient engagement and progress in symptomatic populations.

Conclusion

Patients can engage with an online forum for reporting progress when complying with exercise programmes for managing knee pain. No significant influence was found on reporting progress in an online forum based on gender, age or BMI. It was possible to use individual posted progress data to complete a multiple baseline case study for a selection of participants in the study. Participants were willing to engage in limited discussion posts during their progression on the programme. The parochial nature of the sample is a limitation; future work in the area should look to address discordance between attitudes to technology assisted healthcare, the importance of individualised visual data to patients and the role of forums in monitoring patient engagement and progress in symptomatic knee-pain populations. Socio-economic background and other barriers to accessing these community forums need to be considered in this exploration.

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Conflicts of interest: none

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