

The use of game elements in a home exercise diary smartphone app to improve engagement

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Introduction

Home exercise programs are a key component of at-home rehabilitation. Engagement with home exercise programs can be challenging, resulting in poor adherence. The use of smartphone apps that function as electronic home exercise diaries may improve engagement by offering a convenient and portable way to access instructions for exercise, as well as by promoting goal-setting and self-monitoring. Additionally, apps can connect to the internet to potentially enable supervision by clinicians, which may further promote engagement. However, despite all these benefits, electronic health apps can still be lacking in their ability to promote engagement.

Engagement with health apps could be further enhanced by incorporating game elements into the apps, also known as gamification. Game elements which could be employed include rewards (e.g. points, medals, virtual gifts), competitive leaderboards, feedback on performance, time-limited challenges, a fantasy setting (e.g. narrative or metaphor) and social communication with other users. These game elements may enhance engagement by fulfilling certain psychological needs. For instance, rewards and feedback could enhance perceived self-competence, while leaderboards and social communication could enhance social relatedness. Therefore, game elements can be a powerful tool to improve engagement with home exercise diary apps.

This work describes the *Grow Stronger* smartphone app, which is a home exercise diary app featuring several game elements designed to foster engagement and motivation.

Design: Game elements

The design of the *Grow Stronger* app features a number of game elements and gamification strategies, such as:

- Rewards** – Upon reporting the completion of an exercise, users are rewarded with drops of water to grow plants and a currency to purchase more plants and decorations, allowing them to create a virtual garden.
- Clear goals** – Users can set goals for which exercises they wish to complete that day, which will be clearly displayed on the app home screen. Completed goals will be marked with a green tick.
- Feedback** – The user is given feedback about how many of their daily activities they have completed. Users are also encouraged to self-monitor through the act of filling in the diary and rating each completed activity.
- Competition/cooperation** – A community garden feature is planned to be implemented, allowing users to show off their garden to other users and compare progress with that of others.
- Social connection** – The noticeboard allows users to communicate with one another. The planned community garden mode will also allow users to react (eg give “likes”) to the gardens of other users.
- Appropriate challenge** – The user chooses from a list of exercises from their individual home exercise program, created by a clinician, and can select an intensity level that feels appropriate to them on the day.
- Fantasy** – The growing of virtual garden acts as a fantasy metaphor for exercise adherence, adding meaning to the user's goals and making progression more obvious to the user than it is in the real-world.

Methods

The *Grow Stronger* app was first developed in 2019 in a co-design process consisting of a series of focus groups with multiple stakeholders: older adults with chronic respiratory diseases, respiratory clinicians, health researchers and game developers. Participants in this co-design process created the overall design of the game. Therefore, the resulting initial prototype of *Grow Stronger* was designed to specifically to encourage adherence to home exercises for pulmonary rehabilitation through the combination of clinical supervision and the use of game elements proposed by the co-design participants. This version featured two parallel game modes – a bonsai garden and a caravan trip around Australia – which were selected as virtual analogues of real-world activities that participants found enjoyable and meaningful.

Presently, a more flexible version of the app (see Figure 1), to be used for home exercises for a variety of health conditions, is under development. This version has incorporated the feedback from focus groups with clinicians involved in the rehabilitation of persons with chronic pain conditions. The garden game mode is now the sole focus, and the game will allow users to interact with one another through a community noticeboard and community garden. Additionally, clinicians will have increased flexibility to add new home exercises and supervise users remotely (Figure 2 & 3), as well as directly message patients using the app.

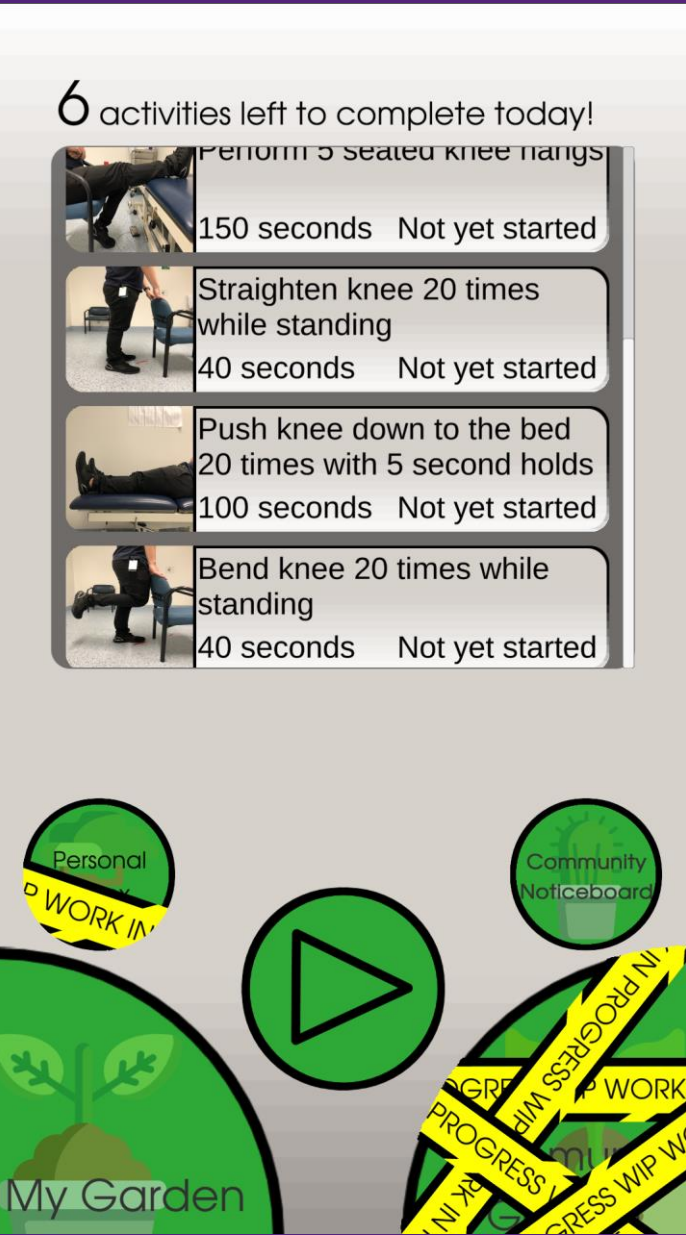


Figure 1A: From the home screen, users select which activity they wish to start, or navigate to other menus. Users can also hit the play/pause button (bottom middle) to pause, signalling they do not wish to choose any activity that day.

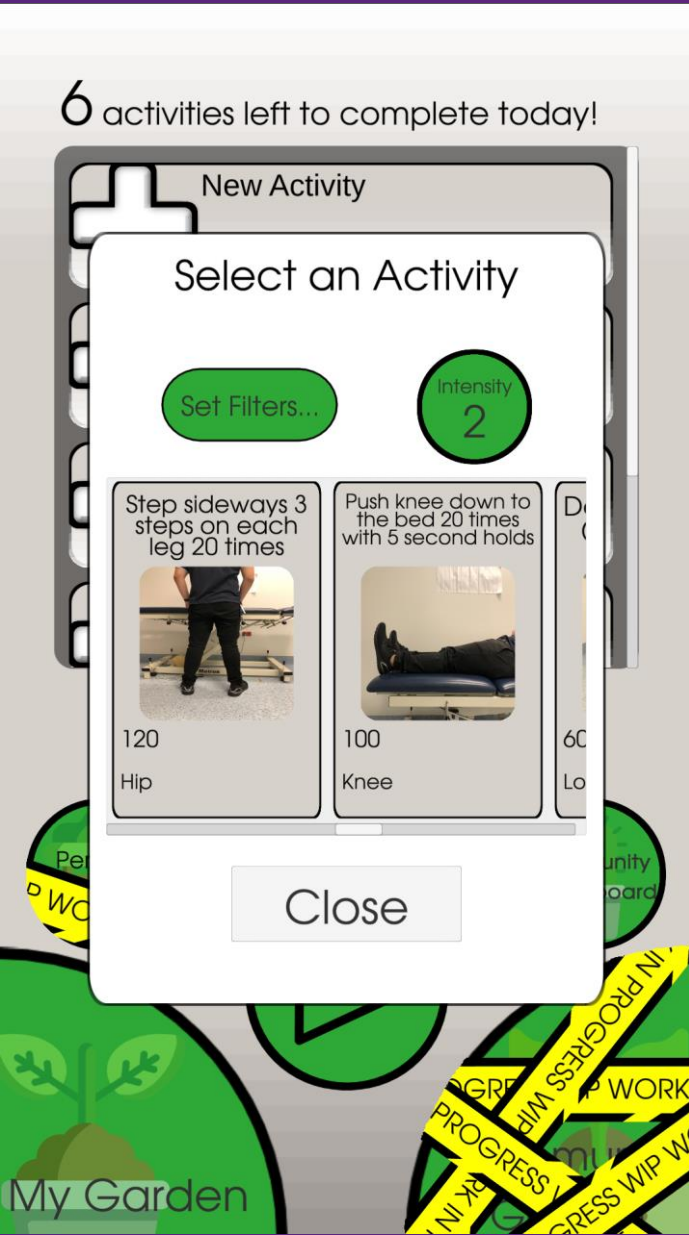


Figure 1B: Users can choose each day's activities from a larger list of activities, derived from their home exercise program. Users can filter these activities (e.g. by body part) and select an intensity level to alter the difficulty.

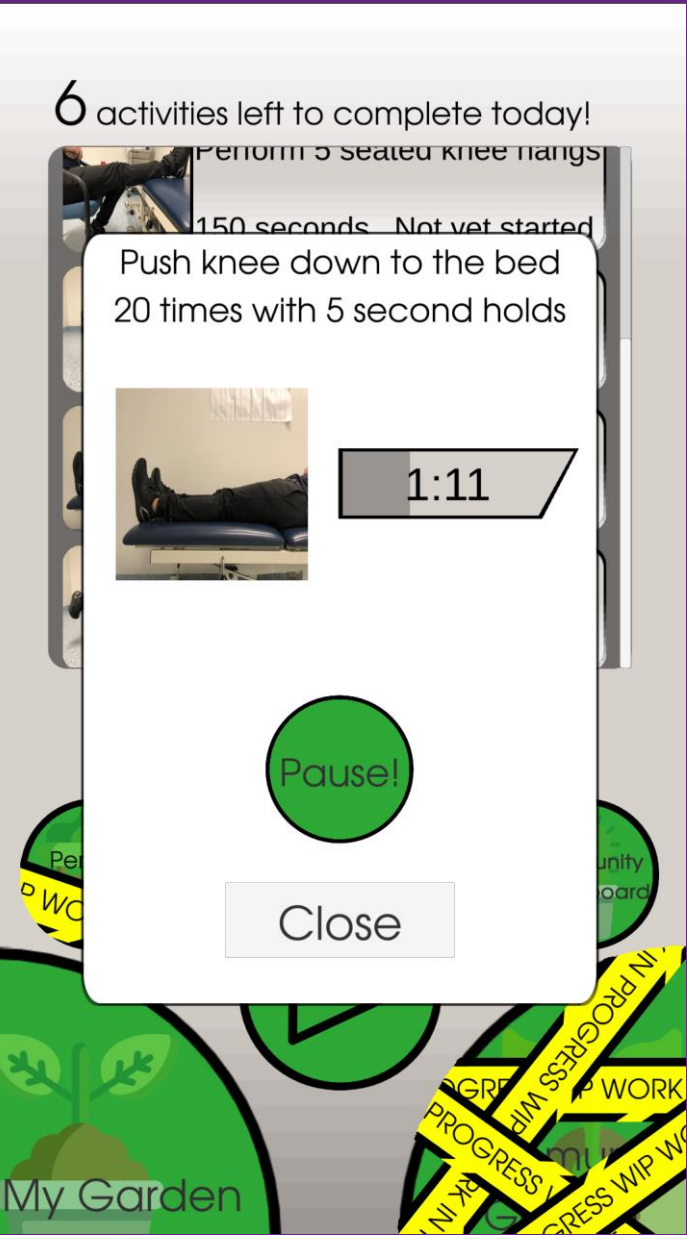


Figure 1C: When an activity is selected and the start button pressed, a timer will be displayed to the user. This timer can be paused and resumed at any time. The activity is completed when the timer reaches zero.

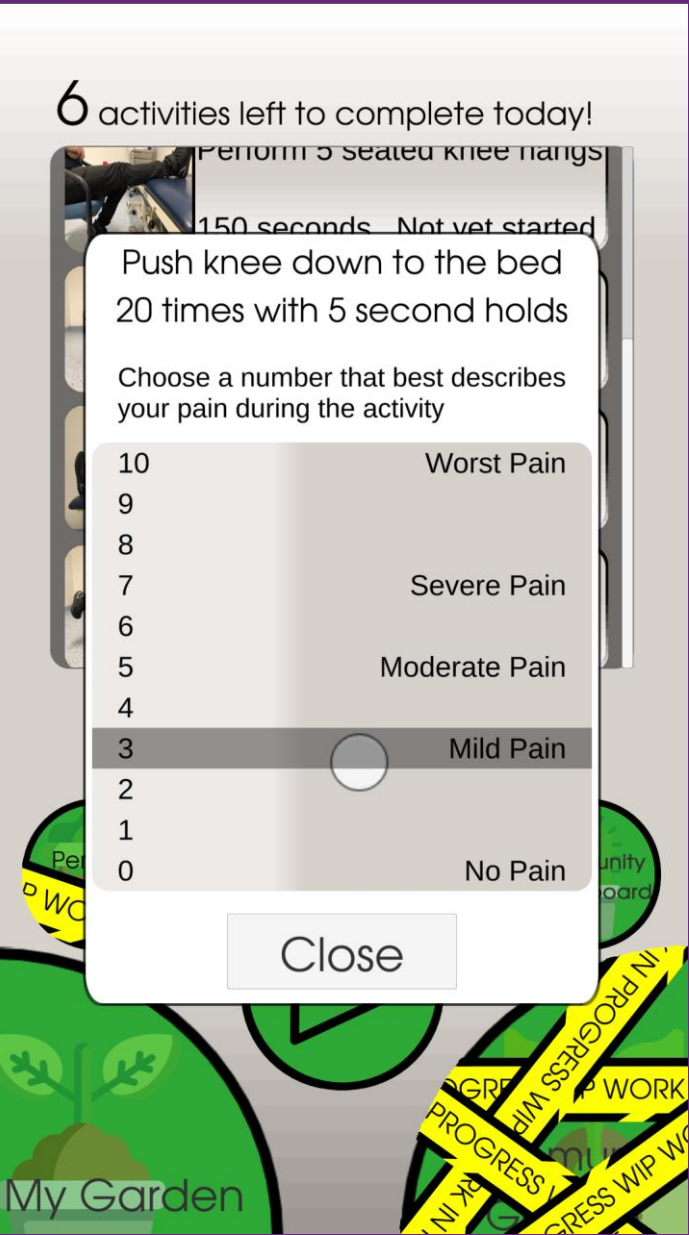


Figure 1D: Immediately after completing an activity, users are prompted to report on how that activity felt on a rating scale chosen by the supervising clinicians (e.g. a Visual Analogue Scale for pain).

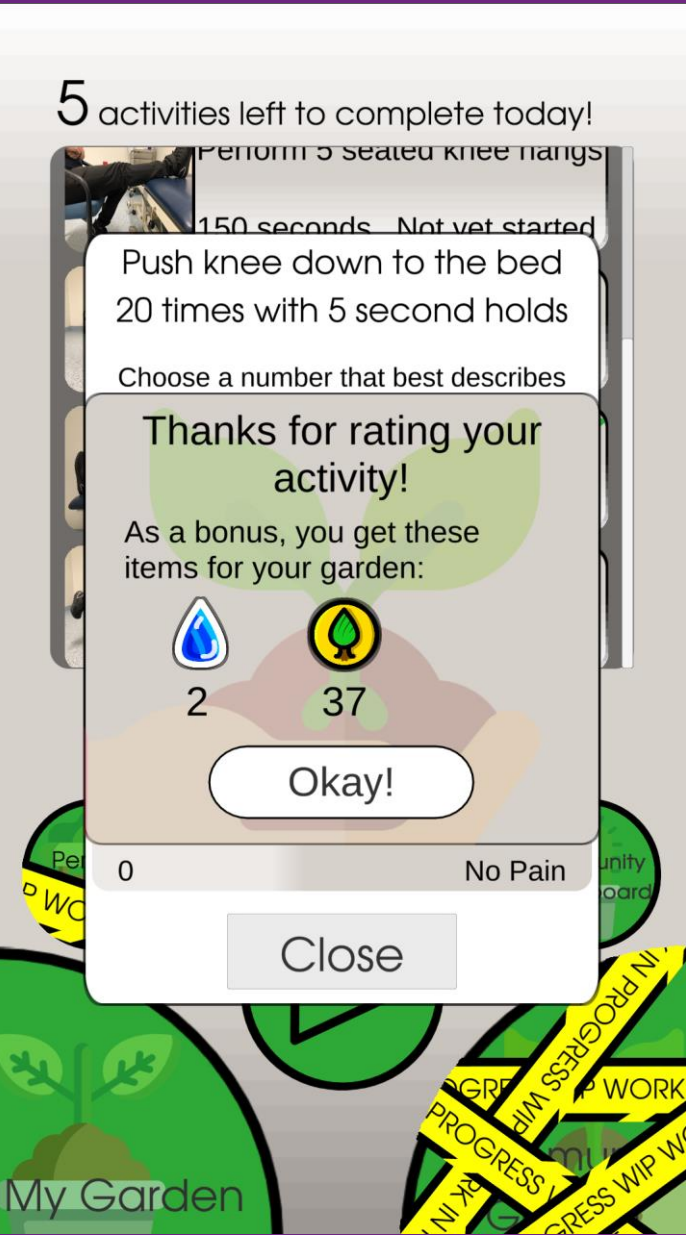


Figure 1E: As a reward for completing and rating an activity, users are given drops of water in a watering can and gold coins to spend on seeds. For completing all activities, users are given a free seed to plant in their virtual garden bed.



Figure 1F: In the user's personal garden bed, users can purchase and plant seeds, grow existing plants by watering them, or sell plants for gold coins. Up to 18 plants can be planted. Plants cannot wilt, even if not watered.

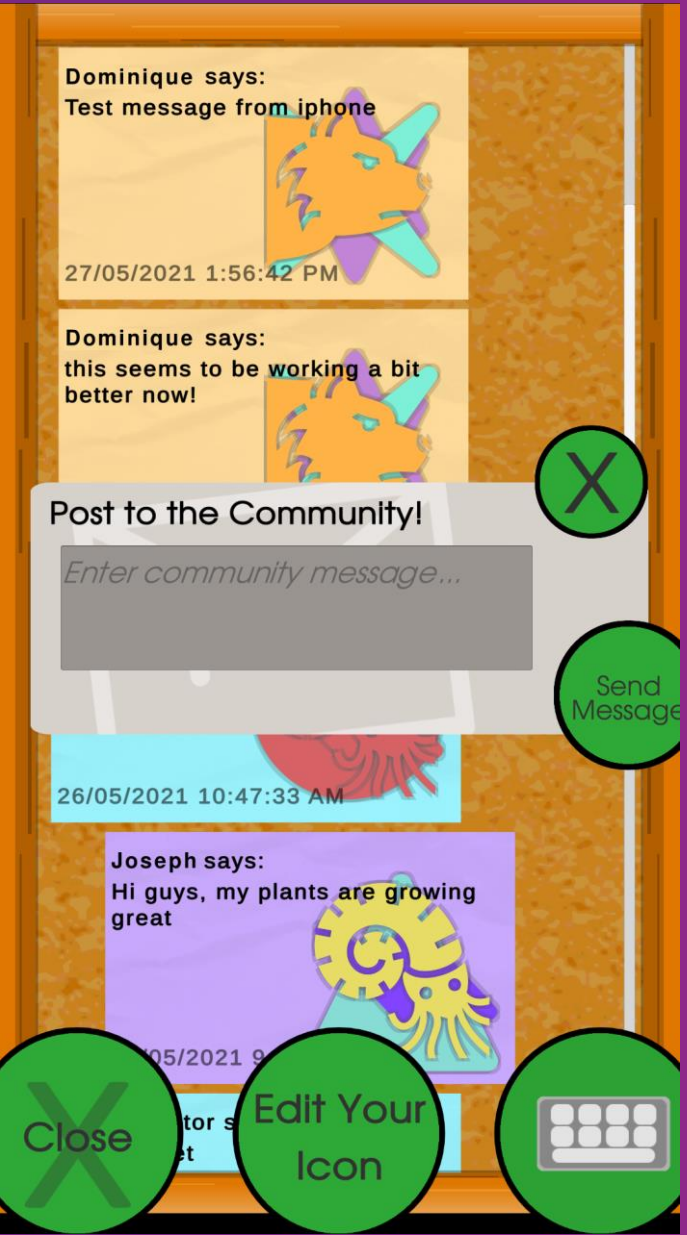


Figure 1G: A community noticeboard allows users to engage and support other users of the app. In addition, supervising clinicians can post messages to the group or provide technical support. Users can change their personal icon.

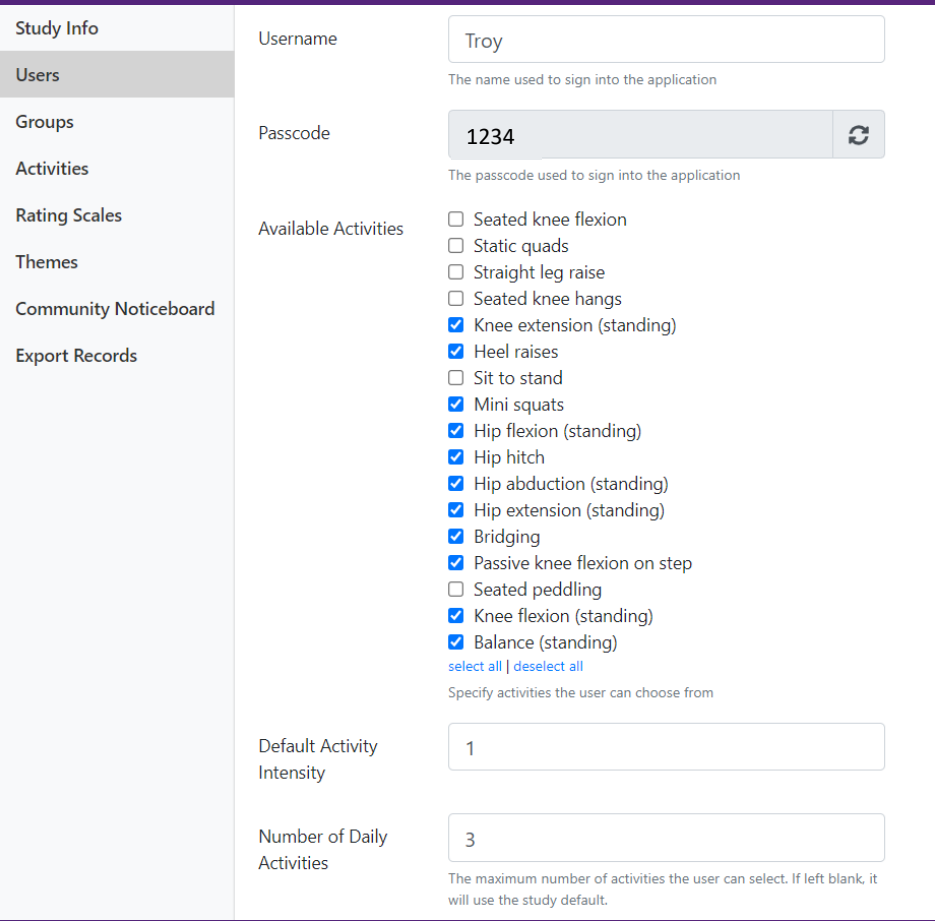


Figure 2: Through use of a website interface, the supervising clinicians can determine what activities are allowed to be selected by each individual user, as well as how many activities each user can select per day. These can be modified at any time to reflect changes in the users home exercise program.

Clinicians will also be able to modify the user's default values for the intensity of an activity, although the users are still free to select a different value than the default if they wish.

This website will allow the clinicians to see what activities have been performed by each user (not shown), and export the records as a backup or for use in research.

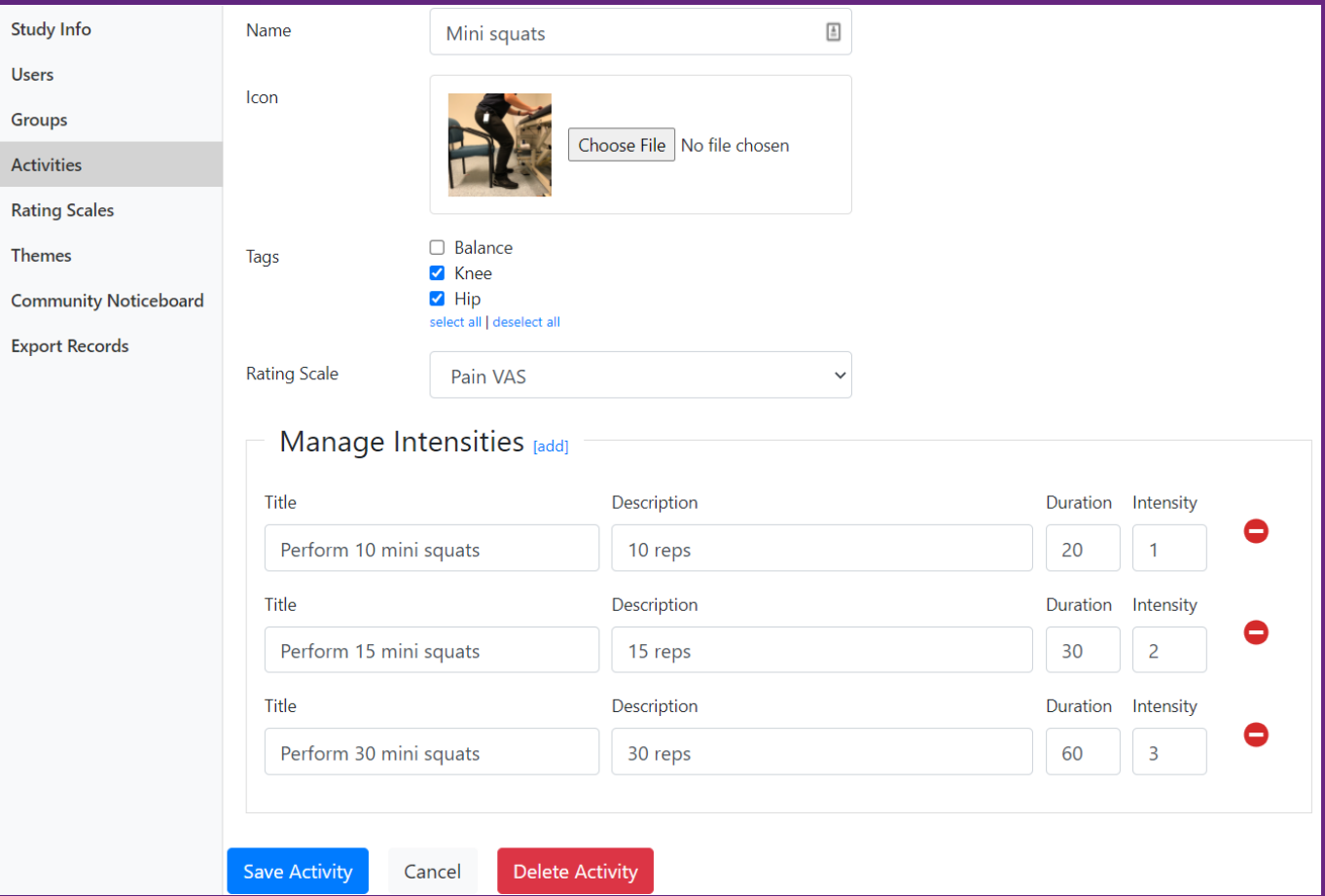


Figure 3: Through the website interface, supervising clinicians are able to create new activities to be added to the home exercise program, or modify existing ones.

For each given activity, clinicians can upload an illustrative image. Additionally, clinicians can modify how many intensity levels exist for each activity. For each intensity level of an activity, clinicians can write the title text will appear on the app under each image. Clinicians can also write a clinical description of the exercise (not visible to users of the app).

Clinicians can also set the duration (in seconds) of the timer that appears alongside the exercise for each intensity level.

Each activity can be given filter tags, allowing the users of the app to easily locate particular types of activities in the app.

Clinicians can select what rating scales appear for each activity, as well as create new rating scales.

Results and Discussion

The redevelopment of the *Grow Stronger* app is due to be completed later in 2021. Pilot testing is also ongoing with persons having undergone total knee replacement surgery. In this pilot research study, participants test the app on their own device for two weeks post-surgery, then provide feedback via an online survey and telephone interview. Findings from this pilot testing will be incorporated in the final design of *Grow Stronger*.

Several features are yet to be implemented into the *Grow Stronger* app. These include reminder notifications to users, the community garden where users can interact with one another, and the ability to send and receive direct messages with clinicians. The addition of these features, when combined with the existing game elements, is expected to further build engagement by aiding in habit formation and facilitating social connectedness between users.

The use of game elements holds promise to improve engagement with home exercise diary apps, thereby allowing these apps to facilitate the self-management and remote monitoring of patients undergoing rehabilitation. The app will be tested in a future trial to assess the effectiveness of this app for improving engagement with the app and adherence to home exercise programs.

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