


BMJ Open Framework to assess the quality of mHealth apps: a mixed-method international case study protocol

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To cite: Tan YY, Woulfe F, Chirambo GB, *et al.* Framework to assess the quality of mHealth apps: a mixed-method international case study protocol. *BMJ Open* 2022;**12**:e062909. doi:10.1136/bmjopen-2022-062909

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-062909>).

Received 15 March 2022
Accepted 14 October 2022



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ABSTRACT

Introduction Healthcare professionals (HCPs) often recommend their patients to use a specific mHealth app as part of health promotion, disease prevention and patient self-management. There has been a significant growth in the number of HCPs downloading and using mobile health (mHealth) apps. Most mHealth apps that are available in app stores employ a 'star rating' system. This is based on user feedback on an app, but is highly subjective. Thus, the identification of quality mHealth apps which are deemed fit for purpose can be a difficult task for HCPs. Currently, there is no unified, validated standard guidelines for assessment of mHealth apps for patient safety, which can be used by HCPs. The Modified Enlight Suite (MES) is a quality assessment framework designed to provide a means for HCPs to evaluate mHealth apps before they are recommended to patients. MES was adapted from the original Enlight Suite for international use through a Delphi method, followed by preliminary validation process among a population predominantly consisting of medical students. This study aims to evaluate the applicability and validity of the MES, by HCPs, in low, middle and high income country settings.

Methods and analysis MES will be evaluated through a mixed-method study, consisting of qualitative (focus group) and quantitative (survey instruments) research, in three target countries: Malaŵi (low income), South Africa (middle income) and Ireland (high income). The focus groups will be conducted through Microsoft Teams (Microsoft, Redmond, Washington, USA) and surveys will be conducted online using Qualtrics (Qualtrics International, Seattle, Washington, USA). Participants will be recruited through the help of national representatives in Malawi (Mzuzu University), South Africa (University of Fort Hare) and Ireland (University College Cork) by email invitation. Data analysis for the focus group will be by the means of thematic analysis. Data analysis for the survey will use descriptive statistics and use Cronbach alpha as an indicator of internal consistency of the MES. The construct validity of the mHealth app will be assessed by computing the confirmatory factor analysis using Amos.

Ethics and dissemination The study has received ethical approval from the Social Research Ethics Committee (SREC) SREC/SOM/03092021/1 at University College Cork, Ireland, Malaŵi Research Ethics Committee (MREC), Malaŵi MZUNIREC/DOR/21/59 and Inter-Faculty Research Ethics Committee (IFREC) of University of Fort Hare

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The Modified Enlight Suite (MES) will be further modified to become a more inclusive framework considering national context across low, middle and high income country (LMHIC) settings.
- ⇒ The evaluation of the framework will be carried out in different settings across LMHICs.
- ⇒ The use of non-probability sampling may increase the risk of self-selection bias.

(REC-2 70 710-028-RA). The results of the study will be disseminated through the internet, peer-reviewed journals and conference presentations.

INTRODUCTION

Background

The WHO defines mobile health (mHealth) as 'medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices'.¹ Mobile health applications can be defined as 'software that are incorporated into smartphones to improve health outcome, health research, and healthcare services'.² Many of these mHealth apps are now available in different app stores such as AppStore (Apple, Cupertino, California, USA) and Google Play Store (Google, Mountain View, California, USA). The use of mHealth apps in low, middle and high income countries (LMHICs) is increasing. More than 325 000 mHealth apps are available to download across the app stores.³ Furthermore, there is an increasing number of mobile phone ownership and mobile internet subscription across low and middle income countries (LMICs).^{4,5}

Healthcare professionals (HCPs) often recommend their patients to use a specific mHealth app as part of health promotion, disease prevention and patient



self-management. mHealth apps serve multiple purposes such as assisting HCPs in identifying the correct drug dosage, supporting communication among different HCPs across the globe and time management.⁶ As the digitalisation of healthcare increases, HCPs are likely to increase their reliance on mobile phones to support patient management and healthcare delivery, both now and in the future.⁷⁻⁹

However, many HCPs are still cautious when adopting mHealth apps,¹⁰ despite the added value such technology could bring to assist their workflow, at a lower overall cost, to care for their patients.¹¹ However, with the anticipated increase in the adoption of mHealth apps among HCPs, there will be associated risks with their usage, given that most of these mHealth apps do not undergo a strict quality assessment evaluation, using a unified or standardised guideline.¹² Until now, even though multiple evaluation frameworks exist, there has not been a standardised evaluation framework that can be used among HCPs to evaluate the quality of mHealth apps. Factors that could limit the adoption include the lack of legislative and regulatory frameworks, poor encryption of patient data and when mHealth app content is inappropriate or has poor software functionality.^{11 13} Similarly, the five-star rating scale, which is available in the two most used app stores (Apple and Google) is subjective, providing a potentially unreliable indication of the quality of the mHealth app. Thus, it is a difficult task among HCPs to differentiate high-quality mHealth apps from low-quality ones.

Recently published research in 2020 discussed that safety concerns within apps related to the quality of their content came up top on the list. The quality of the content presented on apps identified either that they were inappropriate, incorrect, inconsistent or incomplete.¹¹ For example, mHealth apps that were available on the Apple Appstore and Android Google Play Store

used to estimate blood alcohol concentration levels were shown to be highly unreliable. This underscores the need for health authorities to endorse mHealth apps that are accurate and scientifically evidence-based, thus providing credibility in an ever-expanding market of unregulated mHealth apps.¹⁴

Existing frameworks for assessing mobile health apps

Various approaches have been used throughout the world to help HCPs identify high-quality mHealth apps. One example is the NHS Apps Library in the UK (<https://digital.nhs.uk/services/nhs-apps-library>), which provides a collection of approved mHealth apps.¹⁵ The mHealth apps in the NHS Apps Library are evaluated based on clinical safety, accessibility, usability and technical stability, ensuring apps are of high standards before publishing them for patients and HCPs to use. While awaiting national approaches, such as the NHS app library, mHealth frameworks such as the Mobile App Rating Scale (MARS)¹⁶ or Enlight Suite¹⁷ could be used in the interim. Woulfe and colleagues¹⁸ conducted a rapid literature review and identified the Enlight Suite as the most comprehensive framework to evaluate mobile health apps among the existing evaluation frameworks. While the Enlight Suite provides a comprehensive measure for mHealth app assessment (table 1), the suite fails to consider key factors known to hinder the uptake and use of mHealth apps in poor resource settings such as cultural appropriateness, readability and ongoing access to an app.^{13 18} The Enlight Suite was modified through a Delphi study among digital health experts from Ireland, UK and Malawi to adapt it for international use, leading to the development of the Modified Enlight Suite (MES). The MES was then validated through a survey of medical students and HCPs in Ireland.¹⁹ The MES contains five additional questions relating to (1)

Table 1 Comparison of Enlight Suite and Modified Enlight Suite

Concepts	Enlight Suite	Modified Enlight Suite
Quality assessment section		
Usability	Assesses the ease of learning how to use the eHealth intervention programme (EHP) and the ease of using it properly.	Questions added: Question 9: Timeliness Question 10: Errors Question 11: Understandability Question 12: Access
Visual design	Assesses the look and feel of the programme, the visual quality of the graphical user interface (GUI).	No changes
User engagement	Assesses the extent to which the EHP's design attracts users to use it.	No changes
Content	Assesses the content provided or learnt while using the EHP.	Question 25: Cultural appropriateness
Therapeutic persuasiveness	Assesses the extent to which the EHP is designed to encourage users to make positive behaviour changes OR to maintain positive aspects of their life.	No changes
Therapeutic alliance	Assesses the ability of the programme to create an alliance with the user to effect a beneficial change.	No changes
General subjective evaluation of programme's potential	Examines the programme's general potential to benefit its target audience based on the rater's subjective evaluation.	No changes

Table 2 Phases of MES development

Phases	Description	Process	Version	Status
1	Identification of existing methodology (Enlight Suite)	Rapid systematic review	ES	Completed
2	Development of Modified Enlight Suite (Delphi study)	Delphi study followed by a survey in Ireland	MES version 1	Completed
3	Initial validation of Modified Enlight Suite (survey)			Completed
4	International modification of the Modified Enlight Suite (focus group)	Focus group followed by a survey in Malawi, South Africa and Ireland	MES version 2	In progress
5	International validation of Modified Enlight Suite (survey)			In progress

ES, Enlight Suite; MES, Modified Enlight Suite.

cultural appropriateness, (2) understandability, (3) access, (4) timeliness and (5) errors. Questions relating to cultural appropriateness, understandability and access were included based on the Delphi study to make the MES more applicable internationally across LMHIC. Questions relating to timeliness and errors are important for the ongoing use of mHealth apps. The results of the Delphi study and subsequent survey for validation of MES have been submitted for publication.¹⁹ The key modifications to the Enlight Suite based on the previous Delphi study are provided in [table 1](#).

Thus, the MES was developed using a systematic and rigorous approach involving a Delphi study and a validation survey. However, the Delphi study was conducted among digital health researchers and the validation survey was conducted among a population consisting mainly of medical students in a high income country (Ireland). This current study aims to evaluate the applicability and validity of the MES in low, middle and high income countries among HCPs who will be the prospective users of the MES. The study seeks to obtain feedback on what the prospective users perceive as key components to enhance MES and make it more applicable in their various settings.

METHODS AND ANALYSIS

This study is a follow-up to previous studies on MES. [Table 2](#) summarises the five phases of the development of MES with the current study representing Phases 4 and 5.

Study design

This study will employ a mixed-method approach which will involve the collection of qualitative and quantitative data. The first stage will involve the collection of qualitative data through six focus group discussions (two focus groups per country) over Microsoft Teams with HCPs in Malawi, South Africa and Ireland. The second stage of the study will involve the collection of quantitative data in an online survey among HCPs in the three countries to validate the updated MES.

Sampling and eligibility criteria

The study will use non-probability (purposive) sampling to achieve representative cases and comparability for the focus groups. A total of 16 HCPs (8 per focus group) will be recruited per country for the focus group discussions, making a total of 48 HCPs across the three countries. The

participant's inclusion criteria for the focus groups will be as follows:

1. Access to a stable internet connection for the duration of the study.
2. Experience in using any mHealth app.
3. Over 1 year of clinical experience.
4. Ability to understand and communicate in English.

Exclusion criteria for the focus groups:

1. Willingness to be recorded in a Teams Meeting.
2. Conflict of interests.

There is no consensus in the literature on the adequate sample size required for the validation of a questionnaire.²⁰ However, we will not limit the sample size for each country because larger sample sizes are always more representative of the population. The inclusion criteria for the survey will be as follows:

1. Access to a working smartphone for the duration of the study that supports the target app (MySugr).
2. Willingness to install MySugr app on their smartphone for the purpose of the study.
3. Fluent in reading and writing in English.

Exclusion criteria for the survey:

1. Unable to install or use the target app.
2. Conflict of interest.

Recruitment and study procedures

During the first stage, the participants for the focus group discussions will be recruited with the help of university representatives from Malawi (Mzuzu University), South Africa (University of Fort Hare) and Ireland (University College Cork). Participants will be required to provide their written consent before participating in the focus group discussion with the help of clinical leads from their respective countries. The focus group discussions will be conducted using a list of standardised questions as a guide (online supplemental appendix A). Six focus group discussions (two per country) will be held with participants from Malawi, South Africa and Ireland using the Microsoft Teams. The focus group discussions will be recorded after obtaining the consent of the participants. The focus group discussions will serve to obtain feedback on the MES (version 1) (online supplemental appendix B) from HCPs in the three target countries. The findings of the focus group discussions will be used to further update the MES and improve its international applicability.



The updated MES (version 2) from the focus group discussion will be validated in the second stage. During the second stage, HCPs in Malawi, South Africa and Ireland will be recruited for the survey by an email invitation containing an instruction about how to install MySugr app and a link to the survey including participant information leaflet and electronic consent. The updated MES (version 2) will be distributed to the participants through the online survey platform, Qualtrics. Study participants will be asked to use the online version of the updated MES to evaluate the quality of MySugr mHealth app, which is a freely available mHealth app in all the three countries with sufficient features to test all the components of the MES.

Data analysis

The recording of the Microsoft Teams focus group discussions will be transcribed verbatim and analysed using the thematic analysis approach.²¹ The transcribed data will be closely examined to identify codes (eg, ideas, topics and patterns). The codes will be further examined to identify common recurring themes by integrating similar codes. The MES (version 1) will be updated based on the themes to improve its international applicability across LMHIC leading to the development of an updated MES (version 2).

The updated MES (version 2) will be validated in the survey. The survey data from Qualtrics will be exported into SPSS (V.28) for statistical analysis. The reliability of the MES will be assessed by using the SPSS to compute the Cronbach alpha as an indication of the internal consistency for the updated MES. The construct validity of the updated MES will be evaluated by computing the confirmatory factor analysis using Amos V.26 (IBM Statistics).

Ethics and dissemination

The study has been approved by three ethics committees: (1) Social Research Ethics Committee (SREC) SREC/SOM/03092021/1 at University College Cork, Ireland; (2) Malawi Research Ethics Committee (MREC), Malawi MZUNIREC/DOR/21/59; and (3) Inter-Faculty Research Ethics Committee (IFREC) of University of Fort Hare (REC-270710-028-RA). Participation in this research is voluntary. Potential participants will be invited through email to the focus group and survey with the support of local contacts in Malawi, South Africa and Ireland. Data collected from the study will be stored securely and password protected by the researchers. Data protection will be in line with UCC requirements. Should a participant like to withdraw from the study, they can do so up to 2 weeks after the data collection until the data have been analysed. The results of the study will be disseminated through the internet, journals and conference presentations.

Patient and public involvement

The design and conduct of this study will not involve patients. However, the participants will be HCPs who look

after patients and are likely to need to evaluate mHealth apps before recommending them to their patients.

DISCUSSION

When it comes to assessing the quality of mHealth apps, it can prove to be a challenging task. As such, it is not uncommon for certain apps to not have been thoroughly assessed before their release into the market. While guidelines do exist, such as the Enlight Suite and MARS, past research has highlighted potential weaknesses associated with their use when applied in resource poor settings.¹⁸ The MES is a tool that addresses many factors known to hinder the uptake and use of mHealth apps in LMICs. Future work of this research completed in 2021 indicated a need to obtain feedback on the modifications from prospective end-users. Furthermore, the reliability of the modifications has yet to be obtained in an LMIC setting. This study serves not only as a continuation of the aforementioned work, but also allows for additional modifications to the tool to enhance its efficacy.

The strength of this research is that the MES will be further modified to become a more inclusive framework considering the national context across LMHIC settings. Similarly, the validation of the framework across different settings is another strength as this will result in wider applicability of the framework. However, the use of purposive sampling may introduce a risk of selection bias. The choice of purposive sampling is informed by the need to achieve representative cases and comparability across the three countries.

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Contributors TYY, FW and JOD conceptualised the study and drafted the manuscript. GBC, PH, LC, KPF, ST-R read, edited and approved the final manuscript.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

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Focus Group Questions

1. Would you use the MES to evaluate mHealth apps? Yes/No, why?
2. Does the MES question all elements of an app's quality? Yes/No, why?
3. Which components in the MES do you believe is important when considering if they are suitable for your patients?
4. Is there any element in this tool which you believe is not relevant, overly complex or could be improved?
5. Would MES help you in your clinical practice at the moment / in the future?
Yes/No, why?
6. Would you prefer to have a checklist or a list of questions that evaluate mHealth app privacy and security?

Modified Enlight Suite

Start of Block: Welcome to Modified Enlight Tool

Introduction

Information sheet

Background: My name is Tan Yong Yu and I am a 4th year medical student in University College Cork.

Purpose of the Study: I am undertaking a research study entitled “An Evaluation of the Modified Enlight Suite (MES) in High, Low & Middle Income Country settings: A Mixed Methods Approach”. This project is being supervised by Dr John O’ Donoghue and Dr Patrick Henn from the Asser Centre in UCC.

What will the study involve? There are four phases to this project.

Phase I involved a rapid review of the literature to identify current methodologies which can be used for mHealth app evaluation.

Phase II employed Delphi study techniques to modify the Enlight Tool (an mHealth app evaluation tool) to increase its relevance for evaluating mHealth apps in low and middle-income settings.

Phase III involve conducting a focus group session after analysing the survey data of the modified Enlight tool in Mzuzu University, Malawi, University of Fort Hare’s, South Africa and University College Cork, Ireland.

Phase IV of the project will involve reliability testing of the modified Enlight tool in an mHealth app. Mean responses to each question and the distribution of spread of each answer will be assessed to identify whether each question in the tool is reliable.

Why have you been asked to take part? You have been asked to participate in this study as you are an healthcare professional or healthcare student and likely to use mHealth apps in daily practice. Participation is voluntary. If one wishes to withdraw from the study or discontinue after the data has been collected, they may freely do so. Please note: Your responses will be kept confidential.

What will happen to the information which you give? The information which you provide will be kept in a confidential manner and retained on a password encrypted computer along with the UCC NAS server. Data will be analyzed to identify the reliability of each question.

What will happen to the results? The results will be presented in thesis form. They will be seen by my supervisors (Dr. John O' Donoghue & Dr. Patrick Henn), a second marker and the external examiner. The thesis may be read by and shared with future students. A presentation based on my study will be made to the School of Medicine in University College Cork and Malawian Ministry of Health. The study may be published in a research journal in the future.

What are the possible disadvantages of taking part? I don't envisage any negative consequences for you in taking part.

Should you encounter any issues please feel free to contact the following contact points:

Ireland: Tan Yong Yu, 118104027@umail.ucc.ie

Malawi: Dr Griphin Baxter Chirambo gbchirambo@yahoo.co.uk

South Africa: Professor Liezel Cilliers LCilliers@ufh.ac.za

What if there is a problem? One can withdraw from the study even after signing the consent form.

By clicking "**Next**" you are providing informed consent to participate.

Page Break



Elibility Criteria

Elibility Criteria

	Yes (1)	No (2)
Do you have access to a working smartphone for the entire duration of the study? (1)	<input type="radio"/>	<input type="radio"/>
Do you have at least 1 year of practical / clinical / professional experience? (2)	<input type="radio"/>	<input type="radio"/>
Are you comfortable in operating in an english base mobile App? (3)	<input type="radio"/>	<input type="radio"/>
Are you fluent in written and spoken English? (4)	<input type="radio"/>	<input type="radio"/>
Does your working smartphone have the available capacity to donwload a specific mHealth app available in your country (5)	<input type="radio"/>	<input type="radio"/>

Page Break

Introduction Participant Information

Your Participation is voluntary and you can withdraw at any time.

If you agree to participate, you will be asked to click a number on boxes indicating that you are aware of how your data will be used and stored.

Will my information be kept confidential? Yes. All information gathered during this study will be anonymous and cannot be linked to you. Only the researchers / statisticians will be able to access the data.

What will happen to the information I give? The data will be kept confidential for the duration of the study. It will be securely stored as a password-protected, encrypted computer file. On completion, the data will be retained for a minimum of 10 years on UCC Microsoft OneDrive folder securely and then destroyed.

What will happen to the results? The study will be submitted for publication in a peer-reviewed medical/scientific journal.

What are the possible disadvantages of taking part? The research is simply to answer a small number of questions on mHealth Apps. I don't envisage any negative consequences for you in taking part. Should you encounter any issues please feel free to contact your local representative:

Ireland: Tan Yong Yu, 118104027@umail.ucc.ie

Malawi: Dr Giphin Baxter Chirambo gbchirambo@yahoo.co.uk

South Africa: Professor Liezel Cilliers LCilliers@ufh.ac.za

Who has reviewed this study? Approval has been given by the UCC Social Research Ethics Committee.

Page Break

Confirmation Please answer the following to understand how your data will be stored and collected.

	Click to confirm (1)
I understand that my data will be collected and stored anonymously (1)	<input type="radio"/>
I understand that I can withdraw at any time leaving this page (2)	<input type="radio"/>
I understand that I can ask for my data to be withdrawn within 2 weeks of completing the study by emailing my local clinical lead. (3)	<input type="radio"/>

Page Break

Content

Before starting, please download & familiarise yourself with the mHealth app.

This survey is broken into 8 sections which are;

- 1) Demographics (5 questions)
- 2) Usability (7 questions)
- 3) Visual Design (3 questions)
- 4) User Engagement (5 questions)
- 5) Content (5 questions)
- 6) Therapeutic Persuasiveness (6 questions)
- 7) Therapeutic Alliance (3 questions)
- 8) General Subjective Evaluation (3 questions)

Should you experience any difficulties during the survey or have any additional questions, please do not hesitate to contact your local clinical lead:

Ireland: Tan Yong Yu, 118104027@umail.ucc.ie

Malawi: Dr Griphin Baxter Chirambo gbchirambo@yahoo.co.uk

South Africa: Professor Liezel Cilliers LCilliers@ufh.ac.za

Many thanks for your participation.

End of Block: Welcome to Modified Enlight Tool

Start of Block: Demographics

Demographics **Demographics (5 Questions)**

[Section 1/8]

Q1 What age range do you fall into?

- 18-24 (1)
 - 25-34 (2)
 - 35-44 (3)
 - 45-54 (4)
 - 55-64 (5)
 - 65+ (6)
-

Q2 Which race/ethnicity best describes you? (Please choose only one)

- American Indian or Alaskan Native (1)
 - Asian / Pacific Islander (2)
 - Black or African American (3)
 - Hispanic (4)
 - White / Caucasian (5)
 - Multiple ethnicity / Others (please specify) (6)
-

Q3 Are you a healthcare student or healthcare professional

- Healthcare Student (1)
 - Healthcare Professional (2)
-

Q4 Have you used the app before? *Note: please familiarise yourself with the app before proceeding with the survey.*

Yes (1)

No (2)

Q5 How many mHealth (mobile health) apps have you used as part of your work this year?

Page Break _____

Usability Usability (7 Questions)

Assesses the ease of learning how to use the app and the ease of utilizing it properly.

Note: Slow speed of operation should be reflected in all items.

[Section 2/8]

Q6 Navigation. Is it easy/natural/intuitive to navigate through the app?

Note: Pay attention to how easy it is to (a) move from one location to another (if needed), and (b) move backwards.

- Very poor. It is very difficult to move from one place to another. Many features are, therefore, not easily accessible when needed. (1)
 - Poor. It is difficult to move from one place to another, making some features somewhat hard to reach when needed. (2)
 - Fair. Navigation is okay, but not smooth. (3)
 - Good. It is simple/natural to navigate through the app flow (but not ideal). (4)
 - Very good. It is very clear how to navigate through the app and to access every desired / relevant location when needed. (5)
-

Q7

Learnability. How easy is it to learn how to use the app at first? Is it self-explanatory/intuitive?

Note: Consider complexity. Some apps are very complex and so might only score a maximum of 4.

- Very poor. It takes too much time to learn how to use the app. (1)
 - Poor. It takes a considerable amount of time to learn how to use the app. Only highly motivated users will take the time to learn it OR supplementary support is needed. (2)
 - Fair. Users can learn how to use the app without additional support. Only a few of the important features require a considerable amount of time to learn. (3)
 - Good. Learning to use the app is easy (but not ideal). Appropriate explanations appear if needed. None of the important features require a considerable amount of time to learn. (4)
 - Very good. Learning to use the app is very easy, natural, and intuitive. (5)
-

Q8 **Ease of Use.** How easy is it to use the app? Does the user need to exert minimal effort to activate the desired features?

- Very poor. The user has to exert a lot of effort that would have been unnecessary had the app been better designed. (1)
 - Poor. Utilizing key parts of the app demands effort from the end user. (2)
 - Fair. Utilizing some parts of the app demands effort from the end user. (3)
 - Good. Utilization could have been made more effortless by better designing one (not major) feature. (4)
 - Very good. The design best minimizes the effort required from the user. (5)
-

Q9 Timeliness. How accurately/fast do the app features (functions) and components (buttons/menus) work?

- Very Poor. App is broken; no/insufficient/inaccurate response (e.g. crashes/bugs/broken features, etc.) (1)
 - Poor. Some functions work, but lagging or contains major technical problems (2)
 - Fair. App works overall. Some technical problems need fixing, or is slow at times (3)
 - Good. Mostly functional with minor/negligible problems (4)
 - Very Good. Perfect/timely response; no technical bugs found, or contains a 'loading time left' indicator (if relevant) (5)
-

Q10 Errors: Were errors (such as stalling, crashing, failing to save information or app connectivity issues) encountered whilst using the app?

- Very Poor. A couple of major errors were encountered. As a result it is highly likely that the app would be deleted. (1)
 - Poor. A couple of minor errors (e.g. 3) were encountered. Only highly motivated users would likely continue to use the app. (2)
 - Fair. Some minor errors (e.g. 3)
 - Good. Very few minor errors (e.g. 1) were encountered. This error does not have a significant impact on the use of the app. (4)
 - Very Good. No errors were encountered. (5)
-

Q11 Understandability. To what degree would the average person be able to understand the information contained within this app?

- Very poor. The information within this app is written in an excessively difficult manner - Medical Jargon is evident. (1)
 - Poor. Some medical jargon is present. (2)
 - Fair. The information within the app is relatively easy to comprehend, however a certain degree of doubt is present. (3)
 - Good. Most of the Information within this app is readily understandable to the average user. (4)
 - Very Good. Information within this app is explained in everyday terms - All information within this app would be understood by the average user. (5)
-

Q12 Access. Are you guaranteed access to the app at any time?

- Very Poor. The app does not facilitate an offline mode. (1)
 - Poor. The app does facilitate an offline mode, albeit with extremely limited functionalities. (2)
 - Fair. The app does facilitate an offline mode, albeit with limited functionalities. (3)
 - Good. Comprehensive features are available in offline mode. Manual syncing only. (4)
 - Very Good. Comprehensive features are available in offline mode. Syncing occurs automatically when back online. (5)
-

Page Break

Visual Design **Visual Design (3 Questions)**

Assess the look and feel of the APP, and its visual quality

[Section 3/8]

Q13

Aesthetics. Is the interface design of the app attractive and appealing to its target audience? Does the app have a harmonious look and feel (including colors and fonts)?

- Not attractive at all. The choice of colors/fonts/background is very poor. (1)
 - Not attractive. The choice of colors/fonts/background does not make sense; however, some things are still adequately designed. (2)
 - Fair. The interface design makes some sense, but it is not attractive. (3)
 - Attractive. Most parts of the interface design are attractive but could be improved. (4)
 - Very attractive. The interface design is well thought-out, and the app has a harmonious look and feel. (5)
-

Q14 Layout. Does the app appear well-organized? Relate to: structure (e.g., pattern, consistency); how well it displays (only necessary) elements on screen; and whether important information is clear and stands out.

- Very poor. The basic layout is completely wrong and disorganized. Frames don't fit the screen, and important parts are not featured. (1)
 - Poor. The basic layout is poor and disorganized, but some aspects are adequate. (2)
 - Fair. For the most part, relevant elements appear on the screen and more important aspects are featured. However, there are still some issues with the apps structure and organization. (3)
 - Good. In addition to ensuring the relevance and salience of key aspects, the app is also structured and organized. (4)
 - Very good. The app is very well structured and organized. Elements are displayed appropriately. (5)
-

Q15 Size. Are the sizes of fonts/buttons/menus appropriate (for the target audience)? Can the size be changed if needed?

- Very poor. All fonts/features are inappropriately sized. Things do not fit the screen (navigation / scrolling is needed) for no apparent reason. (1)
 - Poor. The main fonts/features are inappropriately sized. (2)
 - Fair. There is at least one key place where the size is wrong. (3)
 - Good. Most of the fonts/buttons/menus are appropriately sized, but there is at least one place where the size is wrong. (4)
 - Very good. All fonts/buttons/menus are appropriately sized and well thought-out. (5)
-

Page Break

User Engagement **User Engagement (5 Questions)**

Assesses the extent to which App's design attract users to utilize it

[Section 4/8]

Q16 Content Presentation. Is the content presented in an engaging/interesting way (e.g., contains the right mix of video/audio/text/graphics)?

- Very poor. The content is poorly presented throughout. For example, there is often text where narration would be more appropriate. (1)
 - Poor. For the most part, the content is presented poorly, but some areas of presentation are adequate. (2)
 - Fair. Some major areas are presented appropriately (e.g., via text or audio), but better ways to present the content are still needed. (3)
 - Good. Content is delivered through an appropriate combination of features, but could be improved. (4)
 - Very good. The content is presented in an engaging/interesting way. (5)
-

Q17

Interactive. Does the app include high-quality interactive features (which enable user input and reaction)?

- Very poor. There are no interactive features. (1)
 - Poor. There are few interactive features, or the interactive features are of poor quality. (2)
 - Fair. There are interactive features, but they are of mediocre quality. (3)
 - Good. The app presents a good interactive experience (but there is room for improvement). (4)
 - Very good. The app presents a high-quality interactive experience. (5)
 - N/A – The app is not (highly) interactive, and so this is not an appropriate way to examine such a program, for example, a trigger-based intervention. (6)
-

Q18 **Not Irritating.** Does the app avoid irritation in the user's experience (e.g., by controlling notifications/alerts/sounds or avoiding irritating colors/fonts/sounds/expressions)? Note: Consider pop-up advertisements.

- Very poor. It is annoying and irritating to utilize the app. (1)
 - Poor. Some of the app's key features are irritating. (2)
 - Fair. There are some irritating features. (3)
 - Good. For the most part, the app is not irritating, and users are able to modify any irritating aspects. (4)
 - Very good. The app is not at all irritating, and, if relevant, users are given the opportunity to control potentially irritating aspects at the outset in order to avoid an irritating experience. (5)
 - N/A – The app is not irritating, and this is not an appropriate way to examine such a program. For example, an app is very lean (e.g., absent of reminders that it should have) and therefore does not have the potential to be irritating (i.e., giving it a high score would inappropriately skew the results). (6)
-

Q19 Targeted/Tailored/Personalized. Are the features tailored to the usage context of the target group? If necessary, does the app enable the customization/personalization (e.g., personalized goals/action items, online diary that maintains personal notes, choice of which content to receive)?

- Very poor. The app does not have any targeted/tailored/personalized features. (1)
 - Poor. The app includes a few targeted/tailored/personalized features. (2)
 - Fair. The app incorporates a fair amount of targeting/tailoring/personalization. (3)
 - Good. The app mostly provides a tailored/personalized experience based on users' needs. (4)
 - Very good. The app is very well designed in terms of offering the user a targeted/tailored/personalized experience. (5)
-

Q20 Captivating. Does utilizing the app engage the user's curiosity and interest (i.e., attract users to use it as needed)?

- Very poor. The app is extremely boring and not desirable to use. (1)
 - Poor. For the most part, the app features are boring, but there are some positives. (2)
 - Fair. The app is neither boring, nor captivating. (3)
 - Good. The app is interesting to use. (4)
 - Very good. The app is highly attractive and engages the user's curiosity, excitement, and interest. (5)
-

Page Break

Content Content (5 Questions)

Assesses the content provided or learned while using the app.

Note: As features (e.g. games) are a way of delivering information, the content conveyed within them should be examined.

[Section 5/8]

Q21 Evidence-Based Content. Is the information provided accurate? Are there evidence-based techniques relevant for achieving the desired clinical aim of the app?

- Very poor. The features/content do not reflect any evidence-based principles in this field. (1)
 - Poor. The presentation of evidence-based techniques is sparse OR the app content is not very accurate. (2)
 - Fair. There is some presentation of evidence-based techniques, and the content is mostly accurate. (3)
 - Good. The app content is accurate and reflects evidence-based techniques (but is still not ideal). (4)
 - Very good. The app content is accurate and based on sound evidence-based principles relevant to the clinical aim. (5)
-

Q22 Quality of Information Provision. Is the information provided clearly for the target audience? Note: Users' age and cognitive and emotional abilities should be taken into account.

- Very poor. None of the information is provided clearly for the target audience. (1)
 - Poor. Some of the information is provided clearly. (2)
 - Fair. The information is provided in a clear way but could be better (3)
 - Good. The information is provided clearly for the target audience, but still not ideal. (4)
 - Very good. The information is provided in the most-clear way possible for the target audience. (5)
-

Q23 Complete and Concise. Is there sufficient information throughout the app without any omissions, over-explanations, or irrelevant data?

- Very poor. There is too much content that does not allow the user to grasp the relevant information, OR there is almost no content. (1)
 - Poor. There is a great deal of content that interferes with the relevant information, OR the content is sparse. (2)
 - Fair. There is some superfluous information, OR there are some omissions. (3)
 - Good. The information is complete, but not concise enough, OR the information is concise, but not entirely complete. (4)
 - Very good. The content is as complete and concise as it can be. (5)
-

Q24 Clarity about the app's purpose. Is there sufficient and accurate information about the target audience, the clinical aim (e.g., potential outcomes), and appropriate ways to utilize the app (e.g., adjunct, standalone)? Notes: Includes who should not use it; could be described in distribution channels such as app stores.

- Very poor. There is no information at all about the app's purpose. / Information is either inappropriate or inaccurate. (1)
 - Poor. There is little information or poor accuracy. (2)
 - Fair. There are some explanations as to the app's purpose, however these are often insufficient. (3)
 - Good. The app explains who should use the program, what its purpose is, and how it should be utilized, but some information is still lacking. (4)
 - Very good. The app provides a thorough explanation of who should use the program, what its purpose is, and how it should be utilized. (5)
-

Q25 Cultural appropriateness: Does the app convey a message in a manner appropriate for its target audience? Note: Users age, Cognitive and Emotional Abilities should be taken into account.

- Very Poor. None of the information is appropriate for the apps target audience. A cultural match is not evident. (1)
 - Poor. Some of the information is appropriate for its target audience. Some images / examples are not be suitable. (2)
 - Fair. The information within the app could be more appropriate for its target audience. A fair degree of cultural match is evident. (3)
 - Good. The information within the app is appropriate for its target audience, but not still ideal. Some images / examples could be improved. (4)
 - Very Good. The information within the app is appropriate for its target audience. (5)
-

Page Break

Therapeutic Persuade

Therapeutic Persuasiveness (6 Questions)

Assesses the extent to which the app is designed to encourage users to make positive behavior changes OR to maintain positive aspects of their life.

Note: Factors of social support (e.g., influence, facilitation, cooperation, recognition) should be taken into account while rating.

[Section 6/8]

Q26

Call to Action. Does the app easily set up measurable and relevant therapeutic activities and inspire/encourage/motivate users to complete them?

Notes: Includes sending out prompts if appropriate; does the user have to take part in the goal setting for the desired action(s) to be relevant/agreeable in this app? If so, rate accordingly.

- Very Poor. Action items are vague, implied, hidden, or non-existent. (1)
 - Poor. Some action items exist, but the app doesn't motivate users at all. (2)
 - Fair. There are some relevant/targeted action items, and there is some degree of inspiration/encouragement/motivation. (3)
 - Good. For the most part, there are relevant/targeted action items and the app stimulates/inspires/motivates users to meet their goals. (4)
 - Very good. The desired therapeutic activities are well targeted, and the app clearly stimulates/inspires/motivates users to complete the activities. (5)
-

Q27 Therapeutic Rationale and Pathway. Is the therapeutic pathway clear? Is it clear how working through each action item provided by the app should lead to the desired therapeutic outcome(s)? Note: This should also be considered from the user's perspective.

- Very poor. Users are asked to engage in activities without the therapeutic pathway being defined. The relationship between the activities and the desired outcome does not make sense. (1)
 - Poor. While the relationship between the activities and therapeutic progress is understood, it is not clear how the app design and the way the action items are provided should lead to the desired therapeutic outcome. (2)
 - Fair. It is somewhat clear how the app design and the way the action items are provided should lead to the desired therapeutic outcome. (3)
 - Good. It is clear how the App design and the way the action items are provided should lead to the desired therapeutic outcome (but still not ideal). (4)
 - Very good. It is very clear how the app design and the way the action items are provided should lead to the desired therapeutic outcome. (5)
-

Q28

Rewards. Does the app recognize desirable achievements and provide appropriate recognition?

Note: This includes documentation of "therapeutic investments," i.e., beneficial work done by the user that is documented in the app in a way that makes users want to stay committed to this pathway (e.g., acquiring points/badges for beneficial activities and showing them on a community board).

- Very poor. The app does not reward users at all. (1)
- Poor. The app uses rewards sparsely/inappropriately. (2)
- Fair. The frequency/appropriateness of rewards is only average. (3)
- Good. The app pays attention to desirable achievements. There are rewards most of the time, but they are not ideal (e.g., the same rewards are used all the time, too many rewards, or rewards not creative/accurate enough). (4)
- Very good. The app does a very good job acknowledging when users reach desirable achievements and rewarding them appropriately/creatively/accurately. (5)

Q29 Real Data-Driven/Adaptive Content. Is the app content influenced by the end user's state and/or achievements? Examples: Content becomes available when the user is ready (i.e., has made appropriate progress); app content changes based on the user's real behaviour/success/failures. Note: The user's state does not have to rely on self-assessment; other methods could include passive sensing and clinicians' input.

- Very poor. The user's progress is not monitored, and content is available regardless of the user's state. (1)
- Poor. The user's progress is not well monitored, and content mostly disregards the user's state. (2)
- Fair. The user's progress is monitored but not in a way that has a strong impact on app content, OR the app is adaptive, but not based on an accurate evaluation of the user's state. (3)
- Good. The app appropriately monitors the user's state and relies somewhat on the user's progress to determine content. (4)
- Very good. The app adapts well to the user's state/progress by changing its available content accordingly. (5)

Q30 Ongoing Feedback. Does the app provide appropriate ongoing feedback on the user's state?

- Very poor. The app does not provide any feedback. (1)
- Poor. The app provides minimal feedback, for example, only after enrolment and taking baseline measurements. (2)
- Fair. Feedback is embedded within the app (e.g., graphs of outcome measures, calorie intake), but not in a way that provides users with a good understanding of their state. (3)
- Good. Feedback is embedded within the app, mainly in a way that provides users with an understanding of their state (e.g., via clear verbal explanation). (4)
- Very good. Feedback is embedded within the app with salient, accurate, and appropriate regard to the user's current state. (5)

Q31 Expectations and Relevance. Does the app convincingly advocate for intervention's relevance, and explain the intervention framework and the general expectations of the user?

Note: Advocating entails relating to one's own state, difficulties in making/sustaining a change, motivation and consequences for using it.

- Very poor. There is no explanation of the app's relevance and its expectations of the user. (1)
- Poor. The app offers only limited explanation of its relevance and expectations of the user. (2)
- Fair. The app offers an adequate explanation of its relevance and expectations of the user. (3)
- Good. The app advocates for its relevance, and explains the framework and general expectations appropriately (but it could be improved). (4)
- Very good. The app effectively advocates for its relevance, and explains the framework and general expectations. (5)
- N/A – The app does not explain its expectations/relevance, but this is not an appropriate way to examine such a program. For example, the targeting of an App makes it irrelevant to set up expectations. (6)

Page Break

Therapeutic Alliance

Therapeutic Alliance (3 Questions)

Assesses the ability of the app to create an alliance with the user in order to effect a beneficial change.

Note: Factors of social support (e.g., influence, facilitation, cooperation, recognition) should be taken into account while rating.

[Section 7/8]

Q32

Acceptance and Support. Does the app make an effort to show that it understands and empathizes with the user; genuinely cares for the user; and relates to the user in a positive fashion?

Note: The app is not a person so this should be done appropriately within the limits of the medium.

- Very poor. There is no positive regard for OR effort to understand the user's perspective. (1)
 - Poor. There is only a minimal gesture to demonstrate understanding/caring for the user's perspective. (2)
 - Fair. In general, there is positive regard and care for the user (some degree of outreach is needed to receive 3). (3)
 - Good. The app is designed to provide users with feelings of basic acceptance and support. (4)
 - Very good. The app proactively shows users that they are accepted and supported as a salient aspect of the App. (5)
-

Q33 Positive Therapeutic Expectations. Does the app encourage users to expect beneficial outcomes from utilizing the program and to rely upon it in the medical context? Note: Consider how well the app instills confidence in users that they are in “good hands” (projecting trustworthiness and professionalism through tone, narrative, convincing presentation, reliable “look and feel”, and meeting people’s exact needs at the right time).

- Very poor. The app does not instill confidence in users that they will benefit from the program. No professionalism/trustworthiness is conveyed. (1)
 - Poor. The app instills minimal confidence in the user and conveys limited professionalism/trustworthiness. (2)
 - Fair. The app instills some confidence in the user and conveys some professionalism/trustworthiness. (3)
 - Good. The app instills a good degree of confidence in the user and conveys a good degree of professionalism/trustworthiness, but something is still missing. (4)
 - Very good. The app effectively instills confidence in users that they will benefit from the program through professionalism and trustworthiness. (5)
-

Q34 Relatability. Does the app offer a good representation of a human factor that is easily relatable within the therapeutic context/process? Examples include a professional who directs the user throughout the program; a peer who was in a similar situation and is now better (e.g., fitness); a vivid virtual character who leads the user; a community of people working together for change. Notes: A community of people NOT “working” to positively support each other does not count; even text messages could create such projections through language, sender’s identity, and responsiveness.

- Very poor. There is no relatable human factor. (1)
 - Poor. Some representation of a human factor exists, but it is not really therapeutic or easily relatable. (2)
 - Fair. There is a representation of a positive human factor, but no effort is made to communicate with the user on a personal level. The human factor seems somewhat distant from the user. (3)
 - Good. There is a representation of a human factor that users can relate to throughout the therapeutic process. However, users might not be able to relate to this factor in an ideal way. (4)
 - Very good. The representation of a human factor is salient throughout the therapeutic process; for example, users are potentially able to become really familiar with this human factor (e.g., professional character) or feel they are part of a community. (5)
-

General Evaluation

General Subjectives Evaluation of the app's Potential (3 Questions)

Examines the app’s general potential to benefit its target audience based on rater’s subjective evaluation. Question Title

[Section 8/8]

Q35 Appropriate Features to Meet the Clinical Aim. Are the apps features sufficient enough to meet its potential therapeutic goals?

- Not at all. (1)
 - Mostly not. (2)
 - To some extent. (3)
 - Appropriate. (4)
 - Very appropriate. (5)
-

Q36

Right Mix of Ability and Motivation. Is the target audience able and motivated to utilize the app as much as needed to reach the potential therapeutic aim?

Note: A change is created when people are able and motivated enough to make the change. If the change is easy, motivation doesn't have to be as high, and vice versa.

- Not the right mix at all. (1)
 - Mostly not the right mix. (2)
 - To some extent. (3)
 - Good mix. (4)
 - Excellent mix. (5)
-

Q37 I like the app.

- Do not like it at all. (1)
- Do not really like it. (2)
- Like it to some extent (3)
- Like the app. (4)
- Like the app very much. (5)

End of Block: Demographics
