Development of a Mobile Application for Detection of Adolescent Mental Health Problems and Feasibility Assessment with Primary Health Care Workers

Gunter Groen, PhD, PsyT[a,*], Astrid Jörns-Presentati, MSW, PhD candidate[a], Anja Dessauvagie, MD, MPH[a], Soraya Seedat, MBChB, FC Psych (SA), MMED Psych, PhD (Psychiatry)[b,c], Leigh L. van den Heuvel, PhD, MBChB, MMed (Psychiatry)[b,c], Sharain Suliman, PhD, MAb[c], Gerhard Grobler, PhD, MMed (Psychiatry)[d], Ronelle Jansen, PhD, MNS[e], Lonia Mwape, PhD, MSc[f], Patricia Mukwato, PhD, MSc[f], Fabian Chapima, MSc[f], Joonas Korhonen, MHSc, PhD candidate[g], Dan J. Stein, FRCPC, PhD, MBChB[i], Deborah Jonker, MSc[j], John Mudenda, MSc, PhD[k], Timo Turunen, MSc[l], Kārlis Valtiņš, MEd, PhD candidate[m], Anete Beinaroviča, Mg Art.[n], Leva Grada, BCompSc[m] and Mari Lahti, PhD, MNS[g,h]

[a] Department of Social Work, Hamburg University of Applied Sciences, Hamburg, Germany;

[b] Department of Psychiatry, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa;

[c] South African Medical Research Council/Stellenbosch, University Genomics of Brain Disorders Research Unit, Stellenbosch University, Cape Town, South Africa;

[d] Clinical Unit, Psychiatry, Steve Biko Academic Hospital and Department of Psychiatry, University of Pretoria, Pretoria, South Africa;

[e] School of Nursing, University of the Free State, Bloemfontein, South Africa;

[f] Department of Nursing, University of Zambia, Lusaka, Zambia;

[g] Nursing Science Department, Health and Well-being, Turku University of Applied Sciences, Turku, Finland;

[h] Department of Nursing Science, University of Turku, Turku, Finland;

[i] SA MRC Unit on Risk & Resilience in Mental Disorders, Department of Psychiatry & Neuroscience Institute, University of Cape Town, Cape Town, South Africa;

[j] Department of Psychiatry and Mental Health, University of Cape Town, Cape Town, South Africa;

[k] Medical Education, Lusaka Apex Medical University, Lusaka, Zambia;

l Riga Technical University, Riga, Latvia; [m] University of Latvia, Riga, Latvia; nLatvian Academy of Culture, Riga, Latvia

*CONTACT: Gunter Groen, Department of Social Work, Hamburg University of Applied Sciences, Hamburg, Germany. Email: gunter.groen@haw-hamburg.de

ABSTRACT

Introduction: There has been a sharp increase in the use of digital health interventions in global health, particularly mobile health applications, in recent years. The extreme shortage of health care providers trained in mental health screening and intervention in low- and middle-income countries raises questions about the applicability of mobile applications to

deliver these services due to their accessibility and availability. This exploratory paper describes the development and feasibility assessment of a mobile screening application for the detection of mental disorders among adolescents in Zambia and South Africa. **Methods**: Eighty-two health care workers (HCW) working in primary care evaluated the acceptability and practicality of the mobile screening application after receiving brief training. The evaluation included questions from the Mobile Application Rating Scale (MARS) as well as open-ended questions. **Results**: The acceptability of the screening app was high and study participants were positive about using the app in routine care. Problems with internet connectivity, and time and staff constraints were perceived as the main barriers to regular use. **Conclusion**: HCW in primary care were able and willing to use a mobile screening app for the detection of mental health problems among treatment-seeking adolescents. Implementation in clinical practice needs to be further evaluated.

INTRODUCTION

Digital technology has become an important vehicle for health care delivery, with mobile technology being particularly relevant (World Health Organization, 2018). In its Global Strategy on Digital Health (2020–2025), WHO states its vision: "to improve health for everyone, everywhere, by accelerating the development and adoption of appropriate, accessible, affordable, scalable and sustainable person-centric digital health solutions to prevent, detect and respond to epidemics and pandemics, developing infrastructure and applications that enable countries to use health data to promote health and well-being, and to achieve the health-related Sustainable Development Goals" (World Health Organization, 2021b). WHO estimates that more than 1 billion people may benefit from universal health coverage and will enjoy better health and well-being by using appropriate digital technologies.

Mobile health (mHealth) has been defined 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" (World Health Organization, 2011). Over the last few years, there has been extensive growth in the mobile health application arena, in high- as well as low- and middle-income countries (LMIC) (Hurt et al., 2016; World Health Organization, 2016). The third global survey on eHealth conducted by the Global Observatory for eHealth showed that 87% of responding countries had at least one governmental mHealth programme (World Health Organization, 2016).

Mobile technology is broadly available, easy to use, and widely accepted. The use of mobile technology has rapidly increased throughout the last 15 years, particularly in the developing world. In 2021, around 60% of the world´s population was using the internet and there were 110 mobile phone subscriptions per 100 inhabitants: 135 in developed countries, 105 in developing countries, and 76 in the least developed countries (International Telecommunication Union, 2022). The ubiquitous availability of mobile technology has created new opportunities for health care delivery and health promotion, particularly in otherwise underserved regions.

mHealth in low- and middle-income countries – opportunities and barriers

mHealth has the potential to facilitate health care management, service delivery, and surveillance supporting health care workers (HCW) who are working in LMIC (Agarwal et al., 2015; Feroz et al., 2020; Källander et al., 2013; Schoen et al., 2017). A review on the feasibility and use of mHealth by nurses and other frontline HCW in developing countries identified five main areas of use: data collection and reporting (1), training and decision support (2), emergency referrals (3), work planning (4), and improved supervision and communication between HCW (5) (Agarwal et al., 2015). Mobile technology is also used to convey essential health care information to the public, improve health behavior, and link individuals with essential health services (Ippoliti & L'Engle, 2017; Malvey & Slovensky, 2014; Royston et al., 2015).

A review by Hurt et al. (Hurt et al., 2016) on the effectiveness of mHealth interventions in LMIC evaluated seven studies of which five showed significant improvements in clinical outcomes, treatment adherence, and health communication. Another benefit was the ability to receive expert advice in underserved regions. Common barriers to the successful implementation of mHealth interventions in developing countries were poor infrastructure, lack of equipment, technology gap, human resource issues, and time or work conflicts (Kruse et al., 2019). A systematic review of 44 studies of mHealth projects in Africa demonstrated that their success is based on accessibility to technology and resources, acceptance of mHealth technology, low cost, adaptation to local contexts, strong stakeholder collaboration, and government involvement. Threats included unreliable infrastructure, dependency on funding, unclear health care system responsibilities, and a lack of evidence on cost-effectiveness (Aranda-Jan et al., 2014).

Since traditional health care systems are typically understaffed, unreliable or resource-constrained, digital health is advancing in sub-Saharan Africa (Aceto et al., 2018; Holst et al., 2020; Naslund et al., 2017). The national department of health of South Africa, for example, developed its mHealth strategy 2015-2019 (NDoH, 2015), with the mission of applying mHealth as an integral part of health care delivery in South Africa. This mission further aims to meet the information, communication, health education, and data management needs of the health care system in South Africa. One example of a successful mHealth project is the Vula app, a South African-developed medical referral and advice app (Mapham et al., 2017). Through this application, clinicians can consult one another, and patients can connect with clinicians. Training happens through digitally based learning and patient referral is facilitated, potentially increasing access to health care.

mHealth in mental health care

There is a large treatment gap for mental disorders in LMIC: According to the WHO, between 76% and 85% of people with severe mental disorders living in LMIC receive no treatment for their disorder (World Health Organization, 2021a). In the face of the extreme shortage of qualified mental health professionals, one approach is to shift tasks to HCW not specialized in mental health care (Ola & Atilola, 2019; Woods-Jaeger et al., 2017). This includes nurses and other health professionals as well as community or lay health workers. The shift to mobile technology may facilitate mental health screening and early detection of mental health

problems by non-specialized HCW (Naslund et al., 2017). In LMIC, primary health care (PHC) is the first point of contact and the setting in which the bulk of health care is provided. Enabling HCW in PHC to better detect mental health problems and refer patients in need could be a huge step toward improved treatment coverage for mental disorders (Wakida et al., 2018).

A sector of the population that could particularly benefit from digital interventions for mental health care are young people (Naslund et al., 2017). As nearly 90% of young people live in LMIC and specialized services for adolescents and young adults are absent in many low-income settings, unmet mental health needs in this age group are a public health challenge. Adolescence, the period that sets the foundation for later life health and wellbeing (Patton et al., 2012), is when most mental health difficulties first emerge (Patel et al., 2007). A recent systematic review on the mental health of sub-Saharan adolescents summarized the available evidence on adolescents between the ages of 10 and 19 years and reported prevalence rates of 40.8% for emotional and behavioral problems, 29.8% for anxiety, 26.9% for depression, 21.5% for PTSD, and 20.8% for suicidal ideation (Jörns-Presentati et al., 2021). In recognition of the negative impact of mental disorders on wellbeing and development, adolescent mental health is increasingly being recognized as a public health priority (Carvajal-Velez et al., 2021; Patel, 2013). Despite this, numerous factors, including limited resources, low investment and stigma, continue to prevent early identification and treatment (Kleintjes et al., 2010). Ideally, early identification and treatment of young people's mental health concerns should take place at the PHC level (Colizzi et al., 2020).

In 2008, the WHO introduced the Mental Health Gap Action Programme (mhGAP) to meet service needs for mental disorders in LMIC (World Health Organization, 2019). mhGap includes an intervention guide which provides guidelines for the detection and treatment of mental, neurological and substance use (MNS) disorders in non-specialist health care settings. The first version was released in 2010 and version 2.0 in 2016 (World Health Organization, 2016). The intervention guide is available in eight different languages and as a digital tool for iOS smartphones. Since its introduction, the mhGAP Intervention Guide has been successfully used in more than 100 countries. Although the mhGAP Intervention Guide also includes a section on child and adolescent mental and behavioral disorders, there were some shortcomings for use in the MEGA project:

1. Complexity and comprehensiveness of the WHO application: Our aim was to develop a short and easy-to-use application for the screening of common mental disorders that primary HCW can use while delivering care.

2. Age-specificity: Our target group were adolescents, while the WHO application has a broader focus (mental health needs of children and adolescents).

3. Participatory development with local HCW: Our application was developed as part of the MEGA project and informed by local HCW, mainly nurses, in the two intervention countries.

In this manuscript, we describe the development process and the feasibility assessment of a mobile application designed for the screening of common mental health problems among adolescents by HCW in PHC. The app development was part of the MEGA project, a 3, 5-year

capacity-building development project (2017-2021), funded by the European Union (585827-EPP-1-2017-1-FI-EPPKA2-CBHE-JP). The project focused on improving child and adolescent access to mental health services and appropriate care, by providing mental health training for health care professionals, mainly nurses, in PHC. The training followed a "train-the-trainer" approach and included the use of a mental health screening tool, a newly developed mobile application, designed for this purpose. The project was delivered in South Africa and Zambia in collaboration with European partners (Lahti et al., 2020).

MATERIALS AND METHODS

The MEGA project set out to develop a tool in the form of a mobile application ("app"), which allows HCW in PHC care to use their limited resources as efficiently as possible and to support access appropriate mental health care for adolescents. Our aim was to familiarize HCW in PHC with the MEGA app as part of a mental health training course, which focuses on basic clinical knowledge and educational anti-stigma interventions. The application and training were developed by the MEGA consortium, which consisted of project partners associated with three South African, two Zambian, and Finish, Latvian, and German higher education institutions. The project was a collaboration between an app development team and psychiatrists, psychologists, researchers, and mental health nurses. To ensure cultural relevance of the application and training, roundtable discussions and interviews with HCW in PHC clinics and local policymakers were conducted in Zambia and South Africa. The preliminary version of the application and the corresponding user manual underwent multiple rounds of review within the consortium and with HCW in PHC associated with the African universities, with suggestions for improvement informing the final version of the application. The MEGA app is now available for free download in several countries ('MEGA App Available on Google Play', 2022).

Prior to the development of the MEGA training course, a training needs analysis for local HCW in PHC in South Africa and Zambia was conducted between October 2018 and December 2019 in a total of 45 health care clinics. The MEGA training does not assume specialized training in mental health, and, due to its modularized form, it can be conducted over 1 to 3 days, followed up by supervisory visits to provide ongoing support to participants in their health care facilities (Lahti et al., 2020). The training course offers different types of learning formats and techniques such as presentations, small and large group discussions, case studies, role-plays, and self-study. The training material was piloted with local practitioners in the Free State, which highlighted the importance of ensuring cultural relevance, for example through including a context-specific video and contextually appropriate articles on depression. The complete training material is available in print form or online as a free download on the MEGA project website (MEGA, 2021). The structure and design of the MEGA training will be described in a separate paper.

The first tier of 'train the trainers' was conducted within the MEGA consortium. The designated trainers were project partners with a background in clinical psychology and mental health research and all trainees were registered nurse practitioners with extensive experience in research and teaching at the participating universities in South Africa and Zambia. Between March 2020 and January 2021 the trained trainers then conducted MEGA training courses across three provinces in South Africa and two provinces in Zambia. Convenience sampling of

participants was used, based on the clinic managers' decisions regarding whether staff members could be released for training. Recruitment of nurses for the eventual formal training proved challenging due to a general shortage of staff and the breakout of the COVID-19 pandemic. Participation in the feasibility study was entirely voluntary and anonymous. Participants were informed that they were allowed to withdraw from the study at any point in the process and provided written consent. Tablets or mobile phones with the pre-installed application were provided to participants by the MEGA research team.

Content design of the mobile application

The MEGA app was designed to be used by HCW to screen for common mental health problems in adolescents, namely depression, anxiety, posttraumatic stress disorder (PTSD), substance use, and suicide and self-harm. The MEGA app was not intended to provide a diagnosis but to rather serve as a screening tool to help HCW identify adolescents who need further assessment. The questions included were based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) and International Classification of Diseases, 11th Revision (ICD-11) criteria, with phrasing simplified to enhance comprehension. The app is divided into five screening modules (Supplementary Table 1), as detailed below, with brief introductory statements included allowing HCW to provide a frame of reference to adolescents as to why the questions are being asked. The app moves through each of the modules sequentially and provides a feedback statement to the adolescent after completion of each module.

Depression screener

The depression screener asks about the two core symptoms of major depressive disorder (MDD) based on the DSM-5, namely depressed mood and loss of interest or pleasure. HCW are instructed that adolescents who screen positive for either item should be assessed further for possible depression.

Anxiety screener

The anxiety screener includes three questions that were not designed to be disorder-specific, but to ask about broad constructs related to anxiety. The first question asks about the subjective experience of anxiety, using common synonyms. The second question asks about common symptoms related to panic attacks. The third question asks about worry (or apprehension) which is linked to generalized anxiety disorder (GAD) and about avoidance, which is a core feature of all anxiety disorders. HCW are instructed that adolescents who screen positive for any item should be assessed further for possible anxiety disorders.

Trauma and PTSD screener

The trauma and PTSD screener introduction provide concrete examples of types of traumatic experiences and the first question asks about exposure to possible traumatic experiences. The question is phrased to reflect mainly directly experienced or witnessed events but has been kept fairly broad to try to increase sensitivity. The question also asks about 'feeling threatened in some way' as children and adolescents may be exposed to child abuse and

maltreatment that can be difficult to describe in exact words, without asking multiple questions. The second question asks about the experience of symptoms related to the traumatic event in the prior month. The symptoms are broad to increase sensitivity and relate to each DSM-5 cluster, using phrasing that may be easier to comprehend. HCW are instructed that adolescents who screen positive for either trauma exposure or symptoms of PTSD need to be assessed further to determine their safety and for possible PTSD.

Substance use screener

The substance use section asks firstly about substance use, namely alcohol and drug use, using some common examples of drugs that people use. The second questions ask about negative consequences related to substance use. The examples are related to some of the symptoms of substance use disorders, as per the DSM-5, including failure to fulfill role obligations (school), continued use despite social or interpersonal problems, and health problems. The symptoms related to tolerance, withdrawal, and increased craving have not been included, as these will be asked for within the context of a diagnostic assessment. The questions are aimed at detecting any possible problems related to substance use that may require attention and further assessment and are thus broadly inclusive. HCW are instructed that adolescents who screen positive for substance use or problems related to substance use need to be assessed further for possible substance use disorders. Substance use in adolescents is a concern, thus adolescents who only endorse use should also be assessed further.

Suicide and self-harm screener

These are questions aimed at identifying adolescents requiring immediate attention regardless of the underlying cause of the problem. The questions are meant to be broad to identify any adolescents at risk. The concept of suicide in the DSM-5 MDD criteria was used as a guide. The first question asks about increased thoughts about death and the second question asks about more direct thoughts regarding suicide and self-harm. HCW are instructed that adolescents who screen positive for either item need to be assessed immediately regarding suicide risk.

Feasibility research

Feasibility research is part of evidence-based intervention development. It is conducted to determine whether and how an intervention can be implemented before it is tested on a larger scale (Bowen et al., 2009; Eldridge et al., 2016; Orsmond & Cohn, 2015). While feasibility studies are comparatively common in medical research, they are not routinely conducted in psychology or educational sciences. In their paper on feasibility research, Gadke et al. (2021) describe feasibility research as one phase of intervention development that should precede a pilot study to identify implementation needs (e.g. infrastructure, resources) and the practicality and usability of the intervention. They define 10 distinct feasibility dimensions with relevance to intervention development: recruitment capability, data collection, design procedures, social validity, practicality, integration, adaptability, implementation, effectiveness, and generalizability. A four-step framework is proposed which includes the following steps:

1. review prior intervention research regarding feasibility dimensions,

2. determine feasibility dimension priorities for the proposed outcome study,

3. conduct feasibility studies on the prioritized dimensions and make changes to the planned outcome study, if necessary,

4. conduct intervention and continue to evaluate and report feasibility dimensions for future research.

Feasibility assessment

The feasibility assessment of the MEGA app was embedded in a training course on mental health for HCW in PHC which constituted the core part of the MEGA project. For the feasibility assessment, we focused on the social validity or acceptability, and practicality of the mobile application. The guiding research questions were:

• Do participants perceive the application as appropriate, reasonable, fair, and potentially effective? (social validity)

• Can the application be implemented with available resources, time, training, and materials? (practicality).

The concept of Bowen et al. (2009) likewise includes acceptability and practicality as two possible focus areas for feasibility assessment. They propose the following outcome categories:

• For acceptability: user satisfaction, intent to continue use, perceived appropriateness

• For practicality (among others): factors affecting implementation ease or difficulty, positive/negative effects on target participants, and ability of participants to carry out the intervention activities.

We assessed the acceptability of the app with a post-evaluation questionnaire, based on five items from the Mobile Application Rating Scale (MARS; Stoyanov et al., 2015). The MARS scale is a well-established and reliable scale for classifying and rating the quality of mobile health applications. The questionnaire included items from four different sections of the MARS scale: Engagement (item 2. Interest; item 5. Target group), Functionality (item 7. Ease of use), Esthetics (item 12. Visual Appeal), and Information (item 15. Quality of information), thus covering all the different quality indicators. Items were rated on a 3-point Likert scale. The subjective quality and practicability of the app were assessed with qualitative interviews: Study participants were asked to rate how comfortable they would be to use the MEGA app in their daily practice on a Likert scale of 1 (not at all) to 5 (absolutely). Additionally, they were given the opportunity to name potential obstacles and give suggestions to improve the training in two open-ended questions.

Data analysis

The Statistical Package for Social Sciences [22] software was used to calculate descriptive statistics (IBM, 2019). Because of the exploratory focus of the study, we used summative content analysis to analyze the qualitative data. Two of the authors coded the material independently. Based on these results, nine categories emerged from the data and the allocated codes were then quantified (Krippendorff, 2018).

RESULTS

Study participants: Eight trainers delivered the MEGA training courses to 43 HCW in South Africa and to 39 participants in Zambia to date. The majority of HCW were trained between March and June 2020 (N = 78). The University of Cape Town (UCT) and Stellenbosch University (SU), both in South Africa, trained five additional nurses in March 2021 due to COVID-19-related delays. Seven of the total 82 participants did not fill out the post-evaluation questionnaire. The trainees were mostly female registered nurses with an average age of 36 years (SD = 10.9). Most participants had a diploma and around 50% had 1-5 years of nursing experience (see Table 1).

Table 1. Participants of the MEGA training (trainees).

	Number	Percent
Gender		
Female	56	75.0
Male	19	25.0
Affiliation*		
UCT/SU	14	17.1
UFS	8	9.8
UP	17	20.7
UNZA	24	29.3
LAMU	19	23.2
Educational level		
Certificate	5	6.7
Diploma	54	72.0
Degree	14	18.7
Other	2	2.7
Profession		
Registered nurse	60	73.2
Clinical officer	14	17.1
Enrolled nurse	4	3.9
Public health officer	1	1.2
MH nurse	1	1.2
Trauma nurse	1	1.2
School nurse	1	1.2
Working experience (years)		
1–5	41	54.7
6–10	11	14.7
11–16	5	6.7
>16	18	24.0

* From South Africa: University of Cape Town (UCT), Stellenbosch University (SU), University of the Free State (UFS), University of Pretoria (UP); from Zambia: University of Zambia (UNZA), Lusaka Apex Medical University (LAMU).

Acceptability of the MEGA screening app

As presented in Figure 1, the highest rating was given for the app content (visual information, language, design), which was perceived as appropriate for the target group, namely HCW in PHC (m = 2.84, SD = 0.37). The app was also perceived to be easy to use due to its clear menu labels/ icons and instructions (m=2.77, SD = 0.43), and participants thought the information conveyed was accurate and relevant to the goal of the app (m = 2.75, SD=0.44). Lower ratings were given for the app's strategies to increase engagement by presenting its content in an interesting way (m = 2.64, SD = 0.48) and for its visual appeal (m = 2.72, SD = 0.45).

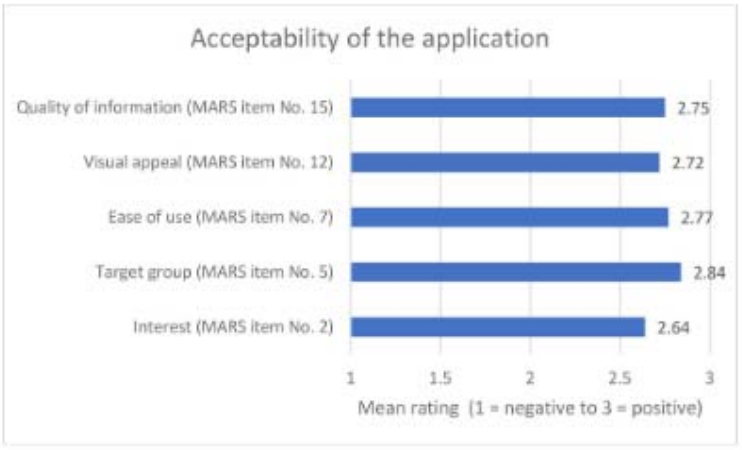

Figure 1. Acceptability of the MEGA screening app, based on MARS quality indicators (n=82).

Practicality of the mobile application

The majority of study participants felt "very comfortable" or "absolutely comfortable" to use the MEGA app in their daily practice, with an average rating of 4.0 on a 5-point Likert scale (SD = 0.91). Table 2 shows an overview of obstacles that HCW mentioned after trialing the application. Problems with internet connectivity and access as well as limited availability of staff and time to use the app (due to a high workload or the use of other apps) were most frequently identified as obstacles. Additional barriers included lack of access to smartphones and tablets, difficulties with certain functions of the app, and difficulties gaining access to the appropriate target group, either because nurses did not work with adolescents during the study period, or were concerned about successfully communicating with them.

HCW proposed that a sufficient number of phones/tablets were made available for their use and that a large enough number of nurses be provided with ongoing training and supervision. Another suggestion was to merge content from existing mental health apps utilised in the South African PHC context and the MEGA app, and to include the perspectives of adolescents in order to make the application more attractive to young patients in PHC and to enhance end-user satisfaction.

Table 2. Perceived barriers to regular application use

Type of barrier	Examples	Frequency of mentioning
Internet connectivity and technical challenges	"Availability of bundles and internet connectivity will be a challenge." "Tech disability"	26
Shortage of manpower	"Time to screen patients might be limited." "Workload may interfere with use of mega app." "Staff shortages - high number of patients, unable to do a thorough consultation."	24
Functionality of the app	"The device (phone) to use is limited in terms of function."	9
Shortage of phones/ tablets	"Sharing the gadget will be a challenge because there will be more practitioners against one tablet"	6
Access to clients	"Gaining trust of the young children to answer questions." "In the case that a patient refuses to give consent to use tablet"	5

DISCUSSION

The main goal of the MEGA project was to assist HCW in providing better access to mental health care services to adolescents by developing a mobile application for the screening of mental health problems in PHC settings in South Africa and Zambia. As pointed out in the introduction, training non-specialist HCW to screen and identify potential mental health problems in adolescents is a significant first step in the early identification and treatment of mental health problems and mitigates the effects arising from them.

The feasibility assessment revealed high acceptability of the MEGA app among HCW, with ease of use, relevance to the target group and quality of information ranking slightly higher, compared to the visual appeal and the presentation of content. Regarding the practicality of the application, study participants indicated that they were very certain that they would use the app, although time and staff constraints were perceived as the main barriers to regular use. Other perceived problems were internet connectivity and shortages of phones and tablets. Problems with internet connection that limited the use of mHealth applications by HCW in PHC have been noted in other studies from LMIC (Agarwal et al., 2015; Feroz et al., 2020; Kruse et al., 2019; Odendaal et al., 2020; Pokhrel et al., 2021). Weak technical support and lack of proper training were other common issues often raised by HCW working in low-resource settings (Agarwal et al., 2015; Feroz et al., 2020; Odendaal et al., 2020). As the evaluation of the MEGA app directly followed the training, lack of technical support was not mentioned in our study, whereas ongoing training and supervision were recommended as requirements for further use of the application. A review of Kruse et al. (Kruse et al., 2019) likewise identified immature or lack of infrastructure and lack of equipment as the most prevalent barriers, whereas lack of training only accounted for 4% of the perceived barriers. The authors suggest building partnerships with local governments and NGOs to secure the

necessary funding, leadership and the establishment of a sustainable infrastructure for mHealth projects.

Other prevalent barriers described by Kruse et al. (2019) were human resource issues and time or work conflict. Both were also mentioned by HCW in our study. Although task-shifting to non-specialized HCW presents a chance to narrow the treatment gap for mental disorders in LMIC (Naslund et al., 2017; Ola & Atilola, 2019; Woods-Jaeger et al., 2017), adding more tasks to already overburdened health personal might not be a sustainable solution. Thus, before implementing mHealth applications, limited resources in time and manpower must be considered. On the contrary, other authors have pointed out that mobile technology can potentially reduce the workload of HCW and improve their retention in PHC (Feroz et al., 2020; Källander et al., 2013; Schoen et al., 2017).

Despite the time and staff constraints, HCW in our study rated the MEGA app overwhelmingly positive and expressed a strong intention to use it during routine care. Our study group mainly consisted of registered nurses and clinical officers, with an average age of 36 years. Nearly half of them had 6 years or more of working experience. The acceptability of mHealth applications might be lower in populations with a higher average age or a lower educational level. Agarwal et al. (2015) recommend considering the age, level of education, and years of working experience when planning mHealth programmes that should be implemented by HCW. They also pointed out the importance of adequate training. Proper training, including refresher training or peer training by technology-advanced colleagues, are crucial for the acceptability and success of mHealth projects, particularly with community or lay health workers with diverse educational backgrounds (Feroz et al., 2020; Odendaal et al., 2020). Ideally, HCW should already be engaged in the development and implementation of mHealth applications—a participatory approach that was realized in the MEGA project.

A recent qualitative Cochrane review on the perceptions and experiences of HCW using mHealth technology in PHC found that HCW were well able to use treatment and screening algorithms on mobile devices and ready to integrate these into routine care (Odendaal et al., 2020). On the other hand, some HCW felt that they did not want to follow such algorithms blindly, while others felt overwhelmed by the information overload. Another concern was that using mobile technology during consultations could negatively influence the interaction with patients (Odendaal et al., 2020; Pokhrel et al., 2021). This was also an issue that was raised by our study participants. To meet these concerns, proper training is imperative, including practical training sessions and role-plays, to make HCW more familiar with the application and help them feel at ease when using technology in routine care.

Pokhrel et al. (2021) conducted a qualitative study among HCW in Nepal who worked with the WHO mhGAP Intervention Guide. The majority of HCWs had positive attitudes toward the application and showed high levels of interest and motivation. They concluded that mobile technology had the potential to reduce several barriers, such as provider workload, a lack of qualified personnel, geographical barriers, and barriers grounded in cultural beliefs and negative attitudes toward seeking treatment.

Regarding the reliability of mobile tools for the detection of mental disorders, a review by Naslund et al. (2017) identified four studies that showed strong support for an effective

assessment of common mental disorders with the help of web-based or mobile screening tools, even if these were used by non-specialized health workers. Two of the studies also evaluated feasibility and user satisfaction (health provider and patient), with promising outcomes (Malhotra et al., 2015; Tomita et al., 2016).

Limitations

When considering the results, some limitations of the study need to be outlined: First, primarily because it was impossible for HCW to be released for several training days due to their workload, the duration of the training was fairly short and focused only on aspects most essential to using the application. Second, the number of participants was relatively small. Third, this study focused on HCW and did not include the perspective of the adolescents screened for mental health problems. Fourth, although participants indicated that they would continue using the mobile app to identify mental health problems, the absence of data about the usage of the mobile app in practice is an added limitation, which needs to be addressed in further studies.

Recommendations

Further research including a larger number of participants may yield more representative findings. Moreover, future training programmes should consider a longer duration of training and include a variable on mobile app usage, especially the use of the app in everyday practice, and its effect on HCW´s ability to identify mental health difficulties among young patients in PHC. These results will be vital in the development of future training programmes which are responsive to the needs of PHC workers. Future research should also include patients' perspectives.

Moreover, the focus should be on how to implement and scale up such tools in LMIC settings (Baxter et al., 2021). It should be recognized that the training for and subsequent use of the app will require access to a smartphone or tablet (Botha & Booi, 2016). The application requires access to a web browser and mobile operating platform with 3G+internet access. It cannot be delivered through voice, text-based or USSD messaging. Sustainable funding for capital as well as ongoing utility costs (such as data bundles) is a limiting factor as indicated by the research participants themselves. A sustainable funding model, that is not donor-based, is yet to be developed for the large-scale roll-out of this mobile application tool and training program.

Lastly, it should also be noted that, although early detection and treatment of mental disorders in PHC can improve quality of life, reduce complications from co-occurring behavioral and medical health problems and save health care costs (Mulvaney-Day et al., 2018), there remains controversy about the usefulness of screening for mental health problems, particularly suicidality. One pitfall is the risk of false positives (Horowitz et al., 2009; Nielssen et al., 2017; Ross et al., 2016). This concern may even be exacerbated in a resource-constrained environment (Fine et al., 2012). Integrating screening for adolescent mental health problems, and in particular screening for risk of suicide, into a wider comprehensive evaluation of a young person´s mental health and social well-being can somewhat reduce the risk of false positives (Harris et al., 2019; Kessler et al., 2020). It is therefore crucial that the

provision of clear guidelines for mental health care referral is a focus of future training with HCW.

CONCLUSION

The study presents a first exploratory evaluation of the feasibility and acceptability of a mobile application for the detection of adolescent mental health problems by HCW in Zambia and South Africa. The acceptability of the MEGA application was high and it was considered easy to use and relevant to the target population. Results show that HCW were open to the use of mobile technology and were able to employ the application after a short training course. Further studies are needed to indicate whether the application will be routinely employed on a larger scale and whether the use of the MEGA app could improve mental health outcomes among the target population.

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ETHICAL STATEMENT

This study was conducted in line with the basic principles and codes of research ethics. Human dignity, confidentiality, justice, and beneficence were closely esteemed at all stages in accordance with research ethics legislation (American Psychological Association, Citation2017; International Council of Nurses, Citation2012; Polit & Beck, Citation2018; World Medical Association, Citation2013). The MEGA project partner universities received all necessary permits for the study from their respective university ethics committees and the National Health Research Authorities of the study regions in South Africa and Zambia between June 2018 and April 2019. The partner institutions signed a data-sharing agreement and ensured continuous monitoring of data and the safety of all study participants. Quantitative data collected at each location were manually transferred to Turku University of Applied Sciences (TUAS) in Finland for safe storage in accordance with the instructions in the TUAS archive protocol.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

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