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Article

Best Digital Practices in Mental Health: Design and Implementation of a Tailored Mobile Application for Vulnerable Populations in the European Union

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Abstract: This paper outlines the ongoing development of a specialised mobile application to address the mental health needs of vulnerable populations in the European Union (EU). Conducted as a mixed-methods research within two EU Science and Technology Cooperation Actions, the study prioritises stakeholder feedback to identify features for initial testing and strategies to improve application uptake, using critical digital health analysis. With a focus on marginalised groups such as refugees, migrants and socio-economically disadvantaged individuals, the application aims to provide an accessible and culturally sensitive platform for mental health support, integrating evidence-based interventions such as cognitive behavioural techniques and mindfulness exercises. Key features include multilingual support, habit tracking, personalised recommendations for support and services, and real-time crisis intervention. Collaboration with stakeholders and ongoing rigorous usability testing are driving the refinement process to ensure usability, acceptability and effectiveness, underscoring the importance of user engagement in technology-based mental health interventions in the EU context and highlighting the importance of collaborative science and technology for societal benefit.

Keywords: critical digital health; vulnerable populations; expert systems; artificial intelligence; ehealth data; mobile application; action-research; mental health

1. Introduction

In recent years, the integration of technology into mental health services has offered unprecedented opportunities to address long-standing accessibility issues and provide scalable solutions tailored to diverse populations. However, the European Union (EU) faces unique challenges in delivering mental health support to its most vulnerable citizens, including refugees, migrants, and socioeconomically disadvantaged individuals. These groups often encounter significant barriers in accessing conventional health services due to language differences, cultural stigmatisation, and economic constraints. The conventional mental health care infrastructure may not be adequately equipped or sufficiently responsive to the specific needs and circumstances of these marginalised populations.

The necessity for a specialised mobile application arises from the critical gaps in mental health service provision (Firth et al., 2017). Digital health interventions (DHIs) present a transformative opportunity to enhance mental health outcomes, particularly for populations that are difficult to reach with traditional methods (Luxton, 2018). Through the innovative use of technology, DHIs can offer a range of benefits that directly address the core challenges faced by vulnerable groups (Rudd and Rinad, 2020). One of the primary advantages of digital interventions is their ability to provide scalable solutions that are both cost-effective and wide-reaching. In contrast to traditional mental health services, which often require substantial resources and can only serve limited geographical areas, digital applications can be disseminated widely with minimal additional cost per user (Schmidt and Wykes, 2012). This scalability ensures that even individuals in remote or underserved areas can access crucial mental health resources (Gallardo et al., 2021). Digital platforms possess inherent

flexibility, enabling the support of multilingual content and culturally tailored interventions, which are critical in serving diverse populations across the EU. This customisation enhances the accessibility of mental health services, increases the relevance and effectiveness of the interventions, and improves user engagement and outcomes.

Digital tools facilitate continuous data collection and real-time feedback mechanisms, which enable both users and providers to monitor progress and adjust treatments as needed (García-Lizana and Munoz-Mayorga, 2010). This fosters a more responsive and dynamic approach to mental health care. For instance, habit tracking capabilities and real-time crisis intervention can provide immediate support in moments of need and contribute to long-term behavioural change and resilience building (Hollis et al., 2017). Despite these significant advantages, the deployment of digital mental health applications is not without challenges and risks (Burr et al., 2020). The protection of user data is of paramount importance, given the sensitivity of mental health data. The prevention of breaches and unauthorised access is essential to maintaining trust and integrity within digital health services.

The potential for digital interventions to exacerbate health disparities is a significant concern (Lupton, 2021). This is particularly relevant in the context of universal accessibility. For instance, individuals without reliable internet access or those lacking digital literacy may find it challenging to benefit from online health resources. This could inadvertently widen the gap between different social groups rather than narrowing it. The effectiveness of digital interventions often depends heavily on user engagement, which can be inconsistent. The design of an application that is engaging over time and effectively motivates users to maintain usage and adhere to treatment protocols requires a deep understanding of user behaviour and sophisticated design strategies.

Ensuring clinical efficacy is a significant challenge. Digital health applications must be rigorously tested and validated to ensure they meet high standards of care and effectiveness. This involves extensive usability testing and ongoing refinement based on user feedback and clinical outcomes, a process that can be resource-intensive and complex. While digital mental health applications offer significant opportunities to improve mental health service provision, particularly for vulnerable populations, they also present a set of unique challenges and risks that must be carefully managed. The ongoing project employs critical digital health analysis and a robust development framework with the objective of maximizing the benefits while effectively mitigating the risks associated with digital interventions (Shore and Mishkind, 2020).

2. Methods and Materials

This study employed a comprehensive mixed methods approach, integrating both qualitative and quantitative research methodologies, with the objective of informing the development of a mobile application designed to address mental health needs in vulnerable populations. The selected methods were intended to provide a robust understanding of the technological, clinical, and social factors influencing the design and implementation of digital health interventions.

A key component of our methodology was the execution of two short-term scientific missions conducted under the auspices of the EU COST Actions. These missions, which formed part of COST Action CA19117 "Researcher Mental Health" and COST Action CA19133 "Fostering and Strengthening Approaches to Reducing Coercion in European Mental Health Services," enabled the collection of unique data and insights that significantly shaped the development process (Saraceno, 2023; Kismihók et al., 2021). During these missions, fieldwork was conducted in various European settings, allowing for an immersive understanding of the current mental health care frameworks and the specific challenges faced by the target populations. This hands-on exploration was vital in assessing the practicality of integrating advanced digital tools within existing health care systems, ensuring that the proposed solutions were not only innovative but also adaptable and aligned with user needs across different cultural and institutional contexts. By situating our research within these EU COST Actions, we were able to leverage a collaborative network of experts and resources, enhancing the scope and impact of our findings. This strategic alignment also facilitated a deeper engagement with key stakeholders, encompassing health professionals, policymakers, and the communities served, thereby enriching our research with diverse perspectives and expertise.

A significant component of the qualitative research was the fieldwork conducted in Trieste, Italy. This city is renowned for its biopsychosocial model of mental health care, which the World Health Organization (WHO) recognizes as a world standard for community psychiatry (Mezzina, 2014; Birnbaum et al, 2018). The fieldwork involved observational studies and informal interviews with healthcare providers and patients within the community mental health facilities. The aim was to understand the practical applications of Trieste's model, particularly how community-based approaches can be integrated into digital platforms to enhance accessibility and effectiveness of mental health care. The insights gained were instrumental in informing the design of the application, which supports community engagement and decentralised care delivery.

The research conducted in Trieste provided profound insights into the intricacies of community-based mental health care. Observations revealed a highly integrated network of care providers, patients, and community resources working collaboratively to support individuals with mental health challenges. This collaborative model highlighted the importance of social support systems and the potential for digital tools to facilitate similar networks. A detailed examination of the biopsychosocial model employed in Trieste demonstrated how mental health care extends beyond medical treatment to include social and psychological support, which are critical for effective mental health management. For instance, mental health professionals in Trieste regularly engage with patients in their living environments, which helps tailor interventions to individual needs and ensures that care is continuous and contextually relevant.

The fieldwork also shed light on the potential of technology to enhance these interactions. For instance, the application of predictive analytics within the community setting could potentially forecast the need for interventions before crises occur, thereby enhancing the preventative aspects of mental health care. Similarly, the utilisation of monitoring technologies could support the continuous engagement of patients with their care routines, enhancing adherence to treatment plans outside of traditional clinical settings (Mohr et al., 2017). The implementation of decision support systems in Trieste was observed to assist clinicians in making informed treatment decisions. These systems integrate comprehensive patient data and provide evidence-based recommendations, which streamline the diagnostic and treatment processes, ensuring that patients receive the most appropriate care promptly.

In order to gain a comprehensive understanding of the technical challenges and opportunities associated with developing mental health applications, a series of structured interviews were conducted with experts in software engineering and the implementation of digital health technologies. These interviews included both academic researchers and practitioners in the field of digital health. The goal was to capture a broad spectrum of perspectives on the technical aspects of mental health applications. Topics discussed included data security, user interface design, algorithmic bias, and the scalability of digital health solutions. The qualitative data gathered was of great importance in outlining the technical specifications for the mobile application, ensuring that it could be effectively implemented within diverse healthcare settings.

The analysis of the interviews provided critical insights into expert opinions on the risks and benefits of expert systems in mental healthcare (Bennett and Duob, 2016). Experts noted several advantages of expert systems, including improved diagnostic accuracy, personalised treatment recommendations, and enhanced patient engagement. Nevertheless, alongside the benefits, experts expressed concerns over ethical issues such as patient privacy, algorithmic bias, and the potential impacts on the patient-clinician relationship (Martinez-Martin, 2022). Recommendations for future development were centred on enhancing transparency, fostering interdisciplinary collaborations, and prioritising patient-centred design principles.

The study employed an action-research approach throughout, with iterative cycles of testing, feedback, and refinement of hypothesis and proposals. Throughout the development process, prototypes of the mobile application were evaluated by both potential end-users and mental health professionals. This ongoing interaction helped to ensure that the application designs and actions were not only user-friendly and met the actual needs of its target audience, but also captured the needs of the community. Regular feedback sessions were conducted, allowing the research team to implement

incremental improvements to the application's design and functionality. This approach not only facilitated a user-centred design process, but also fostered a sense of ownership and acceptance among the community that the application aims to serve.

The integration of fieldwork findings and expert interviews provided a comprehensive understanding of the current landscape of expert systems in mental healthcare. These insights identify significant opportunities for innovation and highlight challenges that must be addressed to fully realise the potential of AI in improving mental health outcomes. This methodological framework supports the study's goal of developing an accessible, effective, and user-centred digital health solution (Philippe et al, 2022).

3. Results

The mixed methods study yielded a comprehensive understanding of the design and implementation of a mobile application tailored for mental health support, particularly for vulnerable populations within the European Union. These insights were derived from the integration of fieldwork findings, expert interviews, and feedback from iterative action-research cycles.

3.1. Fieldwork Findings from Trieste

The fieldwork conducted in Trieste provided a deep dive into the biopsychosocial model of mental health care, known for its effectiveness in community psychiatry. Key findings included

Community engagement: Observations highlighted the critical role of strong community ties and regular interactions among community members in enhancing the effectiveness of mental health interventions. Inspired by these observations, the design of the application included features to facilitate community building and peer support.

Decentralised care: The Trieste model emphasised decentralised and accessible care, which informed the application's approach to service delivery. This model allows users to access mental health resources anytime, anywhere, reducing barriers to entry.

Holistic approach: Trieste's approach integrates psychological, social and biological aspects of mental health care to ensure a comprehensive treatment strategy. This holistic view has influenced the development of the app, ensuring that it addresses multiple facets of mental wellbeing.

Prevention: The fieldwork revealed a strong focus on prevention in Trieste's mental health care model. This includes early intervention programmes that aim to identify and address mental health problems before they develop into more serious conditions. The application also integrates preventive features such as mood tracking and early warning signs of mental distress.

Empowerment and autonomy: The Trieste model empowers patients by involving them in the decision-making process regarding their treatment plans. This empowerment is reflected in the application's features, which allow users to customise their mental health care routines and choose interventions that best suit their needs.

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Interdisciplinary collaboration: The success of the Trieste model is partly due to the collaboration between healthcare providers from different disciplines, including psychiatrists, social workers and community volunteers. The application embraces this interdisciplinary approach by providing a platform where users can access different types of support, ranging from medical advice to community-based help.

Continuity of care: The Trieste system provides a continuum of care from acute treatment to long-term rehabilitation services. This continuity is critical for effective mental health treatment and has inspired similar features in the app, ensuring that users receive ongoing support throughout their mental health journey.

3.2. Insights from Expert Interviews

Interviews with experts in the field provided valuable technical and ethical considerations that have significantly influenced the development of the application:

Data security and privacy: Experts emphasised the importance of robust privacy mechanisms, leading to the implementation of advanced encryption methods and secure data storage solutions within the application. This focus ensures the protection of sensitive user information, a cornerstone in building trust with the application's users.

User-centric design: The need for intuitive user interfaces that cater to diverse user groups was highlighted. Insights from these discussions guided iterative design enhancements to improve usability and accessibility, making the application suitable for people with varying levels of technological sophistication.

Integration with existing health systems: Experts emphasised the importance of ensuring that new digital health tools integrate seamlessly with existing health systems. This integration facilitates the sharing and analysis of data across platforms, improving the continuity and comprehensiveness of care.

Scalability and performance optimisation: The ability to scale the application to handle a growing number of users without compromising performance was identified as critical. Experts provided strategies for optimising application performance and scalability, ensuring that the application could efficiently handle increased loads as the user base grew.

Algorithm transparency: Concerns were raised about the transparency of the algorithms used within the application. Experts advised on implementing mechanisms to make the decision-making processes of AI systems understandable to users and regulators, which is essential for maintaining accountability and trust.

Ethical use of AI: Discussions also covered the ethical implications of AI in healthcare, particularly the potential for bias in algorithmic decision making. Experts recommended the inclusion of diverse datasets during the training phases of AI models, and ongoing monitoring for bias to ensure fair and equitable treatment recommendations.

Regulatory compliance: Given the stringent regulatory environment surrounding digital health applications, experts highlighted the need for compliance with health regulations and data protection laws, such as GDPR. Advice was provided on navigating these regulations, which is critical in the development phase to ensure regulatory compliance and user safety.

Ongoing user education: Experts noted that educating users on how to use the application effectively is essential to maximising its benefits. They suggested incorporating educational materials and tutorials into the application to increase user engagement and correct usage.

Fieldwork in Trieste and feedback from action research cycles complemented the technical findings, focusing on community engagement, decentralised care and the need for cultural sensitivity. These components were integral to the design of a user-friendly and culturally competent application. Insights from expert interviews were instrumental in addressing the complex technical, ethical and regulatory challenges associated with developing a mental health application. Each piece of expert advice has been carefully integrated to ensure that the application is not only effective and user-friendly, but also adheres to the highest standards of data security, ethical use of AI, and

regulatory compliance. This holistic approach to application development is expected to significantly improve the quality and effectiveness of mental health support provided to vulnerable populations.

4. Discussion

The integration of digital technologies into mental health care represents a transformative change in the way services are delivered to marginalised and vulnerable populations. This mixed-methods study has highlighted the complex interplay between technological advances and the socio-structural factors that influence the acceptability and adoption of DHIs. By applying social science approaches, knowledge and methods, this research has critically examined both the potential and challenges of implementing DHIs in diverse communities (Torous et al., 2014).

The social sciences provide a critical framework for analysing how different factors, including cultural norms, social identities and structural inequalities (Andrade et al., 2014), influence the effectiveness of digital interventions. Through the lens of medical anthropology and sociology, this study explored how DHIs are perceived and used by people from different backgrounds, including those marginalised by gender, disability, sexuality and socio-economic conditions. These insights are crucial for designing interventions that are not only technologically sound, but also socially relevant and sensitive to the needs of diverse user groups.

One of the key findings of this research is the significant role of acceptability and appropriateness in the success of DHIs. Acceptability refers to the degree to which people consider the use of a technology to be appropriate, based on anticipated or experienced cognitive and emotional responses to the technology. Appropriateness, on the other hand, refers to the perceived suitability, relevance or compatibility of the intervention for a particular problem, context or population. The study found that when digital tools are designed without inclusive engagement strategies, they risk alienating potential users, particularly those from marginalised groups who may feel that their specific needs and contexts are not adequately addressed.

Socio-structural factors such as socio-economic status, access to technology and literacy levels have a significant impact on the adoption of digital health interventions. For example, marginalised communities often face higher rates of digital exclusion due to limited access to the necessary technology or internet connectivity. In addition, cultural perceptions of mental health and the stigma associated with seeking help can also affect engagement with digital interventions. The study's fieldwork in Trieste provided practical insights into these dynamics, demonstrating that community-based approaches can help bridge these gaps by fostering a sense of ownership and relevance of health technologies in community settings.

This research has particularly highlighted the challenges and opportunities in addressing the mental health needs of minority and marginalised populations. Gender, disability and sexuality often intersect with social disadvantage, complicating access to and effectiveness of mental health interventions. Digital solutions offer a unique opportunity to overcome some of these barriers by providing discreet, personalised and accessible resources. However, for these tools to be truly effective, they must be developed in consultation with the communities they aim to serve, to ensure that interventions are not only accessible, but also resonate with the cultural and social contexts of the users.

Based on the findings, it is recommended that future development of DHIs should prioritise inclusive design and stakeholder engagement to increase the acceptability and adoption of technologies. This includes ongoing engagement with potential users from diverse backgrounds throughout the development process, from initial design to final implementation and evaluation. In addition, there should be ongoing assessment of the socio-structural barriers that may impede access to and the effectiveness of these interventions.

5. Conclusions

This study demonstrates the value of integrating social science methods into the evaluation of digital health technologies, particularly for understanding the nuanced ways in which different populations may engage with these tools. The findings highlight the need for a nuanced approach

that takes into account the different socio-economic and cultural contexts in which these technologies are used. In this way, digital interventions can be more effectively tailored to meet the diverse needs of those they are intended to serve, particularly marginalised and disadvantaged groups. It highlights the critical role of social science methods in evaluating and improving the implementation of digital health interventions, particularly for marginalised and vulnerable populations. It illustrates that to be effective, digital mental health technologies must go beyond technical capabilities to address the complex social, cultural and structural factors that influence access to and effectiveness of mental health care. And it emphasises that the success of these interventions largely depends on their acceptability and appropriateness from the perspective of potential users. This includes taking into account the intersectionality of gender, disability, sexual orientation and socio-economic background. Mental health technologies that do not take these dimensions into account may not only be under-utilised, but may also exacerbate existing inequalities by providing solutions that are misaligned with the needs of those they are intended to support.

The integration of community-based insights, as evidenced in the Trieste fieldwork, highlights the potential for these technologies to facilitate a more connected and responsive mental health care environment. By embedding the principles of decentralised and community-based care into digital platforms, we can potentially transform the landscape of mental health services to be more inclusive and supportive. As we move forward, it is imperative that digital mental health developers and stakeholders continue to engage with and incorporate the findings of social science research. Ongoing collaboration with communities, continuous feedback mechanisms and adaptive designs are essential to refining and improving DHIs. This approach not only ensures that digital solutions are grounded in the real experiences and needs of users, but also promotes a more equitable distribution of health resources.

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