

# A Call for Responsible Innovation in Mobile Mental Health: Content Analysis of the Depression App Marketplace

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**Abstract.** Mobile mental health presents many ethical challenges in the wild. These ethical issues were explored through a content analysis of the depression app marketplace. App search in Google Play Store (UK) and Apple App Store (UK) found 353 unique apps for depression. Analysis uncovered a range of ethical issues and highlighted the limited presence of ethical values. Our findings suggest a need for designers to adopt a responsible innovation approach to creating mental health technologies that meet these ethical demands.

**Keywords.** mobile mental health, ethics, responsible innovation, content analysis

## 1. Introduction

There has been increased discussion of the ethics of mobile mental health [1-5] with authors highlighting issues in areas of privacy and data security; risks and safety; benefits and evidence; and transparency and trust. Content analyses of apps for depression report insufficient evidence of app use and outcomes [1,2,6,7], poor fidelity to evidence-based interventions [1,8], limited disclaimers and integration of real-world care [2,7,9,10], inadequate reporting of expert involvement [8], and insufficient privacy policies [9]. Few authors have framed these discussions within existing ethical frameworks, such as biomedical ethics [5] and the principles of the American Psychological Association [3,4].

Principlism [11] and professional ethical codes [12-14] provide structure for reflection on ethical practice and issues which are highly relevant to mobile mental health. Our research builds on previous content analyses to explore the ethics of mobile mental health, with a focus on apps for depression. Guided by principlism, professional ethics, and the literature on the ethics of mobile mental health, we conducted a content analysis of app store listings of apps for depression to determine: (1) *What ethical issues are evident in the depression app marketplace?* and (2) *How do these issues reflect ethical values in app design, development, and marketing?* This study extends our previous evaluation of depression app store treatment descriptions [1] by providing an ethical review of depression app store listings with the aim of framing findings within existing ethical frameworks and developing guidance for increased ethical practice

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## 2. Methods

App search and data collection was conducted between October to November 2018. Detailed methods were outlined in our companion paper [1] and will not be repeated in full. Search was performed in the two main UK app stores—Google Play and Apple App Store—using the terms “depression” and “mental health”. Apps for depression were defined as those with app store listings mentioning depression or depressive symptoms. Search returned 353 unique apps for depression (see [1] for sampling flowchart).

Data extraction and coding were done iteratively within the research team using a list of variables compiled prior to review and developed throughout as ethical issues emerged (see [1] for coding and list of eligible apps). This was guided by established ethical principles [11] and professional codes of conduct in disciplines relevant to mobile mental health [12-14]. Descriptive statistics were computed using SPSS version 25.

## 3. Results

Analysis found several ethical issues summarised herein under related ethical principles.

### 3.1 *Beneficence*

Beneficence relates to doing good or benefiting others. App store descriptions widely touted the suitability and benefits of apps for depression. Yet, there was a notable lack of evidence to support these claims, with most apps (89.0%, 314/353) lacking research evidence of app use, efficacy, risks, or outcomes. This is an especial concern given our previous findings questioning the treatment validity and fidelity of many apps. As reported in [1], none of the apps reviewed fully aligned with clinical guidelines, with app descriptions conveying limited use of evidence-based approaches.

### 3.2 *Nonmaleficence*

Nonmaleficence relates to doing no harm. In addition to limited evidence of outcomes and potential adverse effects, there were noted issues in areas of safety. Most app descriptions (80.7%, 285/353) did not provide disclaimers of use or limitations, with some even stating inaccurate information (4.3%, 15/352) or unsafe claims (2.3%, 8/352). Moreover, app listings offered limited provisions for vulnerable groups such as children and young people. Most app store age ratings of apps for depression were rated as appropriate for children and young people; 92.8% (233/251) of apps in Google Play were assigned an age rating of PEGI3 (suitable for all ages) while the most assigned age rating in Apple App Store was 4+ (43.5%, 60/138) followed by 12+ (37.0%, 51/138).

### 3.3 *Responsibility*

Responsibility refers to one’s duty or obligation to perform in a certain manner. For our review, it included ensuring the competence of the development team; providing evidence of intervention validity and safety; safeguarding and duty of care; and compliance with regulations. Overall, there was inadequate reporting of the involvement of multisector stakeholders and experts in app design and development. As many as 57.8% (204/353) of apps appeared to be developed by private entities without mention of the involvement of healthcare or other stakeholders. There was also a poverty of apps reporting certification by regulatory bodies, with only five (1.4%) stating some form of certification such as a CE mark for a medical device. There was no standardised reporting of certification in app stores, adding to the difficulty in locating this information.

### 3.4 Integrity

Integrity describes being honest, moral, and accountable. It includes transparency and accuracy of information communicated to the public. A pervasive finding was the lack of thorough and accurate information provided in app listings regarding fundamental aspects of apps, such as treatment information, evidence, risks and safety, developer information, and app costs and sources of funding. While developer contact information was provided for 91.2% (322/353) of apps, a third (31/94) of apps in Apple App Store failed to provide any contact information. Information on sources of funding was also not found for 84.4% (298/353) of apps, with only four apps declaring that they had received no external funding. This not only highlights issues with transparency with respect to app business models, but also raises questions of possible conflicts of interest that can pose potential risks to user rights.

### 3.5 Autonomy

Autonomy relates to self-determination and the right to make informed decisions without deception. Without accurate and transparent information, potential users are unable to make informed choices regarding the selection and use of apps. This applies to all aspects of apps, with the poverty of information in areas of treatment, evidence, developer information, and business models all negatively impacting users' informed consent. This was further seen with issues of privacy and confidentiality. In total, 74.2% (262/353) of app listings provided a privacy policy, yet only 41 (11.6%) apps made explicit mention of privacy policies in app store descriptions. Google Play listed information on app permissions for all apps (n=259), but this was not provided in Apple App Store. Overall, only three (0.9%) apps explained the reason for permissions in their app store description, allowing users to make informed considerations about permissions prior to download.

### 3.6 Justice

Justice describes being fair and reasonable. It includes issues related to equality and access to care, which in the case of mobile mental health may be impacted by initial and future costs. Although most apps were advertised as free to download (94.3%, 333/353), 60.3% (213/353) were free with in-app advertising, purchases, or subscriptions. Yet, these costs were often not outlined in app descriptions, limiting users' capacity to make informed decisions about treatment costs and their ability to access continuous care.

## 4. Discussion

This study demonstrates several ethical issues in app stores and listings of apps for depression. These issues have been presented under the ethical principles of beneficence, nonmaleficence, responsibility, integrity, autonomy, and justice. By using principlism as a guide [11], our review captures not only the ethical shortcomings of depression apps, but their interrelations and complexities. Singular examples of ethical issues, such as a lack of evidence, often reflect multiple ethical concerns, in this case related to questions of benefits and harms, lack of transparency of treatment information, and insufficient information for users to make informed choices. There is therefore value in the application of principlism in helping to frame these ethical issues and their wider impact.

While our review highlighted a range of issues, we can infer ethical priorities in the design of apps for depression based on the reduced incidences of some issues as well as progress made since previously reported findings. This is most apparent in the case of privacy practices, with our study finding a higher frequency of the provision of privacy policies than previously reported [9]. Similarly, while apps continue to fall short in their use of evidence-based interventions, our findings demonstrate an attempt by many to develop evidence-informed apps [1]. App developers appear to prioritise these areas and the associated values of privacy and validity relative to other aspects of app design and development. Despite calls for increased evidence [3,4], apps for depression continue to be significantly under researched. Additional safety concerns persist with the continued

underuse of disclaimers [7] and inadequate guidance and provisions for use by vulnerable populations [2]. This raises concerns of the undervaluing of safety and welfare, risk minimisation, and duty of care. The insufficiency of information throughout also highlights undervaluing of transparency, credibility, and informed consent.

Our review demonstrates the complexity of mobile mental health and the difficulty developers may have in navigating ethical issues and value conflicts. Developers may feel the need to prioritise some values over others, e.g., by prioritising app production over evidence-based development or prioritising universal access over safeguarding. To assist in navigating these ethical complexities, we encourage responsible innovation [15] and value sensitive design [16] in mobile mental health. Responsible innovation is “a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability, and social desirability of the innovation process and its marketable products” [15 p.39]. We believe by applying the four dimensions of responsible innovation—anticipation, reflexivity, inclusive deliberation, and responsiveness—developers would better anticipate and respond to ethical issues and conflicts (Figure 1).

Anticipation	Reflexivity	Inclusive deliberation	Responsiveness
Consideration of potential risks and impacts on users and wider society	Reflecting on the purpose, motivation, and potential impacts of app	Engaging with stakeholders to deliberate all aspects of app, values, and impact	Adapting and responding to reflections and deliberations throughout
Performed at conceptualisation and throughout app lifespan	Consideration of knowns and unknowns, values, assumptions, and conflicts	User and stakeholder involvement from conceptualisation and throughout	"An iterative, inclusive, and open process of adaptive learning" [15, p.38] with feedback into the process

Figure 1. Four dimensions of responsible innovation applied to mobile mental health

A strength of this approach is the emphasis on responsiveness which encourages iterative reflection, inclusion, and adaptation throughout the design and innovation process for the app lifespan. As developers will not be able to fully anticipate all outcomes or risks of apps at design stage, it is crucial through continuous reflection and stakeholder engagement to envisage and amend the long-term impact of apps.

Responsible innovation also encourages developers to use ethical or moral conflicts (e.g., access vs safeguarding) to propel innovation to meet both moral obligations [17]. In such a manner, developers may consider how to design and develop apps that assess users’ capacity to make informed choices regarding their treatment, rather than limiting access to all potentially vulnerable groups or providing open access without safeguarding measures. We encourage developers to reflect on value conflicts and ethical issues and to work with stakeholders to utilise technology to design new ways of overcoming ethical challenges and improving ethical practice.

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