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# Going beyond killer apps: building a better mHealth evidence base

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mHealth relates to the provision of health-related services via a mobile device. It comprises multidimensional elements including provider, patient and administrative applications. Applications include consumer education and behaviour change, wearable sensors and point-of-care diagnostics, disease and population registries, electronic health records, decision support, provider tools (communication, workflow management, professional education) and healthcare management (human resources, financial monitoring, supply chain logistics).<sup>1</sup>

Although mHealth has potential to strengthen health systems worldwide, the evidence base is immature, and consequently, the opportunities to advance knowledge remain limited.<sup>2-3</sup> Mobile devices and apps have become essential tools for disruptive change in many industries, but thus far, this has not happened in healthcare. Here, we discuss five interrelated reasons as to why mHealth has underdelivered and highlight challenges and opportunities for mHealth researchers.

## THE MYTH OF THE 'KILLER APP'

Disruptors often rely on a 'killer app'—a highly popular application that users will consider indispensable for their needs. At last count, there were nearly 260 000 health apps on the market,<sup>4</sup> but most downloads are never opened and consistent use is extremely rare. Further, these apps are often disease siloed, focus mainly on behaviour change, gloss over privacy issues and are not integrated into any overarching healthcare structure. Such apps struggle to achieve large-scale adoption because of their failure to address the needs of diverse stakeholders.<sup>5</sup> Most apps are consumer facing, whereas healthcare systems tend to be provider facing. This important distinction may explain why the 'killer app' approach is not the correct mindset. The diversity of users and the inability to address their varied problems results in user fickleness and ready abandonment of new technologies.

When tools are not connected to systems and human support, they are unlikely to be effective. Consequently, moving beyond a single solution focus towards a 'health ecosystem' approach is needed.<sup>6</sup>

## NEGLECTING USER PERSPECTIVES AND PREFERENCES

Related to the killer app mythology is the tendency to overengineer solutions before having an opportunity to fully understand user needs, contextual factors and the size and specifics of the problem that needs addressing. The Greentree consensus outlines nine principles for digital development, emphasising frequent and in-depth user engagement in all phases of the development process.<sup>7</sup> It stresses the importance of understanding the ecosystem, designing for scale and sustainability, addressing privacy, using open standards and taking a data-driven approach. It also emphasises the need for multidisciplinary collaborations. Although researchers are often the subject matter experts, non-health specialists such as human factors engineers, human computer interaction specialists, anthropologists and ethicists can provide strong methodological frameworks for understanding user perspectives at all stages of the development, implementation, evaluation cycle.<sup>8</sup> By not taking a user-centred approach, we risk overengineering solutions. The most promising use of mHealth to date has not been smartphone apps, but basic functions such as short messaging service or voice calls to address specific issues such as medication adherence and promoting smoking cessation.<sup>9-10</sup>

## APPS ARE NOT PILLS

Researchers tend to lack a good understanding of how developers operate. Two commonly used industry standards include Waterfall and Agile development.<sup>11</sup> Waterfall is a stepwise process whereby developers iteratively revise their software at each stage of



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the product development cycle based on target audience feedback. It may be particularly appropriate for large-scale system development. Agile design takes an incremental rather than sequential approach. Initial prototypes are usually simple and each development effort is completed in short sprint cycles with increasing maturity at each cycle. It is particularly useful when there is not a clear idea what might work. Whichever approach is used, initial deployments are unlikely to work perfectly. The interim goal should be a 'good enough' prototype, known in industry as the minimum viable product.

These approaches highlight differing developer and researcher perspectives. The developer's outlook is plastic, continually updating and refining a product to create novel solutions and stay ahead of the competition. By contrast, a researcher's outlook is more static where interventions are viewed as pills—specific agents that are developed and tested in isolation of other factors. These differences in perspective are often disregarded. Understanding the developer's approach can help research teams to get apps in front of users quickly, fail early and build from the lessons learnt. This approach can also avoid expensive 'scope creep' later in the development cycle when the app is more mature and user testing reveals a major redesign is needed.

#### RIGID APPROACHES TO EVALUATE EVOLVING TECHNOLOGIES

While we strongly support the need for evaluations with randomised controlled trials (RCTs), there are several considerations in applying this design in mHealth. First, traditional RCT designs reflect 'the static view' described above—assuming an intervention is 'fixed' and external factors are standardised or adjusted for to avoid introducing a bias. This is anathema to software development where iteration, bug fixes and new releases as user experience grows are the norm—'the perpetual beta'. The key consideration here is that we test *principles* rather than fixed *apps*.<sup>12</sup> The app market is constantly evolving but principles remain relatively constant and generate generalisable knowledge of public health interest. Second, RCTs are good at testing efficacy but are not so good at answering questions related to the implementation strategy.<sup>13</sup> Incorporation of theory-informed frameworks for understanding factors associated with adoption and non-adoption are therefore essential to evaluate programmes and generate knowledge that can be applied to other settings.<sup>14</sup> A third and unexplored area is post-marketing surveillance mechanisms to safeguard against unintended consequences derived from mHealth-related activities.<sup>15</sup>

#### WHAT ARE THE PRIORITIES OF THOSE WHO PAY FOR MHEALTH TECHNOLOGIES?

Public and commercial payers of health services play a central role in determining whether mHealth can be adopted at scale. Innovation in the business model is just as important as the apps themselves in promoting

disruption. Greater attention to business model specifics may stimulate different research questions. From a researcher's perspective, the priority is to demonstrate clinical effectiveness. This contrasts with the payer's perspective which is broader and includes factors such as reduced administrative burden, improved workflows, greater patient and provider engagement and improved quality of care and outcomes at lower costs.<sup>16</sup> The macro-economic environment is also key to driving particular business models. While profits may be greater in high-income countries, the largest mHealth market in terms of user numbers will be in emerging economies. Just as the pharmaceutical industry tends to be segmented into low volume, high margin products for rich countries and high volume, cheaper products for poorer countries, mHealth markets are likely to evolve differently depending on the payer, provider and consumer environment. It is therefore important that the research community generate evidence on effective business models as much as effective apps.

#### CONCLUSION

Although some may be disillusioned by the lack of 'blockbuster' mHealth trials, we are optimistic that the evidence base for mHealth will grow substantially in coming years. Particular challenges remain, especially in low-income and middle-income country settings where literacy, health literacy, unavailability of smartphones and limited access to reliable data connectivity all pose adoption challenges. However, these factors are improving rapidly, and the opportunities for future growth are substantial. With increasing knowledge of what works and what the challenges are, we will arrive at a more nuanced understanding of the role of mHealth in improving health and healthcare.

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