



# Incorporating guidelines for use of mobile technologies in health research and practice

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This commentary aims to create initial recommendations to guide researchers' decisions on the development and use of mobile technologies for public health research. We recommend that mobile technologies for public health research should be scalable and sustainable; draw on social, psychological and/or behavioral theoretical models; be able to be integrated with multiple communication devices; incorporate social network and/or geographic metrics and take a community-based participatory approach to development and implementation. All of these approaches are discussed.

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Development of mobile technologies and online social networking sites (e.g. Facebook) has created opportunities for researchers to use these technologies in public health research.<sup>1–4</sup> Scientific, health and engineering standards should inform decision-makers on how and when researchers use mobile technologies for health research and practice, yet few of these guidelines exist.<sup>5</sup> This commentary aims to create initial recommendations to guide researchers' decisions on development and use of mobile technologies for public health research.

## Scalable and sustainable

Researchers wanting to integrate mobile technologies into public health efforts have numerous technology choices. As capital is limited, focus should be placed on identifying scalable and sustainable technologies. Scalable technologies are typically built on and utilize 'platforms,' such as websites, tablets or phone applications with reusable components. For example, if multiple functions are needed for a mobile health smartphone-based intervention (e.g. a social networking/communication and geo-spatial tracking technology), one can either create each of these components or search for pre-existing and publicly-available technology equivalents. 'Open-source' technologies are platforms that can enable developers to freely build upon each other's efforts, minimizing redundant application development.<sup>6</sup> However, many current mHealth applications do not allow data to be shared with other technologies. We recommend that public health researchers seek to adopt scalable platform technologies to save resources and development time, while increasing longevity and utility of the technology.

It is equally important that researchers choose to use technologies that are sustainable, or will maintain user participation and engagement. Although mobile technologies often receive tremendous acclaim upon initial release, many fail to gain a sustainable user base and become obsolete. For example, choosing a technology because it is currently making news headlines and therefore thought to be popular is not an approach that facilitates sustainability. No current data exist on whether to and how to categorize a technology as sustainable, especially as the definition of sustainability in research studies might be different from how sustainability is defined in other settings. This is an important issue that needs to be addressed given that large investments are often made in technologies and it is important to be able to predict whether they will exist in the future. Until quantitative information is available to measure and assess whether a technology will be sustainable, researchers should enlist help from those familiar with mobile technology product development to increase likelihood that the technology is sustainable. Collaborations between researchers, user-experience professionals, technologists and users themselves are essential for effective technology development, adoption and engagement.

## Grounded in social, psychological and/or behavioral theoretical models

After the decision has been made regarding choosing an appropriate technology, researchers need to consider their approach in designing the intervention. Behavior change is a fundamental component of any (offline or online) approach seeking to improve

health outcomes through mobile technologies. Specific to mHealth, behavior change is needed at multiple levels in a cycle: 1. technology adoption, or willingness to use the technology; 2. engagement, or interest in continuing to use the technology; 3. health-related behavior change, or willingness to modify offline behavior based on relevant health-related information; 4. health behavior maintenance, or behavior sustainment. Human factors related to the design and use of mobile health technologies, such as user experience, visual and interface design, usability and game mechanics affect behavior. Theoretical approaches, including social, psychological and behavioral theories, can be used to increase likelihood of health behavior change. Little research has explored how these principles can help to inform mobile health design and this research will be extremely important in the future.

Numerous behavioral theories can be applied to the different levels in the cycle outlined above, and these theories need to be tailored to the technology and population. For example, Young et al. created an HIV prevention mobile intervention using a social networking platform to engage users to become educated and communicate about sexual health, and to request an HIV test.<sup>4</sup> The intervention, designed to incorporate social normative theory,<sup>7,8</sup> diffusion of innovations theory<sup>9</sup> and behavioral decision-making theories,<sup>10</sup> invited African-American and Latino men to join a closed Facebook group where they received HIV prevention-related information from respected peers. Although engagement in social networking health-focused platforms has been low, this voluntary intervention led to high rates of engagement. Over 80% of participants actively discussed HIV prevention behaviors among the group, and their conversations were associated with actual requests for HIV testing. The integration of psychological and decision-making principles played a key role in the success of this intervention by incorporating: 1. social normative theory to increase acceptance in discussing HIV-related topics with other group members; 2. diffusion of innovations models for well-respected peers to initiate health behavior change messages and 3. human factors principles<sup>11</sup> into the user experience to ensure participants were using a technology that had been iteratively tested for usability and design.

## Multiple communication platforms and technologies

Mobile technologies are rapidly improving in utility. Hardware platforms, such as personal computers, mobile phones, tablets and video game consoles are compatible. For instance, personal digital assistants (PDAs), now a part of most smartphones, can automatically sync to desktops and tablet computers. Researchers using technologies for public health research must ensure that the technologies are compatible on multiple devices in order to adjust to people's mobile lives. As grants are often projected over a 5-year horizon, it is important to try to anticipate future compatibility needs to improve intervention uptake and effectiveness.

## Mobile technologies that allow measurement of social network and/or geographic metrics

Mobile technologies allow us to be constantly 'connected' to others (e.g. phone-based email programs, text messaging,

social network applications). These connections can be quantified, enabling access to data on participants' interconnectivity (i.e. social network ties). Mobile applications that incorporate the ability to measure social network ties can improve public health by allowing individuals to receive emotional and psychological support from other network members. For example, 'My Fitness Pal,' is a smartphone application that allows participants to share health goals with members of their online community and to solicit encouragement from friends and family in meeting those goals. In an HIV prevention randomized controlled trial on Facebook, investigators were allowed access to participants' social networks, including the size and composition of these networks.<sup>12</sup> These data allow for insights on social network structure and communication patterns associated with HIV testing and sexual risk behaviors. These data can be crucial in understanding how networks maintained through technology impact behavior change.

Researchers can also choose technologies that integrate global positioning systems (GPS) to gather information on individuals' changing physical locations and health risks in a spatial context. GPS has been used in health research to gain information on issues such as pollutant exposure (by tracking how participants move through neighborhoods),<sup>13</sup> management of exercise<sup>14</sup> and monitoring of chronic conditions.<sup>15</sup> Smartphone-based geo-social networking applications, which allow users to connect with others based on proximity, have facilitated targeted geographic recruitment of research participants.<sup>16</sup>

Geographic data can be especially useful given that county health departments already collect geographic and population-based health data linked to zip codes. Using geographic information system (GIS) analysis, researchers can merge data from GPS assessments with publicly available health data to understand how individuals' daily routines may put them at risk for negative health outcomes. Furthermore, researchers can study how people engage in risk behaviors in their mobile lives, and use these geographic data to determine the placement of public health services, including mobile community clinics, vending machines that distribute condoms and HIV tests, and needle exchange programs.

Despite the numerous privacy-related issues that have arisen, users are becoming increasingly comfortable, or at least accepting of the fact that using a technology typically means providing others with access to personal data. As these data are already being used and will continue to be used by for-profit institutions and corporations, researchers and public health workers should learn how to use these data in order to improve global health outcomes. Ethics-based research is already being conducted to better understand and incorporate the attitudes and perspectives of research participants with regard to technology. Initial research has suggested that participants in online studies should be reminded and asked for consent at multiple time points throughout the study, so they do not forget that they are participating in research while using the technology.<sup>2</sup> The decision of how to best inform consumers of the risks associated with using technologies is an important one that still needs to be addressed.

## Community-based participatory research in development and implementation

Community stakeholders, such as local organizations, clinics and community members, must be key players in researchers'

decisions to use technologies for public health research so that community priorities guide technology development. Community-focused mHealth technologies that are built based solely on developer insights, rather than through community input, research and testing, will be less likely to gain user adoption and engagement. Community stakeholders have a firm understanding of the target community's technology use and the potential benefits and consequences of engaging community members to participate in public health research. Best practices in community-based participatory research, such as relying on the guidance of community advisory boards, social service providers and key informants and incorporating target community members feedback on user-interface design for continuous quality improvement can significantly enhance the relevance of mobile health technologies.<sup>17</sup> Researchers must collaborate with their target communities so that the choice to integrate mobile technologies into community-based research can be beneficial for the community as a whole, as well as for future research, service provision and practice with individuals.

### Conclusion

Although this commentary provides examples and guidance from research, before implementation of these principles into practice, additional issues need to be addressed, including ethical, economic and political constraints. It is also important to note that these recommendations should be implemented differently based on the needs of the region and population. For example, although smartphone-based studies may be acceptable, findings will only be relevant and should only be implemented in regions and populations that use these technologies. This is not to say that research should only be conducted with widely-used technologies. Smartphones might not currently exist in all parts of the world, but research suggests that smartphones will soon be widely used in almost all international settings. Before deciding upon a technology to further public health research, it is important to evaluate and anticipate whether and how that technology will be used in order to address barriers to implementation.

This brief report intends to initiate a conversation on guidelines for incorporating mobile technologies in public health research. Future discussions on health technology research guidelines will help to shape and improve participant safety and research data quality. Once standards have been finalized through discussion, an appointed council can help to advise and monitor adherence to standards.

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