

The promise and peril of mHealth in developing countries

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Abstract

The mHealth field understandably arose from a base of practice, developed a nascent, yet ever-expanding, body of inter-disciplinary scholarship, and currently hopes for recognition by, and establishment on, national and trans-national policy bodies and agendas respectively. However, to justify public investment, policymakers require a body of theoretically sound, methodologically rigorous, and generalizable, evidence on how mobile technologies can effectively improve basic healthcare service delivery for hard-to-reach, resource-poor populations in developing countries.

This essay draws upon prior work, ranging from a review article, an mHealth intervention for Indonesian healthcare workers within the medical infrastructure, to a text-messaging project in Uganda focused on beneficiaries. The argument is organized around theoretical, methodological, and sustainability issues, and proposes suggestions for how the discipline of mobile communication studies can add value to the field of mHealth research in developing countries.

Keywords

Development, healthcare, ICT, mHealth, mobiles

The popular imagination has been captured by the potential of mobile communication technologies to revolutionize healthcare service delivery and improve beneficiary health (mHealth), particularly in the context of resource-constrained environments of developing countries (Kahn, Yang, & Kahn, 2010; Mechael, 2009). With the growing ubiquity of mobile phones, decreasing costs, and increased ease-of use, issues of access are gradually subsiding (Lim, Hocking, Hellard, & Aitken, 2008), replaced by a technological focus. However, this techno-optimistic approach has led to ignoring of both appropriation mechanisms at the individual level, as well as resistance arising from existing power dynamics

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in formal and informal social structures. For example, a comprehensive review of the mHealth literature ($n=145$) (Mechael et al., 2010), failed to include a single gender-focused study, despite female community healthcare workers (CHWs) in developing countries playing an inordinately vital role in front-line healthcare service delivery (Chib & Chen, 2010).

Certainly, there is encouraging evidence. The increased scrutiny brought upon mHealth projects in recent years reveals positive health outputs, particularly in terms of process improvements on the supply-side of healthcare systems (Thirumurthy & Lester, 2012). In terms of effectiveness, mobile phones have been shown to provide accessibility to medical services for remote populations, enhance communication flows and coordination amongst the medical organization, improve education and training of healthcare workers, allow timely and actionable data-collection for disease-monitoring and management, and disseminate information to the community (Fjeldsoe, Marshall, & Miller, 2009; Cole-Lewis & Kershaw, 2010; Krishna, Boren, & Balas, 2009).

Nonetheless, theoretical framing and methodological rigor in mHealth research remain at a nascent stage (Fjeldsoe et al., 2009; Free, Phillips, Felix, Galli, Patel, & Edwards, 2010; Leslie, Sherrington, Dicks, Gray, & Chang, 2011), resulting in an overstatement of the benefits of the adoption. This essay addresses theoretical, methodological, and sustainability issues in mHealth research, and proposes suggestions for how the discipline of mobile communication studies can add value to the field. While it must be noted that the studies chosen as illustrations were conducted in the resource-constrained environments of developing countries, the proposed argument might contain value for advanced institutional settings in more developed regions.

Theoretical issues

Theory allows us to generalize results beyond the strict confines of a particular context; yet has been noticeably absent in the mHealth discipline (Fjeldsoe et al., 2009; Riley et al., 2011). The failure of myriad pilot-projects to replicate and scale up to sustainable national projects is but one instance of the diminished role of theory. One heuristic for theory development is to categorize mHealth studies along a pathway of input-mechanism-outputs, with input factors focusing on technology introduction, mechanism factors investigating psycho-social and individual motivations for adoption, and outputs including both healthcare system processes as well as patient health indicators.

A review of mHealth studies in low income and low and upper middle income countries from 2000–2010 categorized along the input-mechanism-outputs pathway ($n=53$; Chib, van Velthoven, & Car, forthcoming). This revealed that a majority of studies ($n=32$) focused on technological inputs with little theoretical support, suggesting a prevailing techno-optimistic view. Whilst a limited number of studies discussed health outputs ($n=15$), even fewer investigated the mechanisms of adoption and appropriation ($n=6$). A key finding was the paucity of studies that could adequately explain the entire pathway from technology adoption to health improvements via adoption of mobile technologies.

The *Midwives with Mobiles* project was one example of a theoretically grounded research project that linked the mechanisms of technology adoption with health process outcomes. This project provided a JAVA-based mobile data-delivery system for remote

CHWs in the tsunami-ravaged province of Aceh, Indonesia. Applying a spatio-temporal theoretical lens from the mobiles literature (Ling & Campbell, 2009), suggests that less-skilled healthcare workers, scattered across multiple remote health centers, were able to deliver information to the centralized provincial hospital.

Applying the ICTs for healthcare development model (ICT4H) (Chib, Lwin, Ang, Lin, & Santoso, 2008), which advances a framework integrating the benefits of technology introduction (based on UNDP, 2005), with barriers to adoption, revealed that CHWs were able to generate medical knowledge, an important healthcare system process (Chib, 2010). Further, drawing upon the psychological tradition of health communication, in particular social cognitive theory (SCT) (Bandura, 2003), we find that cognitive systems such as self-efficacy mediated the effects of social determinants, such as introduction of mobiles, on knowledge acquisition (Lee, Chib, & Kim, 2011). On the other hand, support amongst peers (other CHWs) influenced self-efficacy, while institutional resources, such as access to physicians, did not.

Thus, the impact of technology introduction on health outcomes such as knowledge was mediated by social and psychological constraints. Traditional power residing within the hub-and-spoke healthcare system influenced the outcomes of mobile phone adoption; yet technical design and configuration of the mHealth project continued to be centralized, with CHWs viewed as mere recipients of technology interventions, rather than as partners in design and producers of knowledge in their own right.

Application of the effects-oriented psychological tradition revealed the need for deeper investigation into the constraints that CHWs faced in social and organizational hierarchies, both those existing prior to, and caused by, the introduction of mobile phones. However, the individual-level theories applied (SCT and ICT4H) failed to consider the nature of shifting power-dynamics within the socio-structural system. To overcome this theoretical gap, the dialectical perspective (Baxter & Montgomery, 1996) employed from the critical perspective of gender ICT studies (Hafkin & Huyer, 2007), provided insight into the emergent gender-consciousness of mobile users, as well as the resultant negotiations that were required to achieve stability within the hitherto dominant healthcare system; one that had been challenged by the introduction of technology. In order to attain agency and autonomy, without threatening the prevailing patriarchal power structure, CHWs engaged in strategies such as sharing or hiding mobile phones provided by the mHealth project managers (Chib & Chen, 2011).

Methodological issues

mHealth research requires both theoretical generalizability and methodological rigor, in order to influence practice and policy. Beyond the varied theoretical frames applied, the Acehnese mHealth inquiry revealed the need for methodological plurality to uncover particular research questions. mHealth studies tend to be concentrated on case study approaches for pilot projects, which fail to apply the rigorous criteria required in public health research for generalizing to the population (Cole-Lewis & Kershaw, 2010; Mechael et al., 2010). The randomized control trial (Chib, 2010; Lee et al., 2011) allows for sophisticated analysis whilst remaining the gold standard for attributing causality. However, qualitative research methods (Chib & Chen, 2011) are important as well when

investigating sensitive issues in-depth, particularly socio-cultural topics, such as gender relations within an entrenched power structure, or the issue of sexual and reproductive health.

In summary, an appropriate mix of quantitative and qualitative methodologies are necessary in an inherently trans-disciplinary field that not only involves academics and health professionals, but aims to influence policymakers.

Sustainability issues: Scope and scale

To attract the attention of practitioners and policymakers, successful mHealth projects also need to provide evidence of sustainability in terms of comprehensiveness of scope, and the ability for scale. In terms of scope, the use of mobile phones in health care can be summarized at two levels: the first, as a planned process of implemented interventions using mobile phones for various purposes in the health system, as described in this essay, and the second, as an organic process of spontaneous usage and adoption by individuals. Most of the studies included in the cited literature reviews examined the former phenomenon: namely, pilot projects without large-scale implementation. There is little documentation or understanding of organic processes of mobile phone adoption for healthcare on a mass scale.

mHealth researchers can, and should, utilize existing theoretical frames to study mechanisms of mobile-phone adoption and appropriation that occur at the margins of the healthcare systems, such as the remote clinics in the villages where the bulk of CHWs and patients in developing countries offer and receive essential services respectively. The earlier example of Acehnese midwives appropriating mobile phones could be better understood when applying scholarship developed in the mobile studies arena (Wirth, Von Pape, & Karnowski, 2008).

A second key emphasis in mHealth research has been a bias towards measuring technology usage and job-related performance indicators, the latter described as a process of care by Krishna et al. (2009), rather than impact indicators such as the improvement in individual or community health. Research should concentrate on establishing the causal relationship between the introduction of technology and health impact indicators, rather than just the validation of system process improvements (Mechael et al., 2010).

In terms of scope, it is debatable whether improvements in system processes caused by introduction of mobile technologies translate into actual health outcomes, resolution of which argument requires a broader evidence base. Certainly from the perspective of scale, when measuring changes in health behavior, there is reason to be conservative in considering the impact of mHealth interventions. For example, an SMS-based quiz campaign in Arua, Uganda, to improve HIV/AIDS knowledge and increase HIV counseling and testing (HCT), found that only 2.3% of 10,000 recipients accessed HCT services (Chib, Wilkin, Leow, Hoefman, & van Bejima, 2012), although as many as one-fifth participated in the format. To contextualize these results, a recent review of SMS mHealth projects finds effect sizes equally distributed in low, medium and high categories, even while the majority of studies did not report effect sizes at all (Fjeldsoe et al., 2009).

From a scope perspective, mHealth systems need to be designed for the vulnerable sections of the population, such as those unable to access technology due to socio-economic

barriers of extreme poverty and illiteracy, who remain largely unaddressed by similar campaigns (Chib, Wilkin, & Hoefman, forthcoming; Cole-Lewis & Kershaw, 2010). When evaluating mHealth projects for sustainability when scaling up from pilot projects, beyond the narrow confines of health objectives, one needs to anticipate the fissures that mobile systems implementation can introduce into the existing social-cultural hierarchies. As an illustration from the developing world, mobile-phone usage practices of device-sharing (Stenson and Donner, 2009) makes difficult the dissemination of sensitive medical information for groups such as women, who are reliant on male partners for access to information.

Inevitably, the establishment of a communication-information infrastructure layered over an existing socio-cultural infrastructure, whether a medical institution or a local village community, creates its own tensions. Future research should examine potential shifts in power relationships caused by the introduction and adoption of mobile technologies in healthcare systems, and the extent and the limitations of their impact, as measured by improvements in community health. Another under-investigated area is that examining the cost-effectiveness of interventions (Krishna, Boren, & Balas, 2009), a much-needed requirement for policymakers to guide investment decisions in technological infrastructure and human resources.

A final point on scope addresses the relationship of mHealth to the field of public health as a whole, and particularly to the study of computer- and internet-based healthcare information systems. mHealth implementations are conducted primarily as stand-alone interventions, and rarely as an integrated part of the healthcare system. mHealth needs to be perceived not as a magic bullet revolutionizing healthcare on its own, but instead as yet one more facilitator of healthcare improvements, to be applied in conjunction with other technological platforms.

mHealth research needs to emphasize sustainability, long seen as a financial imperative, but argued here as a social imperative, and scale, or the translation from individual small-scale mHealth pilot projects into integrated parts of national government health plans, and potentially expanded to programs led by private entrepreneurs and corporations.

In conclusion, the future of the mHealth field is dependent upon the application of conceptual theories to multiple contexts, the establishment of rigorous health metrics and use of varied methodologies for evaluation, the development of a trans-disciplinary approach that engages the technological design, practitioner, and research communities together in adopting a long-term sustainable perspective, and importantly, an abundance of evidence-based findings, which include critical analyses in addition to techno-optimistic approaches. Failure to meet these criteria imperils the field, and possibly confines it to the rubbish-heap of ideas that failed to live up to their initial promise.

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