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Health Worker mHealth Utilization

A Systematic Review

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This systematic review describes mHealth interventions directed at healthcare workers in low-resource settings from the PubMed database from March 2009 to May 2015. Thirty-one articles were selected for final review. Four categories emerged from the reviewed articles: data collection during patient visits, communication between health workers and patients, communication between health workers, and public health surveillance. Most studies used a combination of quantitative and qualitative methods to assess acceptability of use, barriers to use, changes in healthcare delivery, and improved health outcomes. Few papers included theory explicitly to guide development and evaluation of their mHealth programs. Overall, evidence indicated that mobile technology tools, such as smartphones and tablets, substantially benefit healthcare workers, their patients, and healthcare delivery. Limitations to mHealth tools included insufficient program use and sustainability, unreliable Internet and electricity, and security issues. Despite these limitations, this systematic review demonstrates the utility of using mHealth in low-resource settings and the potential for widespread health system improvements using technology.

KEY WORDS: Community health worker, Developing countries, Mobile phone, mHealth

The use of cell phones worldwide has expanded rapidly over the past decade in both developed and developing countries. By the end of 2013, there were 6.8 billion mobile-cellular subscriptions globally.[1] Close to 100% of the population was covered by a mobile signal, a drastic increase from 20% coverage in 2003.[1] Ownership of mobile phones is increasing worldwide, even in poor-resource settings.[2] The universality of cell phones provides an opportunity for their use in broad and scale up of technology-based health interventions, particularly in developing and resource- poor areas.

Mobile platforms, such as phones and tablets, have tremendous potential to affect healthcare delivery and health outcomes. A proliferation of innovations that integrate the use of mobile and wireless devices to improve health outcomes, healthcare services, and health research into care delivery, often called "mHealth," has occurred concomitantly with the growth of cell phone usage.[3]

Researchers have implemented mHealth applications in a range of settings and multitude of health targets[4] for facilitation of care delivery, medical records charting, patient and health worker education, disease prevention, and patient self-management. These tools can improve surveillance, clinical care, prevention, and self-management. Furthermore, they have the potential to expand population-level public health impact through wider dissemination and scale-up for widespread use.[5] Successful mHealth interventions intensify their effects when they are guided by behavioral and social science theory to help in the design, implementation, and analysis of effects.[6]

Although mHealth has previously focused on prevention and self-management for behavioral change at the individual level, attention has recently broadened toward targeting the healthcare worker as a possible sustainable intervention model. For this review, the authors considered healthcare workers in developing countries who are foundational to the success of delivery systems. Health workers in developing countries have a range of education, experience, and status within the healthcare system. Positions include informal community health workers (CHWs), such as community leaders, who may not have any formal education; paid CHWs with formal education and training who provide care to community members in rural and urban settings; and paid clinic-based health workers who are primarily located at health facilities. This range of health workers is integral to providing healthcare in rural settings, where infrastructure obstacles, such as transportation, prevent consistent healthcare. The success of programs that target this diverse group providing care is dependent on resources, training and education, and supervision.[7] Evidence shows that mHealth improves communication, decreases transportation time,

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This work was supported by the National Institutes of Health.

The authors have disclosed that they have no significant relationship with, or financial interest in, any commercial companies pertaining to this article.

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Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.cinjournal.com).

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decreases program costs, improves data quality, and increases access to resources.[7] Integrating mHealth solutions for all types of health workers may have the potential to increase efficiency and quality of care delivery, resulting in more positive effects on patient and population health.

While multiple reviews of mHealth in these settings have recently been published, this review is unique in several ways. Hall et al[8] include an assessment of mHealth interventions that target individuals to improve their health behaviors and outcomes. Here, the focus is on health workers and builds on the recent work of Källander et al,[5] who conducted a systematic review of mobile health solutions for CHWs in diverse settings. This work expands on previous reviews in two ways. First, the methods employed for selecting and including articles is comprehensive rather than exemplary. Second, the findings focus on advantages and disadvantages of each type of mHealth solution as evidenced across a diverse number of studies. While Braun et al[7] reviewed mHealth solutions and included strategies for health education more broadly beyond care delivery and included the use of social media to promote health more generally in their review, this review is more focused, emphasizing how mHealth can improve health worker professional experiences.

METHODS

A systematic literature review was conducted of mHealth interventions targeting health workers in low-resource settings published between March 2009 and May 2015. Inclusion criteria for the review included studies focused on the use of mobile technology by a health worker in a low- or middle-income country. Articles without a technological intervention targeted at health workers were excluded. Telemedicine, remote diagnostic tools, and tools specific to education in medical school were also excluded. The PubMed database was used to systematically search a combination of Medical Subject Headings (MeSH), listed in Table 1. This article focused on PubMed because it indexes articles from more than 70 countries, making it particularly appealing to synthesize research from global settings.[9] Terms were categorized by technology user, technology device, use of technology, and health outcome. Terms within each category were linked with "OR" statements and terms between each category were linked with "AND" statements. For the full search entry, see PubMed Database Search Entry, May 2015 (Supplemental Digital Content 1, http://links.lww.com/CIN/A24), which lists specific terms and operators. Searches were limited to English articles studying humans. Articles were then screened by title and abstract. The full text of all remaining articles was read. While reading each full article, reviewers tracked the primary user, country, disease or condition, study design, theory, and technology use. Reviewers documented the objectives and primary findings for each article in an effort to facilitate a synthesis of findings across studies.

A total of 1017 potentially relevant articles were identified through the PubMed database. Of these, 662 articles were excluded based on the title. Subsequently, 303 articles were excluded because the abstract did not meet the criteria. The full text of 52 articles were reviewed. Of these, 21 articles were excluded because they did not focus on utilization of technology by a health worker in care delivery. Thirty-one articles were included in the final review. A κ score of 0.90 was calculated based on the results of a secondary reviewer.

RESULTS

Reviewers categorized objectives and primary findings according to intervention targets at different levels of healthcare delivery. Ultimately, review findings were summarized by and organized into four major groups: (1) data collection during patient visits, (2) health worker and patient communication, (3) communication between health workers doing outreach in the community and those located at clinics or hospitals, and (4) population surveillance. The articles are summarized according to these groupings in Table 2.

Six of the 31 articles were grouped into more than one area (see Table 2). Specifically, 14 articles were related to health data collected at a patient visit to facilitate patient care (group 1). For example, electronic medical records would fall in this category. Seven articles were identified as communication between a health worker and patient (group 2). For instance, health workers would text patients to remind them to take medication. Twelve articles were allocated to communication between health workers (group 3), such as field health workers accessing electronic decision-making aids or contacting a hospital-based physician for decision support. Finally, six articles were assigned to group 4, data collection for surveillance or research-based purposes. For example, community-based interviewers collected sociodemographic data in household surveys. One study employed a crossover design, one study employed cross-sectional surveys, eight were cluster-randomized trials, three were mixed-methods surveys to assess acceptability and ease of use, and the remainder (18) were program evaluations (without control groups).

The most common primary user of the technology was a CHW (14 studies). Other users included clinicians (two studies), pharmacists (one), midwives or birth attendants (five), community interviewers (one), village elders (one), peer mentors (one), field worker (one), caregiver (one), mobile healthcare worker (one), clinic and community health assistant (one), rural health workers (one), and laboratorians (one). The technology used was short message service or text

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Table 1. MeSH Terms Use in PubMed Database Search

Category	MeSH Terms
Technology user	"community health workers," "caregivers," "health personnel," "emergency medical services," "health personnel," "health services," "home care services," "maternal health services," "medical staff," "mentors," "nursing staff," "patient care team," "peer group," "rural health services"
Technology device	"cellular phone," "computers, handheld," "Internet," "medical records," "systems, computerized," "mobile applications," "software," "text messaging," "user-computer interface"
Use of technology	"appointments and schedules," "data collection," "decision support systems," "delivery of health care," "disease management," "health care surveys," "interviews as topic," "mass screening," "medication adherence," "population surveillance," "public health/education," "questionnaires," "remote consultation," "time factors"
Outcome	"communication," "costs and cost analysis," "health behavior," "health communication," "health knowledge," "patient acceptance of health care," "patient compliance," "quality of health care," "treatment outcome"

messaging (12 studies), combination text messaging and voice (2), short message service mobile researcher (2), electronic medical record (2), or smartphone/smartphone application/or personal data assistant (13). Most studies were in Africa, including Ethiopia (two), Ghana (two), Kenya (five), Malawi (two), Nigeria (one), Rwanda (one), South Africa (five), Tanzania (three), Uganda (three), and Zambia (one). Other studies were conducted in Bangladesh (one), China (one), Colombia (one), India (one), Indonesia (one), and Peru (one). Health outcomes studied included AIDS/HIV (5), prevention of mother-to-child transmission (PMTCT) (3), maternal and child health (10), malaria (4), tuberculosis (1), cardiovascular disease, and multiple outcomes or general health (7).

Summary of Findings by Group

The following is a summary of the findings across studies by each of the four groups.

Group 1: Health Data Collected at a Patient Visit to Facilitate Patient Care

Fourteen articles had a goal of improving health data collection at a patient visit to facilitate patient care, of which one was a cluster randomized control trial,[10] one was acceptability survey,[11] and 12 were program evaluations.[12–23] Several consistent themes emerged from these articles, including a high degree of acceptability with a paradoxical low degree of use, documentation of improvements in data quality with mHealth approaches, and identification of barriers to mHealth related to preexisting systemic data management problems.

While several studies documented a high level of interest and acceptability among health workers,[12,15,17,20–22] they also documented low actual use and challenges in use, particularly without incentives other than improved work efficiency (eg, monetary incentives or personal phone-use incentive and no penalty for not using the technology).[13,17,22,23] As such, there was a high demand and need for training with the mHealth technology, as well as training to reinforce skills and health worker responsibilities.[13,16] A study on newborn weights found an increase from 40% to 100% accurate birth weights (recorded within 1 week of birth) because of the efficiency of a mHealth intervention compared with pen-and-paper systems.[15]

Many studies focused on mHealth use at the interface between the healthcare worker and the patient identified underlying issues with the healthcare worker system that were not unique to the mHealth intervention. These included perceived stress from heavy work and patient caseloads, the belief that patients should have greater autonomy regarding their health, and resentment that health workers would not be compensated for additional work generated from using a phone. Patient time increased with the mHealth interventions primarily because questions could not be skipped and visits were more thorough.[13,22] While these outcomes may not be directly related to the mHealth intervention, but rather a symptom of the broader healthcare system, the reviewed studies acknowledged the importance of considering these factors during an intervention, as they may be assuaged or aggravated by the intervention. For example, stress from heavy work and patient caseloads could be increased in the short-term as workers must be trained on how to use the technology. In turn, the efficiency of the technology may result in an increase in patient load, which was generally viewed as a success to the program overall, but resulted in stress to the individual worker.

Group 2: Facilitating Communication Between Health Workers and Patients

Seven articles studied communication between a health worker and patients, with the emphasis on improving health worker efficiency by saving travel time and gaining work time.[10,11,21,24–27] Texts focused on increasing access to skilled attendants at birth,[25] patient medication adherence,[21,24] appointment reminders,[21,25] and tracking patients.[10,11] There was greater improvement in urban areas as compared to rural areas in health outcomes for patients after a text message

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Table 2. Summary of Systematically Reviewed Health Worker mHealth Articles

Author	Group[a]	Population	Country	Disease/Condition	Theory	Design
Andreatta et al (2011)	1	Birth attendants	Ghana	Postpartum hemorrhage	None noted	Program evaluation
Chaiyachat et al (2013)	1	Mobile healthcare worker	South Africa	Tuberculosis	None noted	Program evaluation
Chaplin et al (2014)	1	Clinician	Nigeria	HIV	None noted	Program evaluation
Gisore et al (2012)	1	Village elders	Kenya	Maternal child health (infant weight)	None noted	Program evaluation
Haberer et al (2010)	1	Caregivers	Uganda	HIV	None noted	Program evaluation
Medhanyie et al (2015)	1	HW	Ethiopia	Maternal child health	None noted	Program evaluation
Radhakrisha et al (2014)	1	Clinician	India	Maternal/geriatrics	None noted	Program evaluation
Surka et al (2014)	1	CHW	South Africa	CVD	None noted	Program evaluation
Van Heerden et al (2013)	1	HW	South Africa	HIV/PMTCT	None noted	Program evaluation
Rotheram-Borus et al (2011)	1, 2	Peer mentor	South Africa	Maternal child health (HIV)	None noted	Randomized controlled trial
Mahmud et al (2010)	1, 2, 3	CHW	Malawi	ART, home-based care, tuberculosis, PMTCT	None noted	Program evaluation
Little et al (2013)	1,3	CHW/midwives	Ethiopia	Maternal child health	None noted	Program evaluation
Velez et al (2014)	1,3	Midwives	Ghana	Maternal child health	None noted	Program evaluation
Bruxvoort et al (2014)	2	Pharmacist	TZ	Malaria	None noted	Randomized controlled trial
Lund et al (2012)	2	Midwives	Zanzibar	Maternal/child health (delivery)	None noted	Randomized controlled trial
Siedner et al (2012)	2	Laboratory	Uganda	HIV	None noted	Acceptability survey
Huq et al (2014)	2, 3	Birth attendant	Bangladesh	Perinatal	Diffusion of Innovation	Randomized controlled trial
Chang et al (2013)	1, 2, 3	CHW	Uganda	HIV/AIDS	None noted	Acceptability survey
Florez-arango et al (2011)	3	CHW	Columbia	General	None noted	Randomized prospective crossover
Jones et al (2012)	3	CHW	Kenya	Malaria	None noted	Randomized controlled trial
Lee et al (2011)	3	Midwives	Indonesia	Maternal/child health	Social cognitive theory, self-efficacy	Acceptability survey
Lemay et al (2012)	3	CHW	Malawi	HIV/AIDS, family planning/ reproductive health	None noted	Randomized controlled trial
Ngabo et al (2012)	3	CHW	Rwanda	Maternal/child health	None noted	Program evaluation
Nilseng et al (2014)	3	HW	TZ	Primary care (medication inventory)	None noted	Program evaluation
Zurovac et al (2011)	3	HW	Kenya	Malaria	None noted	Randomized controlled trial
Bernabe-Ortiz et al (2008)	4	Field workers	Peru	Sexual behavior	None noted	Cross-sectional
Kamanga et al (2010)	4	Rural health workers	Zambia	Malaria	None noted	Program evaluation
Onono et al (2011)	4	Clinic and community health assistants	Kenya	AIDS stigma study, PMTCT	None noted	Program evaluation
Tomlinson et al (2009)	4	CHW	South Africa	Baseline survey	None noted	Program evaluation
Rajput et al (2012)	4	CHW	Kenya	HIV	None noted	Program evaluation
Zhang et al (2012)	4	Interviewer	China	Infant feeding practices	None noted	Randomized controlled trial

Abbreviations: ART, antiretroviral therapy; CVD, cardiovascular disease; HW, health worker; TZ, Tanzania.

[a]Group 1: health data collected at a patient visit to facilitate patient care; group 2: communication between a health worker and patient; group 3: communication between health workers; group 4: data collection for surveillance or research.

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reminder intervention,[25] but this was not the case in a program directed at pharmacists to help their patients increase adherence through text.[24] Fuel savings and travel time-savings were substantial for both health worker and patient,[21,26] and it became easier to enroll patients into programs.[21]

Group 3: Facilitating Communication Between Health Workers

Twelve articles studied communication between health workers.[11,21–23,27–34] Communication by mobile phone was highly acceptable to health workers.[29–31] Communication, mostly via text messages and phone calls, improved patient outcomes and health worker efficiency with increased protocol compliance, decreased error rates, and decreased time and expense spent contacting supervisors.[28,31,34] Communication between health worker and supervisor happened more frequently and efficiently when health workers did not have to travel to the clinic or institution[31] and when they had access to systems that linked patient data, such as an electronic medical record system.[14] In addition to improving patient health outcomes, text message reminders facilitated an adherence to protocols, which had not been previously followed.[28,34] Another found that traditional birth attendants increased their skills and confidence using mobile phones to access information via mobile phone on managing birth complications.[27]

Group 4: Data Collection for Surveillance or Research

Six articles studied data collection for surveillance or research-based purposes. These articles were concerned primarily with differences between pen-and-paper collection and personal data assistant or smartphone collection in areas where interviewers collect information in low-resource settings.[35–40] These studies found that mobile phone systems improved pen-and-paper systems because they were easier to transport,[20,37,38] had significantly fewer data entry errors,[37,38,40] were more cost efficient,[37,38] and could detect data falsification or troubleshooting survey problems.[37,39] Overall, these studies found that mobile phone use, particularly smartphones, resulted in significantly more efficient and reliable data collection than traditional pen-and-paper methods.

Advantages and Disadvantages

Advantages cut across all four of the groups reviewed, including acceptability, usability, health and program outcomes, technical infrastructure, data quality, and cost. Specific examples with each of the four groups reviewed are outlined in Table 3. Health worker acceptability, or the acceptance of using technology to facilitate their work, was generally very high in qualitative surveys.[13,19,20,29] In studies comparing pen-and-paper data collection with mobile device collection, researchers consistently observed improvements in data quality.[15,19,37,40] Some improvements in health outcomes were observed,[11,25] and many increased program enrollment due to better organization and workflow.[15,21,32] While initial startup costs were high, phone replacement was low, and most studies reported minimal ongoing maintenance costs.[14,15,31,38–40]

Most studies also reported disadvantages to applying technology, many of which were related to existing infrastructure or healthcare challenges, including Internet access, availability of electricity, theft and security, health worker education level, and absence of local skills in programming and technological operation.[11,35] While acceptability was high, actual use was low when the existing alternative was still available.[13] There were technical issues related to infrastructure, including Internet access and electricity.[11,13,19,37] As mentioned above, maintenance costs were minimal and programs usually resulted in cost savings, even when initial investment was high.[15,31,38–40] One article found no improvement in medication adherence after the intervention.[24]

Although not mentioned explicitly as a disadvantage, an important criticism noted from the review is the very limited attention to theory in design, implementation, or analysis of mHealth for health workers, either from behavioral and social science or computer science. Only two of the 31 reviewed articles explicitly mention the use of theory to guide their work.[27,30] Having a theoretical perspective in mHealth has been identified as critical to enhance program effects, albeit for interventions targeting individual behavior change and health outcomes rather than health worker.[6] In systems design, a growing attention to theory in the design of user interfaces has been shown as important to increase acceptability and usability of programs.[41]

DISCUSSION

This article presents a synthesis of the findings from 31 peer-reviewed studies related to the use of mobile technology by health workers in resource-limited settings. The review identified four main groups where mHealth innovations have been used for health delivery improvement, including data collection during care delivery, health worker and patient communication, communication between health workers and the care delivery system, and health surveillance activities.

Overall, the findings demonstrate a substantial benefit to healthcare workers, their patients, and care delivery systems when mobile technology tools, such as smartphones and tablets, are used. Acceptability of these tools for care delivery is high, and evidence shows that the use of mHealth tools can improve communication between health workers and their patients, health workers and clinic staff, as well

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Table 3. Advantages and Disadvantages to Using Technology to Aid Remote and Rural Workers

Group 1: health data collected at a patient visit to facilitate patient care		
Advantages	**Examples**	**Author**
Acceptability	Positive acceptance	Chaiyachat et al, 2013; Surka et al, 2014
	Fuel savings	Chang et al, 2013
	Unrestricted use generated a sense of ownership and empowerment	Little et al, 2013
Data quality	Improved data quality	Gisore et al, 2012; Surka et al, 2014
	Increased subject enrollment	Gisore et al, 2012; Mamud et al, 2010
Cost	Maintenance was inexpensive, after an initial capital cost	Gisore et al, 2012; Chaplin et al, 2014
Disadvantages	**Examples**	**Author**
Acceptability	Low actual use despite positive acceptance	Chaiyachat et al, 2013
	Concerns with job security	Chang et al, 2013
	Limited personal motivation to use the phone without incentive	Chaiyachat et al, 2013
	Patient confidentiality problems, especially when phones are shared between family members	Chang et al, 2013; Haberer et al, 2010; Velez et al, 2013
	Interferes with the human side of the CHW and patient interaction	Chang et al, 2013
	CHWs feared making mistakes	Haberer et al, 2010
Usability	Application updates were disruptive and caused screen freezing	Chaiyachat et al, 2013
	Patients registered multiple times	Little et al, 2013
	Small keyboard caused data entry errors	Velez et al, 2013
Technical infrastructure	Limited Internet access made it difficult to upload data	Chaiyachat et al, 2013 Chang et al, 2013
	Graphic presentation of data on phones inferior to paper	Surka et al, 2014
	Limited electricity caused problems with battery charging	Chang et al, 2013
	Some phones were lost, stolen, or damaged, but this was rare	Chang et al, 2013; Little et al, 2013; Gisore et al, 2012
	Some CHWs were worried that smartphones would make them a target for theft	
Group 2: Communication between a health worker and patient		
Advantages	**Examples**	**Author**
Acceptability	Fuel savings	Mamud et al, 2010
Health outcome	Higher odds of skilled delivery attendance	Lund et al, 2012
Data quality	Increased subject enrollment	Mamud et al, 2010
Group 3: communication between a health worker in the field and a health worker at a higher institution		
Advantages	**Examples**	**Author**
Acceptability	Improved morale	Chang et al, 2011
	High acceptance among CHWs	Jones et al, 2012
Usability	Decrease in time to contact and receive feedback from supervisor	Lemay et al, 2012
	Increased subject enrollment	Ngabo et al, 2012
Health outcome	Improved patient compliance when they realized direct accountability to clinic	Chang et al, 2011
	Improved medication management	Zurovac et al, 2011
Data quality	Enhanced protocol compliance	Florez-arango et al, 2014
Cost	Decrease in costs, mostly due to a decrease in travel expense	Lemay et al, 2012
Disadvantages	Examples	Author
Usability	Health worker concern with becoming desensitized to repetitive and frequent messages	Jones et al, 2012
Health outcome	No demonstrated impact on medication adherence	Bruxvoort et al, 2014
Group 4: data collection for surveillance or research-based purposes		
Advantages	**Examples**	**Author**
Acceptability	High acceptance among interviewers	VanHerden et al, 2013
Usability	Convenient to carry around because of small size	Onono et al, 2011
	Technology facilitated interaction with interviewees	Rajput et al, 2012

(continues)

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Table 3. Advantages and Disadvantages to Using Technology to Aid Remote and Rural Workers, Continued

Data quality	Improved data quality; limited to no errors	Onono et al, 2011; Zhang et al, 2012
	Real-time information allowed identification of technical issues, data entry issues, and data fabrication	Tomlinson et al, 2009
Cost	Technology was more cost efficient that pen-and-paper surveys because data entry was not required	Rajput et al, 2012 Tomlinson et al, 2009
Disadvantages	**Examples**	**Author**
Technical infrastructure	Limited electricity caused problems with battery charging	Onono et al, 2011
	Limited Internet access made it difficult to upload data	Onono et al, 2011
Cost	High initial capital costs	Zhang et al, 2012

as between health workers and their supervisors. Use of mHealth tools by health workers is associated with improved compliance with treatment protocols among patients and improved health outcomes. mHealth tools are used successfully in surveillance efforts to improve quality and efficiency of data collection.

The articles reviewed also identified some important limitations to the use of mHealth tools for healthcare delivery in resource-poor settings. Although there is high acceptability of tools, there is not universal and continued use. This suggests that incentives are needed to facilitate adoption and use that are targeted at various components of the healthcare system. For example, incentives can be aimed at the health worker through training or monetary compensation. Additionally, policies that obligate use can be established at the systems level. However, before policies that require use of mHealth tools can be realistically established, a careful assessment is likely needed to ensure organizational readiness to train users and offer technical support for devices and data management.

The variability in success across urban and rural settings, suggesting greater benefit in health outcomes among urban compared to rural populations, is an additional limitation to mHealth tools. Although it is not completely clear why this variation may exist, one explanation could be that urban populations may have greater access to and utilization of technological tools. This suggests that careful attention is needed to the availability, distribution, and reasons for cell phone usage across populations served by health workers to ensure using mobile devices, particularly for communication between health workers and patients, is appropriate.

While this review is limited inasmuch as the focus is from a limited time frame, does not include industry reports and publications that are not peer reviewed, and may reflect a positivity bias related to those articles accepted for peer-reviewed journals, it still offers important insights that can be useful to healthcare providers, administrators of care delivery systems, and researchers in mHealth. Because it is becoming increasingly more acceptable and common to integrate smartphones and tablets into primary care delivery in resource-poor settings, systematically understanding the successes and shortcomings is relevant for ensuring best practices become applied.

The information presented in this synthesis reveals numerous advantages for using technology as an integral part of healthcare delivery and suggests that widespread acceptance of these tools may contribute to overall improvements in quality and outcomes. However, more research is needed to understand whether and how the use of phones translates into improvements in health outcomes for patients and improvements in population health for communities.

This systematic review suggests a path for mHealth integration into healthcare delivery, developing appropriate technology and administrative infrastructure to support such initiatives. As implementation increases, a critical consideration of costs associated with technology infrastructure will be required to evaluate whether investment in this infrastructure is warranted. It may be that the existing more "low-tech" approaches to data collection are sufficient. However, if decision makers determine that infrastructural investment in technology for healthcare delivery is appropriate, then attention to multiple areas to maximize this investment is needed. Several careful considerations are necessary, including equipment choices (computers, servers, phones, and tablets), sufficient staff who can program and maintain such equipment, development of protocols and training programs for healthcare workers to effectively use technology, development of policies and incentives to motivate use, and attention to regular process evaluations to ensure efficiency and quality in data collection and communication.

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The authors and planners have disclosed that they have no financial relationships related to this article.

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