



Mobile health interventions in underserved populations: a medical scoping review

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Abstract

The purpose of this scoping review is to identify the efficacy of mHealth for improving patient outcomes, particularly in underserved populations. This review also seeks to identify gaps in current literature to guide future inquiry and study design. We found that adoption of mobile technologies was associated with improvements in many healthcare metrics including patient education, disease prevention, medication compliance, outcomes of chronic diseases, and screening rates with marked utility in resource-poor populations of high-income countries. Though mHealth remains in the early stages of development and there is need for further research and standardization of information, it has already proven to be a uniquely effective, low-cost strategy for implementing and managing care between patient and provider.

Question

Is mobile health an effective method to improve health outcomes in underserved populations?

Methods

- A literature search was conducted between December 26, 2018, and April 19, 2019, for articles published using PubMed and Google Scholar.
- Four topics of interest were identified as prevalent throughout the literature: improving medication compliance, disease prevention, disease screening rates, and chronic disease outcomes.
- Data was formatted into figures to best represent observed patterns and trends observed in recent digital health literature with regard to the stated research question.

Social and Demographic Factors

Low Income

Ethnic Minority

Literacy limitations or language barrier

Access to a mobile device

Chronic Illness (ie Diabetes, HTN, HIV/Aids)

References

1. GSMA. GSMA The Mobile Economy 2019 - The Mobile Economy 2019. <https://www.gsma.com/mobileeconomy/2019/>. Accessed March 23, 2020.
2. Livingston G. *Lifelines and Digital Technology*. 2010. www.pewhispanic.org. Accessed March 23, 2020.
3. Iltis J, et al. *Healthcare 2.0: Ubiquitous Health Systems and the Convergence Towards AG Mobile Technologies*. In: *Health*. Springer US; 2007:3-14. doi:10.1007/978-1-289-24559-7_1
4. Ryu S. *Book Review: mHealth: New Horizons for Health through Mobile Technologies Based on the Findings of the Second Global Survey on eHealth (Global Observatory for eHealth Series, Volume 3)*. *Health Inform Res*. 2012;18(3):231. doi:10.4258/hi.2012.18.3.231
5. Martin T. *Assessing mHealth: Opportunities and Barriers to Patient Engagement*. *J Health Care Poor Underserved*. 2012;23(3):336-341. doi:10.1333/hpu.2012.02087
6. Rensell M, O'Brien H, Schell P. *Mapping mHealth research: A decade of evolution*. *J Med Internet Res*. 2013;15(3):e76. doi:10.2196/jmir.2010.02087
7. Molidoulin A, Moore J. *The Underserved and Health Information Technology: Issues and Opportunities*. *J ASFP*. 2008. <https://www.asfp.com/underserved-and-health-information-technology-issues-and-opportunities>. Accessed March 23, 2020.
8. Cole-Lewis H, Kershaw T. *Text messaging as a tool for behavior change in disease prevention and management*. *Epidemiol Rev*. 2010;32(1):354-49. doi:10.1093/epir/epi004
9. Angold-Alexander H, Liu-Watson G, Martin-Correa M, Santos-Munoz JM, Collins-Jones C. *Does mHealth adherence to medication? Results of a systematic review*. *Int J Clin Pract*. 2015;49(1):3-32. doi:10.1111/ijcp.12582
10. Krishna S, Rosen SA, Balas EA. *Healthcare via cell phones: A systematic review*. *Telemed e-Health*. 2009;15(3):231-240. doi:10.1089/hmj.2008.0099
11. López L, Green A, Tam-McGrath A, King R, Behrman R. *Bridging the digital divide in health care: The role of health information technology in addressing racial and ethnic disparities*. *J Gen Intern Med*. 2011;26(10):437-445. doi:10.1016/j.jamcp.2011.03.005
12. Akter S, Kay F. *mHealth - on the Underserved*. *Health Inform Res*. 2010;16(4):100. <http://www.ncbi.nlm.nih.gov/pubmed/20938579>. Accessed December 9, 2019.
13. Binthim NF, McGeachan C, Trevino L. *Assessing the effect of an interactive decision-aid smartphone smoking cessation application (app) on quit rates: A double-blind randomized controlled trial protocol*. *BMJ Open*. 2014;4(7). doi:10.1136/bmjopen-2014-005371
14. Baiterle M, Shuk L, Gaudin G, et al. *Effect of Mobile Phone Intervention on Quitting Smoking in a Young Adult Population of Smokers: Randomized Controlled Trial*. *JAMA Intern Med*. 2018;178(10):1089-1093. doi:10.1001/jamaintern.2018.0004
15. Palmieri M, Ramond C, Omidvari M, et al. *Effectiveness of short message service-based intervention (SMS) on self-care in type 2 diabetes: A feasibility study*. *Prim Care Diabetes*. 2016;10(4):251-258. doi:10.1016/j.pcd.2015.11.001
16. Vabara M, Pineschi TL, Phillips GL, et al. *Final ICT Results of an mHealth HIV Prevention Program for Sexual Minority Male Adolescents*. *Pediatrics*. 2017;140(1). doi:10.1542/peds.2016.2999
17. Dornak CJ, Contreras-Roldan H, Asturias EJ, et al. *Characteristics of mobile phone access and usage in rural and urban Guatemala: assessing feasibility of text message reminders to increase childhood immunizations*. *mHealth*. 2018;4:9-9. doi:10.2196/mhealth.2018.03.005
18. Dick JJ, Nundy S, Solomon MC, Bishop KH, Chin MH, Peck ME. *Feasibility and usability of a text message-based program for diabetes self-management in an urban African-American population*. *J Diabetes Sci Technol*. 2011;5(3):1244-1254. doi:10.1177/1922948110380024
19. Bravo C, O'Donoghue C, Kaplan CP, Luce J, Ozanne E. *Can mHealth Improve Risk Assessment? Acceptability of a Breast Health Questionnaire App in Ethnically Diverse, Older, Low-Income Women*. *J Health Dispar Res Pract*. 2014;7(4). <http://www.ncbi.nlm.nih.gov/pubmed/25705576>. Accessed December 9, 2019.
20. Lewinski AA, Patel UD, Diamond CJ, et al. *Addressing Diabetes and Family Complicated Hypertension: Pragmatic mHealth Self-Management Intervention*. *J Med Internet Res*. 2017;19(4):e244. doi:10.2196/med.2017.00005
21. Gibson CT, Mulvey SA. *Development and feasibility of text messaging and interactive voice response intervention for low-income, diverse adults with type 2 diabetes mellitus*. *J Diabetes Sci Technol*. 2013;7(3):412-422. doi:10.1177/19229481130070005
22. MacDonald K, Gibson-Scoble W, Lam F, Hoar-King S, Chen X. *Text Messaging to Measure Asthma Medication Use and Symptoms in Urban African American Emerging Adults: A Feasibility Study*. *J Asthma*. 2012;49(10):1092-1096. doi:10.1177/02770903.2012.733993
23. Ramirez V, Johnson E, Gonzalez C, Ramirez Y, Bujano B, Kossler G. *Assessing the Use of Mobile Health Technology by Patients: An Observational Study in Primary Care Clinics*. *JMIR mHealth*. 2016;4(2):e41. doi:10.2196/mhealth.4928
24. Calderon TA, Martin H, Volpicelli R, et al. *Understanding potential uptake of a proposed mHealth program to support caregiver home management of childhood illness in a resource-poor setting: a qualitative evaluation*. *mHealth*. 2013;3:19-19. doi:10.21037/mhealth.2013.04.03
25. Vongpradit M, Meyer V, Fei K, et al. *Smartphone ownership and perspectives on health apps among a vulnerable population in East Harlem*. *NYC Health*. 2018;8(3):31. doi:10.21037/mhealth.2018.03.02
26. Schell H, Bakken S, Rojas M, Travers J, Carballo-Dieguez A. *mHealth Technology as a Resource Tool for Treatment, Care and Management of Persons Living with HIV*. *AIDS Behav*. 2015;19 Suppl 2(2):81-89. doi:10.1007/s10461-014-0984-8
27. Brown TA, Wechsberg WK, Kraschinsky PN, et al. *mHealth versus face-to-face study protocol for a randomized trial to test a gender-focused intervention for young African American women at risk for HIV in North Carolina*. *BMC Public Health*. 2018;18(1):1982. doi:10.1186/s12889-018-5756-8
28. Bisher JA, Fishman J, Garfield D, Fretz A. *Enrolling Underserved Women in mHealth Programs: Results from Text4Moby Outreach Campaigns*. *Health Promot Pract*. 2019;20(2):292-297. doi:10.1177/1524839118763589
29. Cunningham M, Bull S, McNulty MC, et al. *Does a text-messaging program to promote early childhood development reach the highest risk families? mHealth*. 2018;4:55-55. doi:10.21037/mhealth.2018.11.03
30. Montori VM, Helgerson PK, Guyatt GH, et al. *Telecare for Patients With Type 1 Diabetes and Inadequate Glycemic Control: A randomized controlled trial and meta-analysis*. *Diabetes Care*. 2004;27(5):1086-1094. doi:10.2337/diacare.27.5.1086
31. Vandematton C, Müller AM, Short CE, et al. *Past, Present, and Future of eHealth and mHealth Research to Improve Physical Activity and Dietary Behaviors*. *J Nutr Educ Behav*. 2016;48(3):219-228.e1. doi:10.1016/j.jneb.2015.12.006
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Results

Overall, the adoption of mobile technologies was associated with improvements in multiple healthcare metrics. While there was a variety of mobile technologies studied, the cumulative results show improved medication compliance^{9-12,16,19,21-23,27,29}, disease prevention^{5,9,11-13,15,19-19,24-29}, screening rates^{9,12,19,20,23,27-29,31}, and chronic disease outcomes^{9,10,11,12,21-24,27,29,31,32} with marked utility in resource-poor populations of high-income countries (Table 2). Access to mobile devices was not a challenge or barrier in any of the studies. Our review found that usage of mobile technology to access health information was as high as 76% in certain low-income clinics³².

Table 1: Distribution of Publication Types.

Publication Type	No. of Publications (%)
Review	8 (31%)
Systematic Literature Scoping	5 (20%)
Randomized Controlled Trial	2 (8%)
Cohort Study	1 (4%)
Cross-Sectional Study	5 (19%)
Case Series	4 (15%)
Meta-Analysis	3 (12%)
	1 (4%)

Table 2: Factors positively impacted through the utilization of mobile health technologies.

Positive Impact Factors	No. of Publications (%)
Disease Prevention	15 (60%)
Medication Compliance	11 (44%)
Outcomes of Chronic Diseases	11 (44%)
Screening Rates	9 (28%)

Table 3: Distribution of underserved patient populations.

Patient Populations	No. of Publications (%)
Chronic Illness	15(60%)
Ethnic Minorities	15(60%)
Low-income	14(56%)
Young	4(16%)

Table 4: Barriers to mobile health technologies.

Reported Challenges	No. of Publications (%)
Low-literacy	7(28%)
Language barriers	4(16%)
Insufficient Internet Access	4(16%)

Conclusions/Lessons Learned

We identified 25 articles that met specific search and inclusion criteria. We believe that our results demonstrate an accurate depiction of the possible benefits and shortcomings of mHealth, particularly among underserved populations. The small number of publications indicates that the field of digital health, specifically the application of mobile technologies in healthcare, remains in early stages of development as a field of study. Overall, there were noticeable improvements in medication compliance, disease prevention, and screening rates.

mHealth is an effective strategy for implementing and managing care between the patient and provider. These strategies do not require complex computer-programming knowledge, but rather the simple application of using short messaging service (SMS) text messaging in practice. Text messaging can connect patients with providers and drastically limits the barriers that prevent in-office and follow-up visits. Access to a mobile phone was only a minor limitation, as many studies reported that a majority of their low-income patients owned, or had access to, mobile devices regularly. Language barriers to healthcare were reported in 16% of the papers which is easily overcome in a virtual world. While we believe our findings to accurately represent the current literature available on this topic, we would like to clarify that a lower percentage of findings in a certain category might reflect a need for increased research in that area, rather than a lack of mHealth efficacy in that realm.