

# Review of the Prospects and Challenges of mHealth Implementation in Developing Countries

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## Abstract

**Background:** The drastic increase in the applications of mobile voice and data has provided optimism to use mobile telephony for mobile health (mHealth) to bridge healthcare gaps in rural and unserved areas. Global statistics show that mHealth interventions are being scaled up in developed economies but remain less implemented in Africa especially, the Sub-Saharan Africa including Ghana. Even though mobile phone adoption in Africa is high and keeps growing at a faster rate than elsewhere, the continent has not fully engaged the potential of the mobile phone to solve nagging health issues.

**Objective:** Our study seeks to identify the prospects and challenges in the implementation of mHealth in developing countries and suggest ways to resolve them.

**Methods:** To achieve the objective, we conducted a qualitative and systematic review. Sites such as Google Scholar, Web of Science, Health-related and Scopus were surfed for articles containing empirical data on mHealth development and implementation. Selection criteria for articles was based first on mHealth implementation, secondly on the prospects and lastly on the challenges or drawbacks to its deployment in least advanced economies. A well-structured mechanism was applied to extract data and qualitative methods used to analyze them.

**Results:** Searches retrieved 300 citations and taken through rigorous screening to determine the inclusion list. At least 150 records were eliminated as junk URLs and duplicates, leaving 150 articles. Further scrutiny in terms of their titles and abstracts left 100 articles meeting the review criteria. mHealth was observed as a major technological tool used by researchers and innovators to effectively close the health gap. Apart from the benefits of implementing mHealth, almost all the papers discussed the challenges involved.

**Conclusion:** The review demonstrates that mHealth is used by most countries as a tool to improve healthcare access by eliminating the geographic barriers from the healthcare equation. However, technological challenges, illiteracy, sociocultural difficulties, lack of qualified health workers among others, oppose to the success of mHealth. Resolving these challenges would lead to scaled ups, increase accessibility, service quality and cost cuts.

**Keywords:** Mobile Health, implementation challenges, prospects, rural areas, healthcare cost

## 1. INTRODUCTION

The World Health Organization (WHO) defines mobile health (mHealth) as the delivery of healthcare services and practice of medicine using mobile devices such as phones, computers, tablets, wearables and PDAs. The phenomenon has experienced exponential growth in recent times due to high diffusion and adoption of the mobile technology around the world, especially in Africa. mHealth mainly focuses on the collection of data for immediate diagnosis of illnesses, monitor diseases, enhance treatment adherence and provide information to clients in underserved areas in a timeous manner. mHealth is critically important for administering clinicals in remote areas where there is complete shortage of nurses and doctors. These health workers in rural areas depend on mHealth to acquire fast information on ailments and their treatment for themselves and others close by. The technology speeds up education and training within the medical landscape for both interns and students located in rural communities. Even though the technology is widespread in the advanced economies, the developing world is still grappling with piloted projects which do not deliver the required effect. The main aim of this study is to determine the prospects and challenges of mHealth among the least developed countries including Ghana and then suggest way to resolve the challenges.

### 1.1 Future Prospects of mHealth

As mountains of evidence begin to emerge to consolidate the use of mobile communication to solve health needs, it is believed that the phenomenon has the potential to radically improve quality of health care in rural and resource-deprived environments. To corroborate this, [1] examined issues concerning the rapid emergence of mHealth and its impact in poor communities. The results show that even though the mHealth sub-sector is relatively young, it is transforming the health delivery ecosystem around the developing economies where concrete benefits such as increased accessibility and associated information, especially in remote geographies are recorded. There is also rise in diagnostic ability and disease tracking, prompt and quick action on health matters as well as magnified access to medical training and education for health professionals which have been corroborated by [2]. Thomas and Wing [3], identified twenty overweight persons with the aim of evaluating the effectiveness of using smartphones to establish empirical evidence on behavioral weight loss therapy through self-monitoring procedures. They had mean age of 53

years and went through 12 to 24 weeks of weight loss therapy based on behavioral change using the phone to perform self-monitoring and feedback. The findings indicate that average weight loss after 12 weeks is 8.4kg while that for 24 weeks is 10.9kg. The self-monitoring adherence level recorded 91% and 85% for 12 and 24 weeks respectively. Similar studies have been conducted to determine the efficacy of mHealth tools for HIV [4], Text Messaging [5], clinical practice for managing the daily interventions of nurses and self-management for people living with type 2 diabetes [6], and all of them were found to be effective. Other papers related to behavior and self-management interventions with good results are [7-12], while those for chronic diseases include [13-15].

A medicine dosing tool for community health workers evaluated by [16] was observed to improve and enhance workflow for frontline health workers such as nurses. Also, authors of [17] reviewed a self-tracking menstrual cycle app to ascertain its ability to improve accuracy of predictions of date for the next ovulation. It was determined to have the capacity of generating formulas to accurately predict future ovulation. Zhao et al [18] investigated 4925 infant food mobile phone apps in China and was found to be effective. Other investigations include, Huber et al [19] for treatment of lower back pain, apps for health-related research by Atreja et al [20]; and Latif et al [21] for clinical decisions, remote monitoring and epidemic outbreaks, which were all marked with high efficacy levels. World Vision International implemented a mHealth project in the Narsighpur district of India to monitor the nutritional status of newborn, child and maternal health using a simple tool by frontline health workers to capture and analyze data for malnourished children, pregnant women and lactating mothers. The findings indicated access to improved and efficient care, and built the capacity of workers [22]. In another development, Sun et al [23] mentioned quality access, healthcare cost cuts, better clinical outcomes, patient centeredness and adherence as major breakthroughs of mHealth in China. Studies by [24,25] suggest that surveillance, prevention and treatment adherence for the aged are strong in some developing countries.

There exist more than 30 mHealth initiatives operating in very limited scale across Ghana for data collection, appointment reminders via SMS and target group messaging. Available literature shows that there is little knowledge, diffusion and adoption of mHealth in Ghana, despite being a nation with one of the high mobile penetration rates in Africa. Mobile Technology for Health (MOTeCH) is a mHealth intervention which was piloted in 5 districts of Ghana from 2011 to 2014 to monitor pregnant women, postpartum mothers and attendance to health facilities [26]. Average responses from the districts indicate that 50% responses were received from pregnant women within the first trimester but this drastically reduced to 2% in the third trimester. As for the lactating mothers there very few responses because mothers concentrated on their babies. It is believed that Ghana has a great potential for mHealth to reduce help gaps in the rural communities through the provision of quality health care at reduced cost, especially in the areas of reduced travel cost, number of visits to facilities, reduced number of admissions due to proper monitoring and treatment adherence, as well as

few emergencies due to fatalities [27]. Other future potential of mHealth in rural areas can be summarized into:

- Significant impact on clinical outcomes such as longer life span, reduced maternal mortality, child death and infant mortality
- Improved patient health due to compliance and adherence to treatment
- Effective disease surveillance and quick response to epidemic management
- Improvement of public awareness leading to increased quality care delivery
- Improved lifestyle, enables remote treatment and enhances patient-centeredness
- Efficient and real-time transmission of patient information
- Strategy for prevention and early detection of disease outbreaks
- Help to address the spread of communicable diseases
- Increase in average household income levels through reduction in healthcare cost with high life expectancy
- Increases quality healthcare access and contributes towards universal health coverage (UHC)

## 1.2 Challenges in mHealth Implementation

Despite the overwhelming verdict for the potential in mHealth, many are the challenges involved in its implementation. A paper presented at the 6<sup>th</sup> International Conference on mHealth Applications in Germany by Dennis Beckera [28] identified security and efficacy as major problems affecting the use of mHealth in tackling mental health in young adults. The findings revealed that little is known about the intervention and how effective it has been used to treat mental disorders. Apart from potential disclosure of data, availability and accessibility to the application affects adoption globally. Sedrati et al [29] confirm the usefulness of mHealth in the dispensation of quality health but they believe that their efficacy is not assured since developers are not meticulous in testing the products to guarantee reliability and accuracy. The research examined mHealth apps dedicated to stroke patients, brain and spinal cord injury as well as those involved in substance abuse resulting in anxiety and depression, the results indicated that there was lack of proper procedure, processes and technological aids to enhance dissemination and adoption. More than 536 mHealth apps were identified on Google Play and iTunes, and classified according to their efficacy and use, it was realized that little is known of their efficacy and helpfulness [30]. The European Public Health Alliance (EPHA) [31] recognizes the critical role mobile technology plays in the delivery of quality health across the globe. The alliance is however quick to identify financial, ethical, legal and technical deficiencies affecting mHealth implementation.

The objective of [32] was to discuss the experiences gained by the study and outline the conditions under which the technology can be successfully integrated into the traditional care giving process. A multilingual aid tool (xprompt) was deployed together with 160 employees (using iPads) in 10 wards for a period of 6 weeks to administer questionnaire on the tool. Out of 160 participants, 42 returned the documents and 39 actually completing the questions. About 90% had never used iPad, but the participants generally agreed that mobile translation tools were beneficial in communicating with foreign patients. Perceived usability or ease-of-use was rated at 90% while in general terms, participants were less enthusiastic about the practical application of xprompt because it is time consuming. The writers are of the view that enough time was not given to study the app and its implementation and deployment was done in a rush and without wide consultation.

Within the African context, 420 million unique mobile subscribers were recorded in Sub-Saharan Africa (SSA) at the end of 2016 and projected to hit 500 million by 2020 [33]. This is an indication that Africa is well positioned with huge potential to deploy mHealth to resolve its major health issues. The article also supports other authors who are of the view that there are efficacy problems. Many mHealth interventions have been implemented in Africa over the last decade Aranda-Jan et al (34), and these projects determined that issues like little evidence on outcomes, lack of cost-effectiveness and absence of funding to scale up create uncertainty for sustainability. Due to little evidence of mHealth in SSA a study was conducted on surveillance is interventions within the public health domain and results indicated that surveillance helping drive effective, efficient cost-cutting healthcare delivery in the global and advance economic space but not SSA because of financial, logistics and clinic factors [22]. Sun et al [23] observed that projects in Africa fail mainly due to social and economic issues rather than technology. Maar et al [35] strongly support the view that social congruence is a barrier to scale up of projects. A 2011 WHO report including 255 analyzed articles proved that SMS is the most used in developed nations and the Low- and Middle-Income Countries for awareness, surveillance and patient monitoring [36]. Barriers like small and young markets, efficacy uncertainty are key to the development of mHealth in the United States and China, while lack of planning, little stakeholder consultation and insufficient assessment form obstacles in Uganda [37-39]. Limitations in Kenya include inequity in resource distribution, poor regulation of the sector, data insecurity, low literacy and high poverty rates [40].

The most critical challenges in mHealth implementation have been defined by some authors as follows:

**Usability:** Defined per ISO 9241 as the effectiveness, efficiency and satisfaction with which a specific user can achieve the specific goals of a particular environment. Usability poses a huge challenge to mHealth implementation [41, 42].

**Integration of technology and interoperability:** Most of the apps do not have the capacity to update, merger and use under different conditions of technology and devices. This constitute

a serious problem for successful adoption since they cannot be used on different platforms [41, 42].

**Data security and privacy:** Patient data is very critical to treatment and should be put under public view and scrutiny, this could cause patient trauma and public ridicule depending on the type of ailment. mHealth has not shown strong evidence of patient data confidentiality which is a grievous militant against success because data capture, storage and retrieval are not effectively handled [ 43,44].

**Reliability:** This is the ability of the app or device to function properly at a time it is required to. Due to geographic displacement and connectivity variations, apps and devices tend to perform with varying efficiency and accuracy-based positioning which is quite worrisome [ 45, 46].

**Network Access:** The availability and affordability of network access, speed and signal strength are very crucial for the operations of health systems. Network coverage is not evenly distributed with very bad signal in some areas especially the rural areas. Some parts are totally unserved, meaning mHealth cannot be operational in such places. To deliver the mHealth benefits in rural communities, then universal network coverage should be vigorously pursued [46, 47].

**Technically challenged Staff:** Most health professionals are technologically challenged and lack the dexterity to handle certain high definition apps and devices which could lead to a total failure of system. Training, awareness creation and education are highly recommended under such conditions [43, 44].

**Illiteracy:** Illiteracy has always been a problem when it comes to technical issues. Lack of education induces lack of understanding and confusion for technology and its adoption. Users do not appreciate device functionality and are unable to operate them which could lead to very low update [42, 45].

**Policy and regulation:** Even though there widespread mHealth piloting around the world most of them are not barked by law. Policy regulation, regarding the type of intervention to be used for a particular disease have not been formulated in most countries. This is due to lack of consultation among designers, vendors, health professionals and policy makers. In order to resolve this there should be broader consultation among major stakeholders in the health ecosystem [48, 49].

**Financial accessibility:** Cost of apps and devices is a setback to a successful deployment of projects. Users' ability and willingness to pay for a service is seriously jeopardized with increasing cost. A policy regulation is required to stabilize prices while seeking to deploy in rural regions where poverty is endemic [50, 51].

**Acceptability:** The correlation between service providers and the sociocultural needs of individual customers and communities have not been established. Some ethnicities cannot and would not use the service due to cultural beliefs; as a result they will not adopt it if there is shift in the way of thinking and practice [47, 50].

### 1.3 Resolving Implementation Challenges in mHealth

A number of solutions have been suggested by authors to help manage the challenges in mHealth. [1] concedes that a serious collaboration among governments, multinational organizations, the private sector and developers is the first step to resolving the mischief. WHO [2] which supported the idea of collaboration, indicated the need for partnerships among mobile network operators (MNOs). By this, MNOs can demonstrate a clear strategy intention with ministries of health on mHealth apps for scaleups. Bradway et al [51] observed that universal protocols evaluating mHealth apps are good but advised that frameworks should be designed according to the needs, financial muscle of individual countries as well as the existing health system. The integration of mHealth to existing national health systems and the creation of massive public and health worker awareness, according to [52-54] are the surest ways to mHealth success. The most effective ways of resolving the implementation barriers include:

- Integration of all mHealth projects into nationwide healthcare system and strategy
- Align the strategy to comprehensive solutions with the most relevant priorities
- Develop policy regulations and frameworks that enhances the deployment of innovative solutions that links healthcare to mobile health services
- Intense awareness creation, education and training for patients, customers and professionals in care delivery;
- There should be absolute collaboration among all essential sectors and stakeholders;
- Take records and analyze user adoption of apps and satisfaction level
- Institute surveillance and extensive research to help unearth evidence-based results.

## 2. MATERIALS AND METHODS

A PubMed was used in 2016 as the search instrument with keywords such as mHealth, implementation challenges and mHealth potential for the initial review. The PubMed search was reconducted in 2017 to include previously published articles. Keywords included mHealth implementation, benefits or prospects, bottlenecks and strategies for resolving the challenges. Many other sites such as the world health organization (WHO), Deloitte, mHealth Intelligence, Ministry of Health (Ghana), and Price Waterhouse Coopers (PWC) were searched manually. Based on the title of this review, articles in English closely related to mHealth implementation in low income countries were compiled for the project. All duplicates were identified and removed, after which an abstract based review of articles was performed to collect more papers for analysis according to a specific inclusion design. These criteria included: the main focus of the study which is mHealth implementation in rural areas, articles should evaluate the barriers to mHealth implementation,

prospects or potential of mHealth and literature on best ways of combatting the implementation challenges of mHealth in remote areas. Generally, literature was classified into global, regional, national and local. This was to enable us make a comparative analysis of mHealth across the globe under different geographical landscapes, levels and conditions so as to draw a well-informed conclusion.

## 3. RESULTS AND DISCUSSIONS

Searches retrieved 300 citations and taken through rigorous screening to determine the inclusion list. At least 150 records were eliminated as junk URLs and duplicates, leaving 150 articles. Further scrutiny in terms of their titles and abstracts was done and finally 100 articles met the review criteria. Out of this figure 56% were classified as articles with global information, 16% were under the regional category, with 20% and 8% recorded for national and local respectively. The global papers discussed mHealth issues without restrictions to geography, 50% of the regional category related to Asia and Europe while the other half focused on Africa. However, when we come to the studies restricted to nations, 90% are from developed countries while the remaining 10% had to do with Africa. In terms of local or Ghana to be specific only 4 articles were retrieved. The results are a direct proof of that mHealth is still evolving in the low-income countries, in regions where mobile penetration is very high like Africa with specific reference to Ghana. Armed with this knowledge, governments should make deliberate efforts to ensure all bottlenecks are removed for high diffusion and adoption of mHealth in remote areas.

## 4. CONCLUSION

mHealth is used by most countries as a tool to improve healthcare access by eliminating the geographic barriers from the healthcare equation. In other jurisdictions it is seen as a way to improve the poverty situation of people in rural communities. However, technological challenges, illiteracy, sociocultural difficulties and finances are among the serious obstacles to a successful implementation of the intervention. This study is successful in identifying the key barriers to mHealth implementation and the benefits it brings if the bottlenecks are removed, and ways to deal with the challenges provided. A critical review of the vast literature has brought us to one thing; that is if all the challenges identified are given the requisite hearing and actions per the suggestions then the pervasiveness of the mHealth technology in transcending every geography would surely yield the fruits due developing countries. The aggregate contributions from these least developed nations would help in attaining the Universal Health Coverage (UHC). This review has demonstrated that mHealth intervention has evolved over the years to become a critical tool in the delivery of quality and cost-effective healthcare services, especially in the remote areas where health workers are in short supply. So, to fully enjoy all potential and future prospects of mHealth, authorities must design strategies to overcome the challenges involved in its full implementation.

## REFERENCES

- [1] Vital Wave Consulting (2016). "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World". [ Online] [www.unfoundation.org/vodafone](http://www.unfoundation.org/vodafone). (April 15, 2018)
- [2] WHO (2015). "A practical guide for engaging with mobile network operators in mHealth for reproductive, maternal, newborn and child health". [www.who.org](http://www.who.org). [ Online]. (March 26, 2018).
- [3] Graham Thomas and Rena Wing. "Health-E-Call, a Smartphone-Assisted Behavioral Obesity Treatment: Pilot Study". *JMIR Mhealth Uhealth*, vol. 1, iss.1., 2013.
- [4] Kathryn et al (2013) "Mobile Phone Applications for the Care and Prevention of HIV and Other Sexually Transmitted Diseases: A Review". *J Med Internet Res*, Vol. 15, Iss.1, Jan.2013 Jan.
- [5] Shaw et al. "Development of a Theoretically Driven mHealth Text Messaging Application for Sustaining Recent Weight Loss". *JMIR Mhealth Uhealth*, vol. 1, iss.1, Jan.2013.
- [6] Tatara et at. "Long-Term Engagement with a Mobile Self-Management System People With Type 2 Diabetes". *JMIR Mhealth Uhealth*, Vol.1, pp.1-11, Mar.2013.
- [7] Maduka et al. "Using Android and Open Data Kit Technology in Data Management for Research in Resource-Limited Settings in the Niger Delta Region of Nigeria: Cross-Sectional Household Survey". *JMIR Mhealth Uhealth*, vol. 5, pp.1-171 May, 2017.
- [8] Pirolli et al. "Implementation Intention and Reminder Effects on Behavior Change in a Mobile Health System:A Predictive Cognitive Model". *J Med Internet Res*, vol.19, pp.1-397, Jan. 2017.
- [9] Loiselle and Ahmed. "Is Connected Health Contributing to a Healthier Population?" *J Med Internet Res*, vol. 19, pp.1-386, 2017.
- [10] Pereira-Salgado et al. "Mobile Health Intervention to Increase Oral Cancer Therapy Adherence in Patients with Chronic Myeloid Leukemia (The REMIND System): Clinical Feasibility and Acceptability Assessment". *JMIR Mhealth Uhealth*, vol.5, pp.1-17, Jun.2017.
- [11] Xie et al. "Chinese Cardiovascular Disease Mobile Apps' Information Types, Information Quality, and Interactive Functions for Self-Management: Systematic Review". *JMIR Mhealth Uhealth*, vol.5, pp.1-195, Jun. 2017.
- [12] Rathbone et al. "Assessing the Efficacy of Mobile Health Apps Using the Basic Principles of Cognitive Behavioral Therapy: Systematic Review". *J Med Internet Res*, vol.19, pp.1-399, Jan. 2017
- [13] Robbins et al. "Health App Use among US Mobile Phone Users: Analysis of Trends by Chronic Disease Status". *JMIR Mhealth Uhealth*, vol.5, pp.1-197, June, 2017.
- [14] Dou et al. "Patients' Acceptance of Smartphone Health Technology for Chronic Disease Management: A Theoretical Model and Empirical Test Background: Chronic disease patients often face multiple challenges from difficult comorbidities. Smartphone health technology". *JMIR Mhealth Uhealth*, vol.5, pp. 1-177, June, 2017.
- [15] Slater et al. "End User and Implementer Experiences of mHealth Technologies for Noncommunicable Chronic Disease Management in Young Adults: Systematic Review". *J Med Internet Res*, vol.19, pp.1-406, Jan.2017.
- [16] Palazuelos et at. "User Perceptions of a mHealth Medicine Dosing Tool for Community Health Workers". *JMIR Mhealth Uhealth*, vol.1, pp.1-2, Dec.2013.
- [17] Sohda et at. "Relationship Between the Menstrual Cycle and Timing of Ovulation Revealed by New Protocols: Analysis of Data from a Self-Tracking Health App". *J Med Internet Res*, vol.19, pp.1-391, Jan.2017.
- [18] Zhao et al. "How Do Infant Feeding Apps in China Measure Up? A Content Quality Assessment". *JMIR Mhealth Uhealth*, vol.5, pp1-186, June, 2017.
- [19] Huber et al. "Treatment of Low Back Pain with a Digital Multidisciplinary Pain Treatment App: Short-Term Results". *JMIR Rehabil Assist Technol*, vol.4, 1-11. Aug.2017
- [20] Atreja et al (2017). "Mobilizing mHealth Innovation for Real-World Evidence Generation". *Duke-Margolis Center for Health Policy | [healthpolicy.duke.edu](http://healthpolicy.duke.edu)*. [Online]. (March 26, 2018).
- [21] Latif et al. "Mobile Health in the Developing World: Review of Literature and Lessons from a Case Study". *IEEE*, vol. 5, pp. 11540-11556, 2017.
- [22] Brinkel et al. "Mobile Phone-Based mHealth Approaches for Public Health Surveillance in Sub-Saharan Africa: A Systematic Review". *International Journal of Environmental Research and Public Health*. [www.mdpi.com/journal/ijerph](http://www.mdpi.com/journal/ijerph). [Online]. (March 26, 2018).
- [23] Sundin et al (2017). "Why do Entrepreneurial mHealth Ventures in the Developing World Fail to Scale?" presents at the Humanitarian Engineering and Social Entrepreneurship (HESE) Program, Pennsylvania, USA, 2017.
- [24] Y Xiaohui et al. "mHealth in China and the United States:How Mobile Technology is Transforming Healthcare in the World's Two Largest Economies". *Center for Technology Innovation at Brookings*.

- www.brookings.edu/techinnovation. (March 26, 2018).
- [25] M. kiberu et al (2017). "Barriers and opportunities to implementation of sustainable e-Health programmes in Uganda: A literature review". *African Journal of Primary Health Care & Family Medicine*. pp. 2071-2936 [Online]. (March 26, 2018).
- [26] Kate Hampshire et al. "Who bears the cost of 'informal mhealth'? Health-workers' mobile phone practices and associated political-moral economies of care in Ghana and Malawi". *Health Policy and Planning*, vol.32, pp.34-42, 2017.
- [27] Kinful Lartebea Aryee (2014). "The Role of Mobile Phones in Health Education for Rural Communities in Ghana: An Exploratory Study in Digital Technologies".
- [28] Dennis Beckera. "The 6th International Conference on Current and Future Trends of Information and Communication Technologies in Healthcare (ICTH 2016): Acceptance of mobile mental health treatment applications". *Elsevier, Procedia Computer Science*, Vol. 98, pp. 220 -227, Nov.2016.
- [29] Sedrati et al. "Mental and Physical Mobile Health Apps: Review", in *proc. Conference on Enterprise Information Systems / International Conference on Project Management / Conference on Health and Social Care Information Systems and Technologies, Centeris / Projman / HCist, 2016*, pp. 900-906.
- [30] António Cunha et al. "Conference on Enterprise Information Systems / International Conference on Project Management / Conference on Health and Social Care Information Systems and Technologies, CENTERIS / ProjMAN / HCist". *Elsevier, Procedia Computer Science*, vol.100, pp.118-127,2016.
- [31] European Public Health Alliance (2017, May). "Digital Solutions for Health and Disease Management: Digital Health Discussion Paper". Available, [www.epha.org](http://www.epha.org). (March 26, 2018).
- [32] Albrecht et al (2013). "Usage of Multilingual Mobile Translation Applications in Clinical Settings". *JMIR Mhealth Uhealth*, vol.1, 2013.
- [33] GSMA (2017). "The Mobile Economy: Sub-Saharan Africa 2017". Available: [www.gsmaintelligence.com](http://www.gsmaintelligence.com). (March 26, 2018).
- [34] C. Aranda-Jan et al (2015). "Systematic review on implementation of mobile health (mHealth) projects in Africa: *What works? What doesn't work and why?*" Institute of Public Health, University of Heidelberg, Heidelberg, Germany. (March 26, 2018).
- [35] Maar et al. "Framework for the Study of Complex mHealth Interventions in Diverse Cultural Settings". *JMIR Mhealth Uhealth*, vol.5, pp.1-11, Jan. 2017.
- [36] Haitham Abaza; Michael Marschollek. "mHealth Application Areas and Technology Combinations: A Comparison of Literature from High and Low/Middle Income Countries". *Methods Inf Med*, vol. 56, pp.105-122, 2017.
- [37] Y. Xiaohui et al. "mHealth in China and the United States: How Mobile Technology is Transforming Healthcare in the World's Two Largest Economies". *Center for Technology Innovation at Brookings*. [www.brookings.edu/techinnovation](http://www.brookings.edu/techinnovation). (March 26, 2018).
- [38] M. kiberu et al. "Barriers and opportunities to implementation of sustainable e-Health programmes in Uganda: A literature review". *African Journal of Primary Health Care & Family Medicine*, pp. 2071-2936, 2017.
- [39] Odhiambo, Evans Andrew (2017). "The use of mHealth to Improve Quality and Reduce Cost of Healthcare in Rural Kenya". *Laurea University of Applied Sciences Global Development and Management in Healthcare*. (April 15, 2018).
- [40] Tarikwa Macaulay Leveille. "Mobile Health and its Role in Addressing Maternal Health in Sub-Saharan Africa". Master's thesis, Clark University, Massachusetts, USA, 2016.
- [41] Kruse et al. "Evaluating barriers to adopting telemedicine worldwide: A systematic review". *Journal of Telemedicine and Telecare*, vol. 24, pp.4-12, 2018.
- [42] Peters et al. "Poverty and Access to Health Care in Developing Countries". *Ann. N.Y. Acad. Sci.* doi: 10.1196/annals.1425.011, 1136: 2008, pp. 161-171.
- [43] Vital Wave Consulting (2016). "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World". [Online]. Available: [www.unfoundation.org/vodafone](http://www.unfoundation.org/vodafone). [March 26, 2018].
- [44] Sean Lunde (2017). "The mHealth Case in India: Telco-led transformation of healthcare service delivery in India". [Online]. Available: [www.wipro.com](http://www.wipro.com). [March 26, 2018]
- [45] Minh et al (2012). "Financial burden of household out-of pocket health expenditure in Viet Nam: Findings from the National Living Standard Survey". *Elsevier Ltd.* [Online]. Available: <http://dx.doi.org/10.1016/j.socscimed.2012.11.028>. [March 26, 2018].
- [46] John Coggin (2018). "Rural Economic Development & Health Care Access. Presentation to Committee on Access to Healthcare in Rural North Carolina (LRC)". *NC Rural Center*. [Online]. Available: [www.ncruralcenter.org](http://www.ncruralcenter.org). [March 26, 2018].
- [47] Yvonne O' Connor and John O' Donoghue. "Contextual Barriers to Mobile HEALTH Technology in African Countries: A perspective Piece". *Journal of Mobile Technology in Medicine*, vol.4, 2015.

- [48] UNICEF (2017). “Mobile Health Technologies (mHealth) Engaging, connecting, responding – both faster and smarter”. [Online]. Available: [www.unicef.org](http://www.unicef.org). [April 15, 2018].
- [49] Kaushal Modi and Radha Baran Mohanty (2017). mHealth: Challenges, benefits and keys to successful implementation. [Online]. Available: [www.infosys.com](http://www.infosys.com) [March 26, 2018].
- [50] Thomas Martin (2012). “Assessing Health: Opportunities and Barriers to Patient engagement”. *Journal of Health Care for the Poor and Underserved*, Vol.23, pp. 935-941, 2017.
- [51] Marie Ennis O'Connor (2012) “mHealth: Barriers to Global Implementation”. Available: <http://jamia.oxfordjournals.org/>(April 15, 2018)
- [52] Bradway et al. “Mobile and tablet apps, ubiquitous and pervasive computing, wearable computing and domotics for health”. *JMIR mHealth and uHealth*, Vol.5, pp.2291-5222, 2017.
- [53] Catharina Barkman & Lars Weinehall (2017). “Policymakers and mHealth: roles and expectations, with observations from Ethiopia,Ghana and Sweden”. *Global Health Action*. [Online]. Available: <http://www.tandfonline.com/loi/zgha20> [March 26, 2018].
- [54] R. Kayyali et al. “Awareness and Use of mHealth Apps: A Study from England”. *Pharmacy* 2017, vol. 5, 2017.