

# MOBILE HEALTH (mHEALTH) IN THE DEVELOPING WORLD: TWO DECADES OF PROGRESS OR RETROGRESSION

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## Abstract

Mobile healthcare, or mHealth, is one of the key pillars of information and communication technologies for healthcare that consists of telemedicine, telehealth, eHealth, and mHealth. In the past two decades, mobile health has become a transformative concept for healthcare delivery innovations on a global scale. The success was based on the market-driven strategies that utilised the advances in mobile communications, computing, and sensor technologies, especially in recent years. Those market-driven mobile health systems were also closely associated with the global proliferation of smartphones, and based on the correlated usage principle of the smartphone applications for healthcare and wellbeing. However, the global commercial success of the smartphone-based mHealth model was not widely translated into successful scaled-up and tangible healthcare benefits, especially in low- and-middle income countries, compared to the consumer mobile health markets. The numerous healthcare challenges in the developing world remained largely untackled by the existing mobile health systems and models. The much-hyped transformative benefits of these systems remain largely unfulfilled. For two decades since the inception of this concept, the majority of the population in resource-limited healthcare settings still remain in poorer health and live in worsened conditions, with limited if any access to basic healthcare services. The much-hyped mobile health services that promised transforming these fragile and limited healthcare conditions, did not come to wider fruition globally. The COVID-19 pandemic, with its devastating human and economic impact worsened this status. An overview of the origin and the basic principles of mobile health, its current landscape and status in the developing world is presented. The impact of the smartphone-centric model that dominated the landscape of mobile health systems in these countries is discussed, and a critical view on the limitation of this mobile health model adopted widely in these settings is provided.

**Keywords:** eHealth; mHealth; telemedicine; telehealth; COVID-19; digital health

Istepanian RSH, Kulhandjian M, Chaltikyan G. *JISfTeH* 2020;8:e24(1-5).

DOI: <https://doi.org/10.29086/JISfTeH.8.e24>

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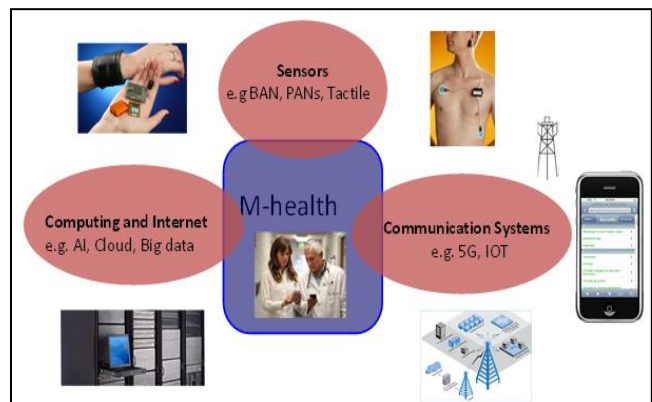
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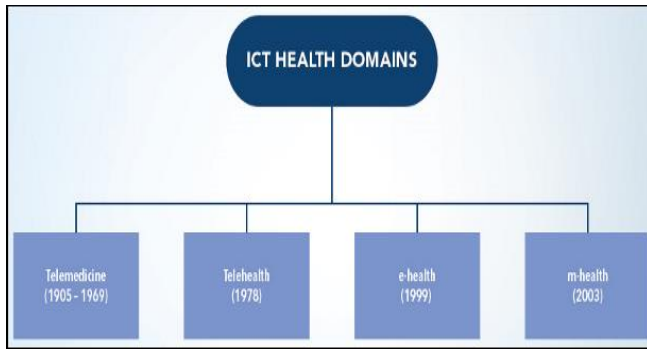
## Introduction

The term “mHealth” was first coined in 2003 by Istepanian, followed by the first definition of the concept as *mobile computing, medical sensor and communications technologies for healthcare*.<sup>1,2</sup> The introduction of mobile health was also represented by three basic building blocks: computing, communications, and sensing as shown in Figure 1. The details of these building blocks and the recent developments associated with each one of these pillars have been described.<sup>3-5</sup>

As shown in Figure 2, mHealth is widely recognised as the fourth domain of the ICT for health domains that include telemedicine, telehealth, eHealth, and mHealth. The premise of this taxonomy is that these terms are not interchangeable



**Figure 1.** The basic building blocks of mobile Health (mHealth).<sup>2,4,5</sup>



**Figure 2.** Key domains of ICT for health (Adapted from Istepanian and Woodard).<sup>4</sup>

because they represent different concepts and related activities, and this becomes evident if we consider their origins. This remains the most valid and established taxonomy of these domains to date.

In 2011, the World Health Organization (WHO) defined mHealth as covering “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices”.<sup>6</sup> The WHO in this view also advocated the inclusion of mHealth within the eHealth domain. This and other confusing views and definitions have contributed to the status quo and to ambiguity over the concept’s original definition and core principles.

The introduction of smartphone technologies in 2007 has played a major influential role in the evolution of mHealth. This role is both a blessing and a curse: the blessing is that technological breakthroughs in mobile and Internet communications are putting mHealth on the global radar, while the curse is the false notion among many experts and non-experts alike is that m-Health is merely smart phone centred application (App) area.<sup>4</sup> This can be best interpreted on following simple ‘telecom formula’ of m-Health:<sup>4</sup> **mHealth = mobile(smart) phone + healthcare delivery service.** Furthermore, the term ‘digital health’ has been increasingly used in conjunction with mobile health in recent years. This relatively new trend has invited major conjecture and discussions on what is digital health and how it relates to mobile health. The ambiguous rapprochement between the two disciplines remains unclear and largely questionable. The arbitrary and frequent usage of this term fuelled further debate and global discussions. These left many unanswered questions on the real motives behind this alternative terminology usage and proliferation process. It is unlikely that alternative usage of terminologies will bring fundamental and tangible changes to the existing healthcare status in the developing world, especially as advocacy of the smartphone-centric model is prominent in many of this and other veiled terminologies of mobile health. These and other aspects of mobile health from the technological, clinical, market regulatory, and policy aspects have been discussed extensively in the following literature.<sup>4,5,7</sup>

### Analysis of the literature review on mobile health in the developing world

In this section, we present an analysis on mobile health (mHealth) applications and interventions in the developing world and discuss the current status of mobile health in these areas. It is widely accepted that most of the low- and middle-income countries (LMIC) face a plethora of efficient and effective healthcare delivery challenges. These countries face a severe lack of specialist healthcare resources, as well as have some of the largest burdens of disease and extreme poverty, compounded by high population growth rates. These challenges were reflected in the United Nations Sustainable Development Goals (SDGs), particularly in the third goal the states to ‘Ensure healthy lives and promote well-being for all ages’.<sup>8</sup> This SDG goal is most relevant to mobile health in translating this objective to effective and efficient healthcare and wellbeing outcomes.

The importance of mHealth from the global perspective is reflected by the numerous initiatives developed by the UN, WHO, World Bank, global telecommunication and medical industry alliances for nearly two decades.<sup>4,5</sup> These aimed to harness different mHealth solutions for addressing healthcare delivery services in the developing world and low-income settings. Predominately, most of these initiatives have emerged from exploiting the power of smart mobile phone technologies, tailored for global healthcare challenges. They are also driven by the assumption of the massive growth in the use of smart phones in most of the developing world can be successfully translated similarly to mobile health solutions with scaling up process in these countries.<sup>4</sup> The reality was different, and these remained within the pilot stages, and at best scaled up in limited global settings.

The extensive literature reviews published in recent years on mobile health applications and interventions in the developing world reflect the interest and limitations of this important area.<sup>9-14</sup> Since most of these studies were evaluated based on the mobile and smartphone intervention models of m-Health, without considering alternative approaches of mobile health interventions.

From this extensive evidence of these interventions and applications, it can be concluded that most of these global mHealth initiatives and programmes seem to lack the necessary clinical rigour and suitable measures for their long-term health impact and efficacy. The popularity of these systems was not reflected in their efficacious and effective impact on larger-scale levels. The most common healthcare areas and challenges mostly identified with mobile health as potentially effective tools were in the infectious diseases, maternal health intervention areas, in addition to patient educations and awareness solutions.<sup>10-12</sup> These studies also indicated that African countries were the most frequently studied settings for mobile health compared to other developing world regions.<sup>10</sup> This can be attributed to several factors, primarily to the existence of significant healthcare

challenges and population-level health problems in most African countries. This was compounded by severe levels of poverty, conflicts, and displacement in the continent. That explains the popularity and availability of low-cost mobile phones with short messaging service (SMS) capabilities among African users.

There has been increased funding interest and donor allocation for various mobile health programmes and initiatives in recent years. These were presented from various international bodies, aid agencies, and other specialist foundations.

From the technology perspective, the mobile SMS was the most common mHealth technology tool used in many healthcare settings.<sup>10-13</sup> However, the limited scope of the SMS interventions and the narrow applicability may have contributed to the problems with sustainability and scaling-up of the services. The proliferation of mHealth “pilotitis” (small, technically driven pilots) in these countries as opposed to large-scale deployments and sustainability, was and will remain a major challenge for the different stakeholders in these settings.<sup>5</sup> Although some level of mHealth success seems to be evident in some regions within the developing world or LMICs; there is still an absence of rigorous and larger evidence base due to the limited deployments following these pilot studies. This clinical ambiguity has repeatedly trended in many areas, including non-communicable diseases (NCDs) such as hypertension, obesity, diabetes, cardiovascular failure, and heart failure.

The major barriers of sustainable funding, mobile health leadership, and the required infrastructure to scale up these services were identified from these studies and pilots.<sup>10-14</sup> The recently announced WHO guidelines for digital health interventions are an important step in the future proliferation and standardised deployment of mobile health systems and services in the developing world.<sup>15</sup> These can also contribute to alleviating some of the existing barriers and challenges mentioned above.

### **The impact of COVID-19 pandemic on the developing world and the role of mHealth**

The impact of COVID-19 pandemic on the developing world was devastating with major human and economic implications, especially in poorer regions and settings of the world. Most of the mHealth systems that were in place were unable to cope with the ‘tsunami’ impact of this disease. The pandemic also exposed the ‘digital divide’ between the developed world and the developing countries fighting this disease from the mobile health perspectives. The rapid development of low-cost testing linked to mobile health systems to accurately identify, trace and track COVID-19 patients is vital for the effective fight against this pandemic. The availability of these systems for this and future pandemics, combined with effective mobile health pandemic preparedness strategies are critical tools for the fight against future pandemics. The COVID-19 pandemic also exposed

the serious gaps and shortcomings not only in the existing capabilities of the analogue healthcare systems in these settings, but also similar gaps in the existing digital health strategies used to mitigate the impact of this disease.

The new global health realities during and post COVID-19, demand urgent revisions of these strategies as well as identifying their limitations. Some of these shortcomings were evident in the initial reactions in the worst affected countries within the developing world. In line with the ongoing efforts to vaccinate the populations against the SARS-CoV-2 and its variants, there is more and urgent need for developing more creative mHealth solutions and tools, especially for these countries and regions that are most affected by this pandemic.

### **Discussion**

Mobile health or (mHealth) has been hailed by the market driven proponents as the key transformative concept for healthcare innovations. However, this ambitious vision was not crystallised successfully due to successive and narrow interpretations of mobile health over the last two decades. These consequently boxed the concept within the ‘telecom formula’ discussed earlier. The recycling this process as digital health is ongoing by the same proponents.

The human and economic impact of the COVID 19 pandemic particularly within the developing world and the failure of the existing mobile health models to respond effectively and globally to this pandemic vindicated this view and verdict. The absence of effective and sustainable global mobile health solutions and strategies that could have mitigated this impact in these countries was evident during this pandemic. The much-hyped perceptions of the smartphone-based mobile health systems were diminished in the face of this pandemic, proving that the science and not the market of mHealth is the necessary path for the future.

From the market-driven mobile health perspective, the complex healthcare processes and infrastructures in the developing world need to be matched to relevant cost-benefit business models for mobile health that are completely different from the same models adopted in the developed world. These must take into consideration the economic realities, planning, management, monitoring, collaboration, information extraction, education, and training levels in these countries.

From the technological perspective, the recent advances in the computing, sensors and telecommunications areas will be fundamental in altering the current status quo of mobile health. From the 5G communications perspective, high spectral- and power-efficiency, massive connectivity, and low latency are among the requirements for next-generation communications, and these requirements are expected to increase in the future, as researchers turn their efforts towards sixth-generation (6G) wireless communications.<sup>16</sup> The novel ICT technologies such as enhanced mobile broadband

(EMB), Internet of Things (IoT), Artificial Intelligence (AI), Big Data analytics, cloud computing, and blockchain can play a vital role to facilitate the environment fostering protection and improvement of health and economies, especially in the developing world. The capabilities that these technologies provide for pervasive and accessible health services, are crucial to alleviate the pandemic-related problems. These 5G technologies will enable ubiquitous digital health services which can be described as 5G Health or 5G based healthcare use cases.<sup>16</sup> However, any future 5G health system will not be available in most of the developing countries for at least a few years due to the many barriers already described.

Despite the technological advances and use-cases of 5G concerning healthcare in the foreseeable future, there are two main challenges for deploying these in the developing world:

(i) Identifying the most urgent healthcare challenges that can benefit from these systems in a cost-effective way.

(ii) The scalability of these systems taking into consideration the socio-economic factors that include technology awareness, acceptance by users, and other human interaction factors.

Among the most effective mHealth tools for the developing world will remain largely cost-effective solutions tailored to the developing world and poor healthcare settings. These include, for example, the introduction of low-cost virtual mobile teleconsultation systems between clinicians and patients in resource-limited settings. These need to depend on free Internet access and not be entirely dependent on the telecommunication operators in these regions. Access to the Internet in remote areas, to enable the outreach of mobile health services, remains vital for the large-scale adoption of these technologies in these settings.

The COVID-19 pandemic necessitated the need for urgent attention to future public health emergencies, and for reshuffling the current mHealth technologies and strategies used in the current pandemic. These measures are more urgent and need to be more rigorous for the developing world where the failure of the current ‘digital health’ systems that were based on the smartphone applications were evident in the poorer regions compared to the developed world.

## Conclusion

An overview of the origin and the basic principles of mobile health, its current landscape, and its status in the developing world has been presented. The impact of the smartphone-centric model that dominated the landscape of mobile health systems in these countries has been described and provided a critical view on the limitation of this mobile health model adopted widely in these settings. The smartphone-centric (telecom formula) model was widely if not exclusively used in the majority of the mobile health systems applied in the developing world for different healthcare applications. The analysis of these systems from the published literature

indicated limited patient outcomes and poor scaling-up levels in most of the care settings and applications, with few exceptions.

The role of new mobile health systems in improving the more urgent healthcare needs for the developing world remains important if not vital. The current COVID-19 pandemic necessitated the need for a new rethinking of the current mHealth strategies for more effective and robust mobile health approaches that can mitigate the impact of this and future pandemics.

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