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LEVERAGING MOBILE PHONE TECHNOLOGY TO IMPROVE COMMUNITY AND PUBLIC HEALTH INTERVENTIONS IN INDIA: A REVIEW OF CURRENT INITIATIVES AND DIRECTIONS FOR FUTURE INNOVATION

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Abstract- Around the globe mHealth initiatives are being implemented to increase the reach of public and community health programs. This paper provides an introduction to mHealth, an overview of current programs, and an analysis of the ways in which IT and public health program developers could partner to further advance the scope and impact of mHealth programs in India.To illustrate thesekkey points,it describes a study conducted in India to offer a solution to the basic source of health related issues.

Keywords –mHealth, Endemic Disease, LMIC, Mobile Phones

I. INTRODUCTION

With the exponential spread of mobile phones, even into more remote and rural areas of the globe, the technology originally developed to connect people for conversation and commerce is being repurposed to address many pressing needs. The emerging field of mHealth is focused on using the mobile phones, personal digital assistants (PDAs), and other wireless devices to support patients and providers in the delivery of clinical andpublic health services[1].

mHealth interventions are increasingly being used around the world in public and community health arenas to improve maternal and child health outcomes, show and track the spread of endemic diseases like HIV/AIDS, malaria, and tuberculosis, and to address health disparities that tend to beexacerbated by both poverty and remote location[1]. mHealth programs are also being developed to assist clinicians in providing direct medical care by facilitating diagnosis, managing drug shortages, and increasing providers' own clinical education and capabilities[1].

Although the adoption of mHealth initiatives holds great promise for health programs in India, they are not a panacea. As with any new technology, the desire for innovation cannot outpace the need for thoughtful and deliberate development. Emerging initiatives need to be subjected to

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careful evaluation[2]. Developing programs should complement existing national health programs, and would ideally be based upon programs already in use for related health issues[2] that, following best practices, would have a demonstrated history of both success and sustainability.

The World Health Organization has identified five different ways in which mHealth is being used around the globe to improve health[1].These include-

1. Facilitating communications between individuals and health services (for instance, help-lines that allow patients to call to receive advice with symptoms and treatment);
2. Enabling communications between health services and individuals (for instance, sending reminders to patients to keep medical appointments or take medications);

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3. Allowing consultation between health professionals (for instance, using telemedicine to teach innovative medical procedures to doctors in remote areas);
4. Permitting for emergency communications between medical facilities and providers in times of crisis (such as during flooding of cities or villages);
5. Providing a mechanism for the surveillance of disease and illness- especially in remote locations;
6. Supporting access to essential information for health professionals[1].

Given the vast scope of these different types of interventions, the authors will focus in this article on the first two modes of mHealth delivery. Specifically, it will address the facilitation of bilateral communication between patients and providers, since this is *sine qua non* in the provision of public and community health interventions. Although all of these uses of mHealth warrant further exploration and development, it is the first two modalities that offer the most immediate promise for community and public health interventions.

II.mHEALTH INITIATIVES IN LOW AND MIDDLE INCOME COUNTRIES

A global study of 112 member countries conducted by the Global Observatory of eHealth Services in conjunction with the World Health Organization found that the most frequently reported mHealth interventions among all reporting nations were health call-centers or health care telephone help lines (which had been implemented in 59% of participating countries) and emergency toll-free telephone services (implemented in 55% of participating countries). Low-income countries were significantly less likely to have adopted mHealth services (77% of participating countries) as compared to high-income countries (87% of participating countries)[1].

Although lower income countries have been shown to be less likely to implement mHealth initiatives, and have typically implemented fewer initiatives than their higher income counterparts,[1] this does not mean that such initiatives cannot be successful in less affluent regions of the world. Globally, there have been a number of interventions that have been both conducted and evaluated in low and middle-income countries (LMICs) and contribute to a growing body of literature that suggests that mHealth interventions can improve patients' adherence to various treatments and attendance at clinical appointments[4]. If anything, mHealth programs may offer more promise for low-income countries, because in these regions the coverage of mobile phone networks often far exceeds other infrastructure including paved roads,

electricity, and wired Internet[1]. This reality makes mHealth a more cost-effective and immediate way of reaching remote areas.

III. mHEALTH IN INDIA

The potential of mHealth is especially rich in India, most obviously because India has theone of the fastest growing mobile phone markets in the world[5]. According to 2014 data,62.5% of the population, or a total of 893.3 million people in India, have mobile phones[6].This number most likely under-represents true access to mobile phone technology sinceresearch has shown that Indian family members often share phones[7]. For instance, onestudy in Rajasthan found that 72-92% of participants had access to mobile phones thatwere either personally owned or shared between family members[6]. This widespreadsharing of phones suggests that the real-world penetration of mobile technology mayactually be much more vast than documented phone ownership rates depict.

There are several factors that contribute to the exponential growth of mobile phone usewithin India. First and foremost may bethe sense that mobile phones are portable yetpersonal devices that allow people to make both personal and business connections[8].Mobile phones in India are also relatively affordable to even the poorest individuals sinceIndia has the second lowest mobile phone tariff in the world, after Bangladesh[8]. The costof phone ownership is further reduced because one-quarter of all mobile phone handsetsare recycled, allowing for the purchase of these second-hand phones at reduced prices[8].This affordability is changing phone use and uptake. For many Indians mobile phones arereplacing wired phone lines[8]. For others mobile phones represent their first opportunity tohave and use private, or semi-private, telephone and text services.

With the increasing adoption of mobile phones even in the more rural and remote areas ofIndia, there has been a surge in mHealth interventions utilizing both text messages (SMS)and telephone calls. mHealth interventions have been developed and implementedthroughout India to help people with mental illness,[6][7][9] improve maternal and childhealth outcomes,[10] encourage breast cancer screening[11], study tobacco use[12], increaseHIV/AIDS treatment adherence[5][13], support behavioral interventions to prevent type-2diabetes,[14] and improve dental health through both appointment reminders,[15] and oralhealth education programs for mothers of pre-school children[16].

This burgeoning body of research has found many potential benefits of mHealthinitiatives. These interventions tend to be low-cost to implement and can be scaled tolarger populations, should the initial pilot study show promising results[13]. Automated,mobile phone interventions have the ability to cross barriers of time and space to reachpatients wherever they are and whenever they are available[13]. This is an especiallyimportant consideration for those programs targeting disadvantaged populations who maynot have access to stable housing or employment. Traditionally this insecurity meant thatthose individuals most in need of public health interventions were the most difficultpopulations with which to initiate and sustain programs. mHealth provides an opportunityto at least partially overcome this barrier. Additionally, mHealth interventions have thepotential to be sustained, at relatively low costs, for extended periods, or conversely,implemented quickly to meet a sudden demand or crisis[13].

Finally, research suggests that mHealth interventions are likely to be welcomed by Indianhealth consumers. One study found that the overwhelming majority of interviewees(99%) reported that, they not see health-related text messages on their mobile phones asan invasion of privacy - rather they limited their own calls to the program for fear ofinconveniencing the doctor providing the

outreach[17]. Another study of young urbanwomen with mental illness found that participants were reassured by having someoneavailable via their phone who could text back or call them[7]. It ispossible that mHealthinterventions may increase participants' sense of connection to caring others[7]. Thisconnection has the potential to improve not only physical but also emotional and socialhealth outcomes.

IV. ISSUES TO BE ADDRESSED

There arestill logistical matters regarding mHealth development and delivery in India thatneed to be addressed. First and foremost is thefact that, although phones are inwidespread use throughout India, they are not yet ubiquitous. This disparity is especiallynoticeable in rural areas; cell phone penetration in remote locations is less than a quarterof that in the urban regions of the country[8]. The adoption of mobile phones in rural areasand telecom manufacturing inIndia has been lower than had previously been predicted[8].This is believed to be, in part, related to the difficulty in establishing right-of-way andpurchasing land for fiber optic cables,[8] but other barriers and avenues to developinginfrastructure need to be explored and addressed. Currently there is a lack of skilledtechnologists within Indian health ministries to develop and direct these initiatives[1].

There is also a gender gap in mobile phone ownership. Less than 30% of women in Indiaown mobile phones[8][18].This disparity has especially significant implications for maternaland child health initiatives, in which sustained contact with mothers is essential. Povertyalso presents special challenges for mHealth in India. The requirement to prepay phonescan mean that disadvantaged people have intermittent service and patients or communitymembers may be lost for follow-up with health programs[6]. Finally, less expensive phonesare unlikely to have Internet connection or be able to download data[1][16]. This restricts theways in which phones may be used for m-Health. Impoverished users are also less likelyto use their phones' text-messaging or SMS services[6], further limiting the scope ofpotentialinterventions in these populations.

V. NEXT STEPS TO LEVERAGE TECHNOLOGY AND MHEALTH

Innovative collaboration between public and community health personnel and universityand college information technology (IT) programs is required by both fields for thebudding potential of mHealth in India to bloom into full flower. Each side of thisequation has an essential and unique role to play, since both partners have distinct skillsand knowledge. IT developers understand not only what is present, but also what ispossible with current and emerging technology. Public health providers understand thecurrent and emerging threats to health and safety in both the general population and tothose who are most disadvantaged. IT developers are essential to address issues ofconnectivity, and also provide analytics that will allow public health providers to betterunderstand both patterns of disease and patterns of health behavior and health resourceutilization[20].

Regardless of their area of expertise, mHealth program developers must have a clearerunderstanding of patterns of mobile phone use, barriers to this use, and the perceivedneeds of users[6]. In the language of public health this is a needs assessment; in the ITworld it is a market analysis. For both realms it is essential for future program planningand development.

The challenge of providing public health information and outreach in LMICs is enormous.Given India's vast population, the task is even greater. Successful programs will require apartnership between those skilled in providing technology infrastructure support andsoftware solutions, and experienced public health personnel responsible for contentcreation and ongoing support.

Successful programs must utilize existing communicationsnetworks, while at the same time forging new collaborations between healthcare andtechnology experts.
The transition of mHEalth initiatives from a start-up phase to fully developed programsof national significance and impact has been one of the major barriers in mHealthdevelopment[19]. Community health programs havestruggled to develop sustainablemHealth programs of lasting impact, but alliances between governmental, not-for-profitand for-profit entities have been shown to be both to have exceptional promise[20].The potential of these partnerships is limited only by the vision and resources of theparticipants.

VI. STUDY AND ANALYSIS MADE WITHIN INDIA ON SANITATION ISSUES WITH FOCUS ON MHEALTH

Given the progress in the incorporation and use of technology, India is still lagging far behind many countries in the field of environmental sanitation[3]. But what is more important is what is done about it, in terms of remedial measures. Things are getting better e.g. the fight malaria "The commitment of the Government of India to eliminate malaria by endorsing the Global Malaria Technical Strategy 2016-2030 and setting a national malaria elimination target of 2030 is a huge step forward that will have a major regional and global impact.[22]".
In view of the above-mentioned initiative toward better health, the application of technology for resolving health issues via mHealth would achieve its anticipated effect only when that specific automated mechanism functions as intended. However, disorganized processes or broken social and civic systemic functions may result in inefficient implementations of that mechanism and may not justify the cost. The difficulty that could arise - first and foremost, is in the flawed thinking process - the wrong mind-set, the absence of basic hygiene, sanitation and rational thinking; lack of desire, adaption and retention of ideal environment as a precondition for general health and welfare. The source of this presumptive reasoning is a set of survey statistics gathered with relevance to monitoring the root cause of social and economic problems in two specific geographical locations in India, i.e. districts of Mangalore and Udupi in the state of Karanataka.
Survey questionnaires were developed and used for collecting information on the most significant constituents of maintaining cleanliness in these two (Mangalore and Udupi) surroundings. The study provided ample evidence to believe that environmental cleanliness and hygiene could be well maintained if people were made aware of the negative impact caused by related environmental neglect. This study complements the concept of mHealth by way of setting the prerequisite of good health before mHealth could be fully deployed.
Factors such as air pollution, water contamination, food and material decomposition and decay could actively contribute as breeding ground for spread of various diseases. These are basic structural components that, if managed well, can lessen the onset of health crises. Pollution can manifest itself in many forms such as – unmanaged vehicular traffic with its uninhibited exhaust fumes, unhygienic open waste disposal, uncontrolled noise emission from vehicles, social pollution such as disruptive behavior that affects civility and/or the general indiscernible laxity and lack of accountability etched into the social structure due to the perception that any matter not of material personal benefit, is not worth anyone's time. Ambiguous and indecisive municipal assistance, or rather the interference, only worsens the situation.
In the interest of the society and as a solution, apart from the initial fact-finding survey, the team also developed an application that could be used by the municipal authorities for monitoring and maintaining the general upkeep of the city. The general public could use this application to report issues (textual narrative with option for image-upload and geographic location indicator) that are

of public safety and health concerns. The information, received by the municipal monitoring squad could be used to rectify related issues by dispatching required personnel to the affected area. This may be applicable to most issues that affect the general public, within reason.

VII.CONCLUSION

A coalition between public health and IT programs would allow for the development oftargeted pilot projects, based on a needs model that is scalable, tailored to specific userdemographics in terms of language and other cultural considerations, and responsive toemerging crises. mHealth interventions have been shown to be adept at both deliveringand collecting medical information, disseminating targeted healthcare interventions andcontent, and dispensing individualized behavioral change programs[21].

Public health and IT industry collaboration could dramatically increase the reach, depth and timeliness of public health programs in India. The authors intend that this paper will serve as a clarion call to both public health and IT professionals to join in a concerted effort to leverage mHealth innovation for the good of all in India.

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