Global Health Information Technology Solutions for a Community Health Innovation Framework

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Abstract
With an increasingly connected world, information technologies can be used to offer many solutions to global health challenges. In low- and middle-income countries Community Health Workers (CHW) are an important provider of healthcare; however, they often lack access to adequate technologies, low-cost training, and networking opportunities. To address these challenges, the authors explain the Community Health Innovator Program (CHIP) framework, which facilitates local innovation to improve health behaviors, and the use of a web-based portal to support its work. This paper details the growing use of low-cost social media technologies in healthcare and the development of the specific CHIP website prototype. The authors further discuss the potential for expansion of the CHIP model and associated IT solutions for increasing vaccine up-take in low- and middle-income regions, as well as how these technologies can effectively respond to other priority challenges in global health.

1. Introduction

Development work utilizing “local” and “innovative” methods has become increasingly prominent in global health literature [1]. Local innovation is central to providing low-cost health and social benefits to vulnerable and marginalized populations (VMP). A major component of this concept includes the use of new low-cost technologies to reorient health interventions and communication between Community Health Workers (CHWs), international, national, and local researchers and global health professionals, and clients. CHWs are a proven mechanism for reaching vulnerable and marginalized populations, and programs implemented in diverse
settings and addressing a broad range of local health needs have been shown to effectively drive positive behavioral changes. CHW programs have a significant public health impact, as they constitute a link between health providers and community residents. However, the success of CHW programs has been limited by many factors including limited availability of IT solutions for global health, inadequate technical assistance, the absence of continuing education for Community Health Workers, and inadequate integration of the CHWs and communities within existing health systems and the design of health promotion strategies [2][3].

To address these challenges, an interdisciplinary global health team, including authors of this manuscript and an International Advisory Board, developed a framework entitled CHIP: the Community Health Innovator Program. The remainder of the paper is laid out as follows: Section 2 will review the CHIP model and role of a web-based portal to support CHIP. Section 3 will discuss prior research in the design of web portals in healthcare in general and how this can inform the effective development of such a model for CHIP. Section 4 will discuss the requirements for the first stage of implementing the CHIP web portal. Section 5 will detail the development of the website prototype and pilot and Section 6 will explore the potential for expansion of the CHIP model and associated IT solutions for increased vaccine-uptake in low-and middle-income (LMIC) regions. The final section will provide concluding comments.

2. The CHIP Model

The Community Health Innovator Program, or “CHIP”, is a framework that facilitates local innovation to improve health behaviors. CHIP empowers communities to identify health challenges and to address these challenges through innovative local (“on-the-ground”) and global (“adaptable”) solutions. CHIP is grounded in the theory that homegrown health promotion has the most positive outcomes. Often, community residents are less supportive of reforms when they view them as being externally imposed [4]. On the other hand, when health challenges are identified locally, and communities obtain the support to create innovative solutions, community residents are more likely to embrace health behavior interventions [5]. Therefore, by promoting local health innovations that provide low-cost health and social benefits to marginalized and vulnerable communities, CHIP proposes avenues for wider and more inclusive participation in global health strategy design.

From the beginning, the CHIP model itself was formulated at the local level, by including a diverse group of community members, health professionals, and academics in the creation of the program. CHIP utilizes IT solutions to build capacity around community-based Innovators and provides the Innovators with tailored resources to create solutions. Through CHIP, the Innovator is equipped with the skills and tools necessary to work with and identify barriers to maximizing the effectiveness of CHW programs and develop locally-relevant interventions. In addition, CHIP is designed to foster mentoring and professional networks, which enable both intra- and inter-national exchanges of information and strategies to address local health challenges.

In low- and middle-income regions innovators frequently lack access to low-cost training, adequate technologies, funding initiatives, and multi-sectoral networks that are interested in facilitating and adopting social innovations. Innovators in Haiti, particularly after the 2010 earthquake, have struggled in supporting projects in their local areas such as Gonaïves and Port-au-Prince. Current social innovation frameworks and incubators have varied outcomes, but often lack required inputs for success. The CHIP program was designed to address these current limitations and its structure evolved through a collaborative effort between the global health program team and an International Advisory Board (IAB), composed of practitioners, academics, and community members from Detroit, Haiti, Ghana, and Nepal. The IAB identified CHIP as an approach, which is needed, feasible, and can be integrated within local infrastructures.

CHIP brings together a variety of participants including: Innovators, the Program Team, the International Advisory Board, Mentorship Teams, and CHWs. The Innovators are community-identified individuals who work with CHWs and utilize a range of skills (for example, skills in business, technology, health, education and community organization) to impact health outcomes for communities. The Program Team is an interdisciplinary global health team aided by its International Advisory Board. The multi-stakeholder Mentorship Teams are composed of in-country Mentors from academia, business, government, healthcare, and other disciplines as needed.

The CHIP model is laid out in several stages. Initially, the Program Team and International Advisory Board identify both Mentors and Innovators in each country, as well as build curriculum for the Innovator trainings
and launch a web portal and supported interactions using mobile technologies. Next, after receiving training and being linked with a Mentor, the Innovators meet with CHWs to conduct a community health needs assessment and learn about barriers that the CHWs within that community experience. In the third stage, the Innovator connects with the Program Team, the Mentor Team, and other Innovators across sites, to engage with the community and innovate possible solutions to locally-identified barriers and health challenges. As we move to stage four, the Teams help connect the Innovator with tools to develop the health solutions and generate resources to successfully implement and sustain these solutions.

A web portal is the linking technology. As we move through each of these stages, the role of the CHIP web portal will grow in sophistication from a simple knowledge exchange platform to knowledge interaction, knowledge sharing and lastly information broadcasting and knowledge dissemination, by leveraging the use of various IT-enabled discussion and other social media platforms. This will be discussed in the next section.

3. Social Media Communication and Healthcare

Use of web-based communication (Web 1.0 knowledge exchange) and in-depth web-based interaction (e.g. Web 2.0: social networks) is increasing with the recognition that such support structures are needed if individuals, especially in geographically dispersed environments, need both context-specific help from experts who are not easily accessible for face-to-face interaction, as well as discussion with peers and other experts using asynchronous and synchronous modes of communication.

Social psychology-related discussions have established that social networks supported by digital media consist of two components: the media-used and the social interaction. The social interaction is based on the notion that individuals can use a set of socially recognizable actions to influence others [6]. Social media can hence allow users to generate, share, receive, and comment on social content among multiusers through multi-sensory communication [7][8].

The emerging use of social media in healthcare is centered around interactions between individuals and healthcare organizations, and the nature and speed at which these interactions support communication of health-related issues [9][10][11]. In the United States, 61% of adults search online and 39% use social media such as Facebook for health information [12]. Globally, the adoption rate is similar. Several examples are illustrative: 45% of Norwegian and Swedish hospitals are using LinkedIn, 22% of Norwegian hospitals use Facebook for health communication, and Facebook is emerging as the fourth most popular source of health information in the UK [13]. Moreover, with the focus on decreasing the growing costs of healthcare, social media is poised to provide a cost-effective means to support patient-doctor interactions [14].

Irrespective of the increased use of social media sites in healthcare, design issues have posed a significant challenge for their effective use in diagnosis, treatment, and care related interventions. Several healthcare social networking portals use communication methods such as emails, published articles or discussion forums [15]. There is limited evidence on the efficacy of online communities in their ability to support effective delivery of health-related information to patients and positively impact people’s health [16][17]. They point out that quality concerns, lack of reliability of information, and blurred lines between content producer and user are three major limitations. Beyond these limitations, the most important ones are the “information overload” and “lack of validity of the information” as these pose a bigger challenge to the use of social media for meaningful purposes [18][19].

Studies have suggested three plausible alternatives for greater healthcare provider engagement in the use of social media [20]. First, similarly to Internet sites, there is a need for greater interactivity in social media for patients and support groups to upload information in free form and not be constrained by medical jargon or established diagnostic codes and terminology. The information posted will be meaningful to the patients experiencing the disease symptoms or post-treatment effects [19] and may help providers glean useful insights into the underlying patients’ needs and concerns. Mikki Nasch, the co-founder of AchieveMint4, discussed their use of social media platforms to let patients voluntarily interact with each other, so that healthcare providers can gain useful information on patient adherence to certain desired behaviors, using “Mashup” technologies [21]. Second, reliability concerns can be mitigated if the social media communication and relevant information extraction can be given to third party agencies [22], thus allowing healthcare providers to focus on developing appropriate strategies based on this data. In the above example, AchieveMint is the third party
used by Sanofi-Aventis, a pharmaceutical firm. The third and most important suggestion is to improve “media richness” by making the information communicated contextually relevant to the situation at hand [23]. In support of the third suggestion, to improve media synchronicity, a design framework that supports synchronous video communication (SVC) in a healthcare context has been proposed in the literature [15]. This framework is currently undergoing physician-patient evaluation within the context of pain management: a rheumatology specialist interacting with patients and other physicians in support of consultation.

While SVC communication, as envisioned in Figure 1, is ideal to support many of the goals associated with CHIP, the many technical, educational and cultural challenges call for the development of the web portal for CHIP in stages (see Figure 2), with each stage mapping to the evolution of CHIP into a fully developed and sustainable platform in support of global public health. Stage 1 of the CHIP web portal focuses on the communication of basic health-related information between CHIP team members, while the second stage supports peer-interaction among Community Health Innovators using discussion forums and focused consultation with healthcare provider Teams. Multi-group interaction with Innovators, public health workers in the local region, and experts from other areas will occur in stage 3, with the SVC web portal becoming a tool for broadcasting and other entrepreneurial activities in support of the CHIP program’s sustainability in the final stage. As the technology infrastructure is being developed in stages, the competency development among the Innovators will also be developed as discussed early on with knowledge acquisition and assessment in Stage 1, knowledge sharing and interaction in Stage 2, knowledge dissemination and public education in Stage 3 to social entrepreneurship in order to support global community health in Stage 4.

The next section provides the requirements for the first stage of competency building in the CHIP program and the fifth section of this paper illustrates the outline of the technology platform that is being designed for evaluation between Community Health Innovators in two regions: Detroit, Michigan and Port-au-Prince, Haiti.

4. Requirements for Building a CHIP Website

Technology is a significant component in implementing CHIP, which is designed to support multi-country collaborations. To establish and foster long-distance communication, e-health and m-health tools are essential. The CHIP teams are linked to one another and the Program and Mentorship Teams through an interactive e-health (Internet-based) and m-health (mobile phone-based) system to host training programs, community and Innovator profiles, and cross-site communication. Throughout the development of the CHIP program, we will consider the exact nature of technologies most feasible for local use, including text message-based applications (m-health) to trigger alerts, short messages, and web application links on PCs/desktops for further reference. Applications will be developed using HTML that can be operationalized on traditional web platforms on desktop devices, as well as imported to mobile devices, and adjusted, based on the usage, experience, and communication bandwidth. This will ensure designs maximize accessibility for LMIC users.

There are several technological components to be used throughout the CHIP project period including the web portal, integration of existing social media platforms, virtual conferencing, and an m-health application for capturing and disseminating information. The remainder of this paper will focus on the development of one of the CHIP IT solutions for global health - the CHIP website. A public website is necessary to display the details of the CHIP program, those partners involved, and the current progress of the innovations. Thus, members of the Program Team identified the following requirements for this website to fit program needs.

1. The website must be publically accessible and visually appealing in order to simply convey information about CHIP and why it works. The website should be easily navigable and quick to load in program countries on standard connections. As international communication is necessary, every effort to include translation (English for the US, French and Haitian Creole for Haiti—and for future versions, including Twi and Nepalese video/voice recordings for Ghana and Nepal) will be created.

2. Innovators must be able to create a profile on this website to present a personal bio and their contact information. Members of the Mentor Teams also need to have profiles online, detailing their areas of expertise in which they could provide guidance to the Innovators. As an essential element of CHIP is matching the Innovators to a Mentor, another requirement is the development of a web-based mechanism in which Innovators could request a Mentor who matched their interests or needs.

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3. Offering online training to the Innovators in the form of class modules is essential to the functioning of the CHIP program. The web portal should be able to collect and organize course materials in an easy-to-navigate manner. Certainly taking into account differing Internet speeds across countries is necessary; thus the course content is varied, including videos and PowerPoint lectures, but also PDF articles for those who are unable to stream videos. Content must also be downloadable so that participants can save the content and access it as convenient in case of Internet connectivity problems. Further, to ensure the information has been adequately communicated, an online assessment evaluation will be included at the end of each module. Finally, the website must include the ability for both the Innovator and the Program Team to track the courses completed and evaluation outcomes.

4. Innovators should be given the ability to ask questions in response to the training content that can be directed to the trainer. A mechanism to direct other questions (for example, in case of technological difficulty accessing the website) to the Program Team should be set up.

5. A method for documenting feedback from the Innovators regarding their experience with the website should be included. This will allow the Program Team to evaluate the accessibility, effectiveness, and usefulness of the website and the course content.

6. The program will enable synchronous communication between Innovators, Mentors, and the Program Team to facilitate exchanges of information and enable an intra- and inter-national approach to problem solving. This would be similar to other professional sites (LinkedIn, ResearchGate) that allows for the establishment of interest groups and postings and interchanges between group members.

5. Website Prototype Development & Pilot

The first stage of technology development is intended to support both the education of the CHIP team members through video/audio and other presentation mechanisms, as well as their assessment of the knowledge acquired. The knowledge exchange will occur between the healthcare provider institutions and groups (Henry Ford Health System Global Health Initiative investigators and global health professionals) and CHIP team members. Some of the screen shots of the Stage 1 implementation are shown in Figures 3-5. For example, after CHIP member profile page is used to attract and recruit members to be a part of the CHIP program, education module page with video/course layout and assessment pages are used to assess their knowledge (Figures 3 and 4). A discussion form page (Figure 5) is used to support CHIP team members and select Mentors to engage in discussions and seek guidance and support.

Currently, the backend database is being developed to support Mentor interface to the CHIP team for communication. The requirements for the CHIP web application have been analyzed and discussed in various sessions. Wireframes were developed that replicate the visuals of the CHIP web pages. With the approval of the wireframes, the website’s user interfaces were developed using HTML, CSS, and Javascript technologies to create easily navigable, attractive web pages. PHP is used for server side programming and user interface features are supported by MySQL databases in the backend.

To ensure the operation of the web pages on devices with low network bandwidth, training content web page is incorporated with PDF articles. With the completion of the training content, the Innovator can access the assessment web page to test their learning. The assessment web page displays the results immediately after the submission of the test. A discussion forum has been set up for the Innovators to discuss the course topics and a login page is created to allow access to the forum. Screenshots of the prototype website can be found at the end of the article.

The CHIP web portal will be piloted by two CHIP teams in Detroit and Haiti. These sites have been selected because existing community research and training initiatives will facilitate local adaptation of CHIP for the pilot. After completion of the pilot, the web portal will be evaluated through an iterative process. The central purpose of the pilot will be to test the functionality of the CHIP web portal and assess the feasibility of using this e-health technology in both a low-income country (Haiti) and a low-income region of the United States (Detroit). The web portal will be evaluated for: 1) Logistical issues for program implementation and participation; 2) Maximized accessibility for LMIC users; 3) Ease of website navigation; 4) Ease of accessing and downloading course content; 5) Usefulness of course content; 6) Usage of the web platform components; 7) Communication issues (e.g. between Innovators, Mentors and the Program Team); and 8) Similarities and differences in issues across sites. These were identified by collaborators as issues that CHIP aims to improve the quality of.
Based on feedback, the Stage 1 phase of the CHIP web portal will be completed and Stage 2 will begin. At the same time, groups in the other partner countries (Nepal, Ghana) will be provided access to the CHIP web portal for further assessment of the technology as well as some of the process/workflow challenges faced by the global community healthcare workers. It is anticipated that the successive stages of implementation and CHIP team member learning will continue in 2015.

6. CHIP – IT Solutions for Increased Vaccine-Uptake

The CHIP program and associated technologies are designed for adaptability and will be able to respond to emerging priority challenges in global health. This section outlines how the CHIP model can be expanded to respond to the growing global threat of vaccine hesitancy. The International Advisory Board (IAB), in collaboration with the Program Team, has identified CHIP as a solution to improve vaccine uptake in low-resource settings. Locally identified barriers to vaccine uptake and associated innovative solutions are more appropriate and relevant to community members and thereby more likely to engender trust in vaccines and providers of vaccines. Consequently, more locally appropriate and relevant interventions and higher levels of trust will increase vaccine uptake and decrease rates of vaccine preventable diseases in both children and adults [24].

While over 83% of children worldwide receive vaccines through the Expanded Program for Immunization (EPI), 22 million children are not immunized and 1.5 million children die annually from vaccine preventable diseases [25][26]. Vaccine hesitancy is a significant threat to global health [27][28]. Vaccines are a fundamental tool for the prevention of infectious diseases in LMIC [29] and have significantly decreased incidence of many of these diseases over the past 30 years. Newly licensed and promising vaccines for diseases which contribute substantially to global disease burden (e.g., typhoid fever, cholera, malaria) have the potential to markedly decrease morbidities and mortalities worldwide [30][31][32]. However, children and adults continue to not receive vaccines and/or meet dosage requirements for maximizing efficacy. Economic restraints on the expansion of access to sanitation and clean water in the short-term and evolving multi-drug resistant (MDR) microbial strains increase the urgency for effective preventive measures including immunization of vulnerable populations.

Vaccine advocacy refers to wide-ranging programs including research, conferences, and country- and community-level social mobilization activities designed to inform and engage stakeholders about the science and public health impact of vaccines [33]. To date, multiple international organizations have advanced the introduction of new generation and underutilized vaccines; however, vaccine hesitancy at individual and community levels has diminished the effectiveness of vaccines to prevent disease and minimize associated physical, social, and economic burdens. Vaccine advocacy campaigns are most successful when developed within the targeted communities [34]. The role of pharmacies are changing in providing care (e.g. a recent change of CVS pharmacy name to CVS Health), and hope to include pharmacy professionals in the CHIP board for additional insight [35]. The role of social media in patient care comes with many challenges. CHIP leaders have to leverage its power in support of global health, but also recognize that the same media may be used against some basic health education efforts in remote areas that are often suspicious of modern medicine [36, 37].

In summary, the Community Health Innovators Program (CHIP) can enhance existing infrastructures of community health workers (CHWs) by utilizing emerging telecommunication and electronic technologies to identify local barriers to vaccine uptake and create culturally salient solutions. Through CHIP, international, national, and local scientists, business leaders, health providers, and community residents will exchange skills, knowledge, and materials to advocate for vaccine uptake and decrease morbidity and mortality from vaccine preventable diseases. The CHIP program and its use of the web portal will allow challenges and solutions to be identified locally, and communities to obtain support to create innovative solutions. Therefore, interventions can address both culturally-specific and global barriers to vaccine up-take, CHWs can be conduits for communication between stakeholders (e.g., vaccine advocates, providers, community residents), and community members will be engaged and empowered to make informed decisions about vaccines.

7. Conclusion

There are a number of contributions that this paper makes to existing studies of information technology. Most importantly, the paper demonstrates that information technology offers innovative solutions to global health challenges. Specifically, through the Community Health Innovator Program model, the authors have identified a locally acceptable approach
for enhancing training and mentoring for CHWs and other community members. To date, the first stage of designing a web-based portal aimed to address challenges faced in community health has been implemented. Because the CHIP model is global in nature, the IT solution needed to be adaptable throughout diverse regions of the world, in order to address widely-varying resources, infrastructure, cultures, and languages. By creating technologies to maximize access in LMIC countries and by providing a platform for CHIP members to interact and exchange ideas across the globe, the CHIP web portal accomplishes its aims.

As the CHIP web portal continues to advance through its development stages, its global health significance will expand. After testing and evaluating the technology in Haiti and Detroit, the next stage will provide web portal access to teams in two other countries, Ghana and Nepal. Implementing the technology in these locations will provide important technical information on the functionality of the website in other resource-limited countries, but also will allow the CHIP model to address the challenges faced by communities and CHWs in these new locations. Further, by allowing increased communication among CHIP members across the globe, the web portal will facilitate intra- and international interchange of ideas and solutions. CHIP offers a model of adaptability to numerous global community health challenges including the urgent issues associated with vaccine hesitancy and infectious disease in many low-resource settings. In the future, there is potential to expand CHIP to address emerging priority challenges in global health from local perspectives. This global-to-local approach can enable the development of solutions which are culturally salient and thereby more likely acceptable and effective in bringing about change.

CHIP applies innovative health IT solutions across the globe to improve population health and community healthcare. The interdisciplinary nature of CHIP in utilizing international, national, and local scientists, business leaders, IT specialists, health providers, and community residents ensures that this model will remain relevant and cutting-edge in the further development of global healthcare solutions.

8. References


[34] Newman PA, 2006, Towards a science of community engagement, Lancet 367


Figure 1. Synchronous video communication to support patient-physician communication

Figure 2. Staged model for developing support for CHIP team members

Figure 3. Training content page

Figure 4. Assessment Page

Figure 5: Discussion Page