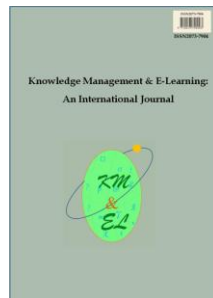


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## **Knowledge Management & E-Learning**

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ISSN 2073-7904

### **Leveraging open-source technology and adapting open eLearning content to improve the knowledge and motivation of Ghana's rural nurses**

**Lisa Mwaikambo**

Johns Hopkins University, Baltimore, USA

**Akuba Dolphyne**

Grameen Foundation, Accra, Ghana

#### **Recommended citation:**

Mwaikambo, L., & Dolphyne, A. (2016). Leveraging open-source technology and adapting open eLearning content to improve the knowledge and motivation of Ghana's rural nurses. *Knowledge Management & E-Learning*, 8(1), 55–67.

## **Leveraging open-source technology and adapting open eLearning content to improve the knowledge and motivation of Ghana's rural nurses**

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Lisa Mwaikambo\*

Center for Communication Programs  
Johns Hopkins Bloomberg School of Public Health  
Johns Hopkins University, Baltimore, USA  
E-mail: lbasall1@jhu.edu

Akuba Dolphyne

Grameen Foundation, Accra, Ghana  
E-mail: adolphyne@grameenfoundation.org

\*Corresponding author

**Abstract:** Access to training opportunities is strongly correlated with health workers' motivation because it enables health workers to take on more challenging duties. Mobile technology can be leveraged for professional development support by providing access to open education resources. Community Health Nurses (CHNs) in Ghana are the frontline health workers of the Ghana Health Service (GHS) and play a vital role in extending maternal and child health care to rural communities. However, as the lowest credentialed nurses, they are at the bottom of the GHS hierarchy. CHNs have limited opportunities for career advancement and report challenges with isolation and lack of resources. Leveraging open-source technology platforms and open eLearning content, the Care Community Hub (CCH) project sought to address these barriers in CHN motivation by developing and deploying a mobile application (app), CHN on the Go, to CHNs in five rural districts. The app supports CHNs through tools for continuous learning, diagnostic decision-making, and improved nurse-supervisor interactions. This paper focuses on the adaptation and use of the open eLearning content to address CHNs' motivation challenges and, ultimately, improve their knowledge and job performance as a result of having access to open education resources.

**Keywords:** Open-source technology; Open learning; Mobile technology; Continuing professional development; eLearning; mLearning; Open education

**Biographical notes:** Lisa Mwaikambo is a Project Officer II on the Knowledge for Health (K4Health) Project based at Johns Hopkins University Center for Communication Programs. She manages the USAID Global Health eLearning Center. She has a Master of Public Health in Health Promotion and Disease Prevention from Case Western Reserve University.

Akuba Dolphyne is Senior Technical Manager for mHealth Services at Grameen Foundation Ghana, and the Project Manager of the Care Community Hub (CCH) Project. She is an Information Technology and International Health professional with a MS in Information Technology and an MS in Public Health.

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### **1. Maternal, newborn and child health: What do health workers have to do with it?**

Sub-Saharan Africa accounts for half of maternal deaths worldwide (World Health Organization, 2014). The Government of Ghana has shown a strong commitment to reducing these preventable deaths. According to the WHO, UNICEF, UNFPA, The World Bank, and the United Nations Population Division (2015), maternal mortality has decreased from 410 maternal deaths per 100,000 live births in 2010 to 380 maternal deaths per 100,000 live births in 2013. Likewise, infant mortality has declined from 50 infants dying before reaching the age of one per 1,000 live births in 2010 to 46 deaths per 1,000 live births (UN Inter-agency Group for Child Mortality Estimation, 2014). Yet, maternal and infant mortality rates remain alarmingly high and concentrated in rural areas.

Ghana has established community-level facilities to bring basic maternal, newborn and child health (MNCH) care closer to both urban and rural-dwelling families, but the country is still far from meeting the Millennium Development Goals (MDGs) for maternal and child mortality (MDGs 4 and 5) and the newly announced Sustainable Development Goals (SDGs), specifically goal 3 “Ensure healthy lives and promote well-being for all at all ages.” According to (United Nations, 2015), the MNCH targets for Sustainable Development Goal 3 include the following.

- (1) By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births
- (2) By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births

Human resources for health (HRH) are essential in the attainment of these health objectives. The central role that health workers play in improving people’s health has been long known and is now explicitly stated and emphasized in the new SDGs: “Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States.” Unless urgent action is taken to address the shortage and uneven distribution of health workers, none of the health goals can be met. It is predicted that by 2030, an additional 10 million health workers is needed (World Health Organization, n.d.). Studies on developing services to meet the MDGs emphasized the importance of having health workers with the appropriate skills available and motivating them (Jha & Mills, 2002). The problems noted by many studies include lack of technical skills, low motivation, and poor support networks (Kurowski, Wyss, Abdulla, Yémadji, & Mills, 2003).

At the same time, health workers face unimaginable challenges in addressing the ever-changing health care needs of their communities. The recent Ebola outbreak highlights the critical importance and need for well-trained health workers in low- and middle- income countries that are susceptible to emerging epidemics. There are more health worker in-service training programs than ever before, with training often representing the lion’s share of investments for strengthening human resources for health (Bailey et al., 2013). However, evidence shows that a continuum of learning from pre-service to in-service training is needed. Often times, the investment in training is made in pre-service with little thought given to in-service, which is needed for the continued maintenance and updating of one’s skills. This is especially important when considering

the real-time needs of emerging infectious diseases and the rise in non communicable diseases and the unique challenges that both pose to various health care professionals.

The combined pressures of an ever-changing disease landscape, increasingly globalized international economy, as well as a rapidly changing technological environment means that all individuals, but especially health workers, need to continually update their skills and knowledge throughout their adult lives. Health workers must become life-long learners dedicated to updating their professional knowledge, skills, values, and practice. Continuing professional development encompasses all of the learning activities that health workers undertake -- both formal and informal -- to maintain, update, develop, and enhance their professional skills, knowledge, and attitudes.

The open education movement, which encompasses not only open-source technologies but also open access and open publishing of content (Peters, 2010), provides an enabling environment for addressing this need. The exponential growth in Internet access and information and communication technologies (ICTs) has led to more people than ever before having access to open education resources via their mobile phones. At the same time, there has been an increase in open education resource repositories from Khan Academy to OpenCourseWare to Massive Open Online Courses (MOOCs).

According to GSMA, “The mobile phone represents the fastest growing technology innovation in history. Introduced roughly 25 years ago, there are now more than 6.6 billion connections in use (with an 80% penetration in the developing world) – serving a global population of seven billion” (Gaudry-Perkins & Dawes, 2012). mLearning is especially meaningful in rural areas where infrastructure is poor and access to the resources needed to face the rising demand for continuing education materials can seem insurmountable. Gaudry-Perkins and Dawes (2012) state the benefit of mLearning best: “mLearning provides anytime, anywhere educational and life enhancing content delivered via mobile technology.”

This paper outlines the process undertaken by two donor-funded projects committed to open education in their adaptation and use of open-source technology to create a repository of adapted open learning resources to meet the needs of Community Health Nurses (CHNs) in rural Ghana.

## **2. The health workforce situation in Ghana**

Despite its recently achieved status as a middle-income country and a more robust health care system than many of its neighbors, Ghana is still experiencing a national shortage of skilled health workers. The Ghana Health Workforce Observatory estimates 69,000 people currently work in the health care delivery system (Ghana Health Workforce Observatory, 2011). According to projections by IntraHealth International, by 2050 Ghana will need a 29% increase in health workers to meet the health needs of its population (Pacqué-Margolis, Muntifering, Ng, Noronha, & IntraHealth International, 2011). As in many countries, inequitable distribution is also a problem in Ghana, with more acute shortages at primary care facilities versus tertiary facilities, and in poorer districts versus richer. Although 65% of the population lives in rural areas, the highest concentration of highly skilled health professionals is in the greater Accra region in southern Ghana.

The misdistribution in human resources has exacerbated the inequality of human resources because nurses working in demanding posts are more likely to leave than staff in more attractive posts (World Health Organization/World Bank, 2004). It has been

particularly difficult to recruit and retain health workers in Ghana's rural areas. Health workers would rather live in urban areas for many reasons, including schools, housing, other job opportunities, greater cultural, recreational, and commercial diversity, telecommunications, and proximity to family and friends.

Over the last fifteen years, Ghana has made efforts to implement many policies and strategies in the development of its human resources for health. To address workforce shortages in rural areas, Ghana has used community health nurses (CHNs) who are trained to provide ambulatory care for malaria, childhood immunizations, family planning, and community health education. CHNs are the frontline health workers of the Ghana Health Service (GHS) and are often the primary providers of MNCH care in rural communities. In 1999, Ghana adopted the Community-based Health Planning and Services (CHPS) initiative, which aims to address geographical barriers to health care access (Nyonator, Awoonor-Williams, Phillips, Jones, & Miller, 2005). CHPS health facilities are built with local resources with significant support by the communities, in which they are placed. CHNs live and work in these facilities to make them more accessible to the communities they serve. The sub-district health centers are less effective due to their distance from rural communities (Awoonor-Williams et al., 2004), emphasizing the importance of CHNs living and working in the rural communities. Ghana, like several countries with a shortage of skilled workers, is increasingly relying on CHNs to perform certain advanced tasks where higher skilled workers are unavailable; this practice is known as task shifting. Adapting open learning resources that were specifically developed for midwives can now readily benefit CHNs in helping them to upgrade their knowledge and skills to provide more advanced services where appropriate. However, the CHN program coverage is constrained by logistics problems, supervisory lapses, and resource shortages. In addition, as the lowest credentialed nurses, they are at the bottom of the GHS hierarchy, lacking status at the health centers and opportunities for professional development and career advancement, which reduces their sense of professionalism and, therefore, their job motivation. Feelings of isolation and low job satisfaction can result in CHNs leaving their remote posts, further exacerbating low access to MNCH care within vulnerable rural communities.

Health sector performance is highly dependent on the motivation of health workers because health care delivery is highly labor-intensive. In addition to affecting service efficiency and equity, health workers' willingness to apply themselves to their duties and tasks also mediate health service quality. A worker's performance is greatly dependent on their motivation, inspiring them to come to work regularly, work diligently, be flexible, and willing to carry out their duties (Hornby & Sidney, 1988; Dieleman & Harnmeijer, 2006; Ashraf, Bandiera, & Lee, 2014; Kok et al., 2015). The challenge was to determine what factors contributed to CHN retention and which evidence-based approaches would simultaneously improve job satisfaction and technical skills.

A systematic review found that health workers felt motivated when there were opportunities for them to progress professionally (Willis-Shattuck et al., 2008). According to World Health Organization (2006), access to training opportunities is strongly correlated with motivation because it enables health workers to take on more challenging duties. It also helps curtail health worker attrition when it is focused on local needs. Research by Dil, Strachan, Cairncross, Korkor, and Hill (2012) found that health workers in Ghana really value enhanced access to training because of their desire to learn more but also it betters their chances to be promoted and posted to larger towns and urban areas (McGough, 2013). The increasing availability of online open education resources provides this access to training.

### 3. Using technology to motivate CHNs to remain in rural health posts

The Knowledge for Health (K4Health) project, led by the Johns Hopkins Center for Communication Programs and supported by USAID's Office of Population and Reproductive Health, Bureau for Global Health, collaborated with Ghana Health Service and Grameen Foundation (referred to as Grameen throughout the manuscript) under the Concern Worldwide US, Inc. (CUS) *Innovations for Maternal, Newborn and Child Health* initiative Care Community Hub (CCH) project, to address one of the reported obstacles to CHN's job satisfaction and motivation: the lack of professional development opportunities in five rural districts of Ghana. Key to the project was understanding how the provision of learning materials for continuing education could improve workplace satisfaction and equip CHNs with new technical knowledge, advancing their careers and improving the quality of MNCH care in rural areas.

User research conducted by the design firm ThinkPlace Foundation identified five drivers and roadblocks to CHN self-reported retention and job satisfaction in rural areas. Factors that contributed to greater job satisfaction among CHNs included: feeling valued, recognition, access to information and tools, learning about new advances in health, and the ability to connect to a supportive peer network. Unsurprisingly, CHNs felt demotivated by the opposite factors: a lack of appreciation for hard work, limited resources, a lack of advancement opportunities, disconnection from family and friends, and disrespectful treatment or bullying at work. Through the CCH project, Grameen sought to build upon an open-source mobile application to provide access to open learning resources, such as decision-making tools like job aids, eLearning courses, and general wellness quotes, to address the demotivating factors but also build on existing motivating factors. The resulting mobile phone application (app) designed was "CHN on the Go" whose modules include Point of Care, Planner, Learning Center, Wellness, Achievement, and Supervisor Dashboard.

One of the key modules developed was the Learning Center where Grameen planned to deploy open learning course materials adapted to address CHNs' expressed need for "Learning about what's new in health" and "Restricted opportunities for career progression". Given the short timeframe to build and implement the app, Grameen sought to revise and redistribute existing global health eLearning content from the USAID Global Health eLearning Center (GHeL) website. The K4Health project manages GHeL, an open-source, Drupal-based learning management and content management system, with over 75 free, expertly vetted global health and development courses. GHeL was established to meet the growing training needs of USAID field staff and staff from implementing partner organizations working in global health and development in low-resource and low-bandwidth settings. eLearning allows USAID and its partners to strengthen the knowledge base of public health practitioners with the ultimate goal of increasing the use and dissemination of evidence-based, accurate, and up-to-date information to improve health service delivery and health outcomes worldwide. Today, GHeL reaches over 130,000 registered users with over 300,000 course certificates earned. For more information on GHeL, please see Mwaikambo, Avila, Mazursky, and Nallathambi (2012) and Limaye, Deka, Ahmed, and Mwaikambo (2015).

Although GHeL is mobile-responsive, it is a website, requiring an Internet connection. In addition, it is a free global resource, meaning that content is developed for a broad audience of public health program managers, health service providers, and policy makers, not specific to any one country or health cadre. To meet the needs of CHNs working in rural settings in Ghana, Grameen and K4Health collaborated to adapt GHeL content to make it more relevant and accessible to them specifically. K4Health serves

health service providers and program managers working in international settings, connecting them to critical information and a network of experts and peers. K4Health is also a leader in knowledge management – a dynamic, process-oriented approach that links health professionals with technical know-how, continuing education opportunities, and expert resources that are all made publicly available for adaptation, use, and redistribution. The goal is to have the resources used – whether that is adapted for a specific context or audience, combined with other learning materials, and/or redistributed. As a knowledge broker, K4Health was also able to connect Grameen’s Tech team to that of Digital Campus, the creators of OppiaMobile, which works in combination with the open-source eLearning platform Moodle to deploy content to mobile devices. This open-source mLearning platform is the foundation from which Grameen expanded upon to build the CHN on the Go app.

While Grameen designed the app’s technical platform, the process of content adaptation began. The first step was to review GHeL family planning (FP) and MNCH course content for suitability to CHNs and the needs of the local context of Ghana. Content was then reviewed in detail for language and understandability, content relevance, and to make sure that it was in line with local health protocols. During this stage of the adaptation process, Ghana Health Service (GHS) created additional content where key topics were not included in the original courses. The review process was a collaborative effort between a number of departments of the reproductive and child health division of GHS to revise the content to suit the local context.

The adapted courses are offered on the open-source application, CHN on the Go, via two other open-source platforms, Moodle and OppiaMobile, which accelerates the pace of content delivery to CHNs. The user-friendly Moodle platform has enabled courses to be formatted for deployment by Grameen staff that are not software developers or have advanced technical skills. Moodle is used to format content including quizzes, exams, and images. The content is exported to OppiaMobile, which then formats the packaged content into html files so that the mobile device can interpret for display. Courses are limited to 5MB or below in size, with an average of 3MB in size and can, therefore, be easily downloaded in areas with limited network strength. The courses are stored on the device once downloaded and can be accessed without Internet connection; this is a great benefit to CHNs working in rural settings with inconsistent network access. In addition, all courses once made available on the server are perpetually available. Through OppiaMobile, any new courses made available produce a notification on the mobile device to the user for quick and easy download.

The mobile app makes the course content available to anyone who has downloaded it. Users can download them at any time to commence reading the courses. Students can take pre- and post-test quizzes and final course exams at any point and, however, many times necessary to earn a passing score of 85% or higher or simply to continue to improve their score. The GHeL quiz content was of particular interest to Grameen because it wanted to objectively assess students’ progress through the learning materials and ultimately whether or not their knowledge improved.

Evidence and experience implementing ICT-based solutions reveal that community health worker-targeted mobile programs often function differently in the field than originally planned or designed, creating a strong need to iterate on any new system with real users over a substantial amount of time to improve upon the tool based on real use. Given that “literature on the use of mobile technologies for information support for health professionals and service delivery in developing countries is anecdotal and fragmented” (Mechael et al., 2010), Grameen made sure to engage with CHNs

throughout the design, implementation, and monitoring and evaluation of the project. This also included launching the app in two phases in order to ensure two rounds of training with CHNs and supervisors, testing, and iterative improvements based on user feedback.

- Phase I introduced FP courses on the app (July 2014)
- Phase II introduced MNCH courses on the app (November 2014)

#### **4. Findings**

Through a number of focus group discussions and interviews, CHNs reported that the Learning Center was their favorite module of the CHN on the Go app. In a self-administered survey, about 60% of CHNs and a similar percentage of supervisors chose the Learning Center as the most useful module of the app. A CHN supervisor explained, “Information presented in the courses is both a good refresher and teaches them something new. It boosts their clinical knowledge and they are eager for more courses to be added.” Research findings reveal that among all the modules, CHNs use the Learning Center, Planner, and Point of Care modules the most in their day-to-day work and report wanting to continue to use these three modules in the future.

To date, 14 adapted GHeL FP and MNCH courses have been deployed on mobile devices to 220 CHNs and 55 district supervisors in five districts of Ghana: Ada East, Ada West and Ningo Prampram in the Greater Accra Region and South Tongu, and South Dayi in the Volta Region. The Learning Center continues to be the most accessed, but the level of interaction with the modules has decreased over time. However, that said, 95% of CHNs installed all 5 FP courses and 78% installed all 9 MNCH courses. The MNCH courses were deployed as part of Phase II and, therefore, have been available for about half the time as the FP courses. From June 2014, when the courses were deployed, to September 2015, CHNs have successfully completed 234 courses, passing a course final exam with an 85% or higher. More than half passed the final exam on their first attempt. This finding may reveal a technical or connectivity issue or an issue with the content and its level of either difficulty, newness, or digital literacy and language issues that should be further explored. However, it also reveals a certain level of internal motivation that CHNs have in improving their knowledge. Another interesting finding relates to ensuring that content is relevant and meets the information needs of one’s audience, which is supported by the literature. The top five most popular courses account for 85% of the successful course completions and represent the areas in which the CHNs provide the most counseling services to clients; see Table 1.

Research reports indicate that the CHN on the Go app helps the CHNs obtain additional information and broaden their knowledge. The app also guides them to provide the right information to clients, and it serves as a source of information when their supervisors are not around. A CHN from Ada East reported, “For me, it has improved my knowledge on the courses. How to take care of the client, how to counsel the client, that is for my personal use too.” Another reported, “I now feel very confident as a CHN in the community because I am able to answer clients questions on family planning issues well.” Another CHN reported “it improves on our confidence level and also increase our knowledge.” Many CHNs mentioned that access to family planning information [on the app] is very useful, because they now understand all the family planning options, and they can advise their client on the best options to meet the client’s needs. Some CHNs have given the phone to their literate clients to read for themselves the information on



contraceptive options. CHNs report that such clients have found this very useful in making an informed decision on contraceptive choice. The availability of this health content on a mobile device accessible in this manner to a rural client has greatly supported the intent to provide education for all that underlies the open education movement as well as the SDGs.

**Table 1**

The top 5 most popular courses account for 85% of successful course completions

| Course title                         | Total number of successful course completions |
|--------------------------------------|---|
| Diarrheal Disease                    | 74  |
| Family Planning Counseling           | 48  |
| Essential Newborn Care               | 40  |
| Malaria in Pregnancy                 | 25  |
| Emergency Obstetric and Newborn Care | 13  |

In order to address the CHNs' restricted opportunities for career progression and encourage participation, Grameen engaged Ghana's Nursing and Midwifery Council (NMC) to accredit the adapted open learning courses so that they would count as continuing professional development credit towards the CHNs' annual renewal of their professional license. In June 2015, Grameen received an accreditation letter from NMC, signifying national level approval of the courses as high quality and important learning resources for CHNs in updating and improving their knowledge. This was the very first mLearning courses that NMC had ever approved. In fact, another international nongovernmental health organization, Jhpiego, who is a key content provider for nurses in Ghana, has followed suit and has recently received accreditation for its midwifery eLearning courses for students in midwifery schools across Ghana. Those courses will soon be deployed via OppiaMobile, the same open-source mLearning platform as CHN on the Go's Learning Center.

In order to obtain the accreditation, we had to put in place a second level skills assessment beyond the course final exam to ensure that students who pass a course on the app actually read and understood the material. Working with NMC and GHS, K4Health and Grameen developed scenario-based practical questions that the CHNs' supervisors will administer in-person at the district or sub-district level. The evaluator, who would be a district or sub-district supervisor such as the District Public Health Nurse or head of the Reproductive and Child Health (RCH) unit of the sub-district health center, will ask questions that will ensure that the user understands how to apply the content they have read in practical situations that do not always follow the script of the courses. We envision that this will become an additional learning experience as the evaluator guides the student in understanding what they are missing from the course content that they may have learnt on-the-job and through other in-service training.

## 5. Lessons learned

Offering adapted open learning course content via a mobile app allows CHNs in any setting to read the course content on their own time – between busy times at work, down

time at home in the evenings, or when on vacation – and at their own pace. In addition, we found that CHNs also share the course content by sharing their phones with their clients who are literate to educate them, particularly on available family planning methods and how they work. This extends the learning process to new users and enables the student (the CHN) to now become a teacher, creating a continuum of learning. In addition, three new districts beyond the five project-targeted districts have begun using the app on their personal devices, increasing access to the courses and opportunities for learning to an additional 100 CHNs.

Evidence indicates that good quality continuing professional development is a positive incentive and helps to motivate and retain health workers. By applying an open learning approach, requirements to undertake continuing education can be made a condition of continued professional registration and licensing and can, thereby, provide some guarantee of competence. By leveraging open education resources, Ministries of Health, regulatory bodies, and health care professional associations can more easily and effectively implement high quality continuing education programs or at least ensure that the continuing professional development that they are requiring meets their standards. In many cases, the large investment in basic training is lost because of lack of maintenance, so that shifting some resources to updating and renewing skills is efficient (Hongoro & Normand, 2006). This collaboration found this to be true. However, without incentivizing the uptake of courses from the beginning by ensuring that they were accredited, the project has seen a steady decrease in the regular interaction with the app as well as the number of certificates earned. This trend will be monitored to see if it changes now that the official accreditation of the course content has been announced.

Government engagement and processes can be quite time-intensive, posing a challenge to project timelines. Coordinating with a Ministry of Health – especially one in a decentralized system – can be very time-consuming given their competing priorities, even when ministry officials are as highly engaged as they were in this project. That said, the project benefited greatly from a collective openness, complementary experiences, and strong relationships with all partners and stakeholders. In line with the open education movement, partners shared technology, content, experiences, and data. From the project's onset, Grameen had strong relationships with GHS officials at multiple levels and had strong health expertise to guide the content review process with GHS. Grameen also had access to CHNs who were readily engaged for feedback. K4Health brought not only expertise at developing global eLearning content, but also experience establishing an accreditation process in other country contexts.

We learned the benefit of flexibility, particularly with regard to the app's delivery through mobile platforms. Using Moodle allowed Grameen to reduce its reliance on its Tech team, while OppiaMobile simplified the process of translating course content into phone-ready material that can be accessed both on and offline, allowing users to synchronize data and download new courses whenever they have an Internet connection. By extending these platforms, Grameen has managed to reduce development time while extending the platform's core functionality to include new features, such as the Planner module where CHNs can set targets for taking their Learning Center courses. The ease of use will make it possible for GHS and interested local training institutions to take over management of the CHN on the Go platform without the usual constraints of lack of human resources with advanced technical IT skills. We envision that if adopted by training institutions, this app could lead to wider access to education “for all”.

In addition, we learned that about 80% of GHeL global content is relevant as is; however, the remaining 20% needs to be reviewed and tailored in line with local

protocols and policies to meet the needs of a specific field-based audience. This may differ depending on the level of the cadre as well as their familiarity with English given that the majority of GHeL content is in English. Furthermore, rolling out the project in two phases proved beneficial as it allowed the opportunity to fix bugs in the application, clean-up data reporting outputs based on needs, and incorporate initial user feedback before launching Phase II.

## **6. Conclusion**

The collaboration between K4Health, Grameen, and GHS resulted in a repository of high quality open learning materials on key FP and MNCH topics, specifically adapted for CHNs in five rural districts in Ghana. Usage data from the app and focus group discussions and in-depth interviews with CHNs indicated that they have successfully taken the open learning courses and improved their knowledge and built their confidence and skills in delivering primary health services to their clients as a result. Globally, there is an increased interest in leveraging mobile phone technology to solve a number of health care challenges, including improved logistics, diagnostics, counseling, patient education, and job performance and support. Most projects and organizations in this area of mHealth and mLearning focus on the excitement and novelty of transforming the mobile phone from a technology perspective to address said challenge or need. In most instances, the content that will be disseminated via the phone is often overlooked or shortchanged in terms of budget and time allotted for its development. Content is key to any successful use of technology for capacity building and job performance support and, in this use case, addressing barriers to motivation. The open education resources that are already available for adaptation, reuse, remix, and redistribution can quickly address this oversight. However, open content is not sufficient in and of itself. According to a review of the open education resource movement commissioned by The William and Flora Hewlett Foundation, "Content was king, and open content we hope will be even more royal, but perhaps today the ruler is content + context" (Atkins, Brown, & Hammon, 2007, p. 65). The importance of context cannot be overlooked. As a result, all organizations and projects engaged in mHealth and mLearning must engage stakeholders in the adaptation process of open learning materials to make sure that the content is technically relevant to the target audience and appropriate for the local context as well as well synthesized for delivery via a mobile phone. Although open education resources and open learning provide a potentially equalizing playing field for end users to high quality education and continuing professional development, it also highlights the importance of a new skillset for educators, trainers, and even technologists who are being asked to play the role of technology and content provider related to the identification of knowledge needs and gaps and adaptation of content to address these.

At the same time, the open-source IT community is allowing for greater improvements to existing codebases and innovation through its transparency and sharing. Adapting a user-centered designed approach to developing and/or building off of existing platforms and code allows for an iterative learning process. Leveraging open-source technology platforms as well as open learning content has made the CHN on the Go app more easily scalable within the GHS structure.

A commitment to understanding one's target audience and to the culture encapsulated by the open-source IT community and the open education movement were central to the success of this collaboration. Grameen and K4Health leveraged each other's distinct areas of expertise: Grameen's in-depth knowledge of the local health system as well as app development considerations working in rural Ghana, and

K4Health's knowledge of and connections to the global mHealth landscape and decade's worth of experience developing high quality, expert vetted open eLearning content for health providers. This collaboration was one of mutual benefit, where the scope of work fit within each organization's core mandate and there was no exchange of funding.

The broader theory of change model that underpins the overall purpose for the app's development is currently being evaluated by John Snow, Inc. In the meantime, K4Health and Grameen are in the process of documenting the adaptation process for the courses hosted on the Learning Center and plan to share this process with the broader global health community.

### Acknowledgements

K4Health is supported by the Office of Population and Reproductive Health, Bureau for Global Health, U.S. Agency for International Development under the terms of grant number AID-OAA-A-13-00068. The views expressed in this document do not necessarily reflect those of the U.S. Agency for International Development or of the U.S. government. The Care Community Hub (CCH) Project, part of the *Innovations for Maternal, Newborn and Child Health* Initiative, is funded by the Bill & Melinda Gates Foundation.

### References

- Ashraf, N., Bandiera, O., & Lee, S. S. (2014). *Do-gooders and ladder-climbers: Career incentives, selection, and performance in public service delivery*. Retrieved from <https://bepp.wharton.upenn.edu/bepp/assets/File/AE-S14-Ashraf.pdf>
- Atkins, D. E., Brown, J. S., & Hammon, A. L. (2007). *A review of the open educational resources (OER) movement: Achievements, challenges, and new opportunities*. Retrieved from <http://www.hewlett.org/uploads/files/ReviewoftheOERMovement.pdf>
- Awoonor-Williams, J. K., Feinglass, E. S., Tobey, R., Vaughan-Smith, M. N., Nyong'o, F. K., & Jones, T. C. (2004). Bridging the gap between evidence-based innovations and national health sector reform in Ghana. *Studies in Family Planning*, 35(3), 161–177.
- Bailey, R., Bluestone, J., O'Malley, G., McCarthy, C., Ngobua, S., Petracca, F., Schaefer, L., & Wuliji, T. (2013). *In-service training improvement framework launched at the third global forum on human resources for health*. Chapel Hill, NC: IntraHealth International/CapacityPlus.
- Dieleman, M., & Harnmeijer, J. W. (2006). *Improving health worker performance: In search of promising practices*. Geneva, Switzerland: World Health Organization. Retrieved from [http://www.who.int/hrh/resources/improving\\_hw\\_performance.pdf](http://www.who.int/hrh/resources/improving_hw_performance.pdf)
- Dil, Y., Strachan, D., Cairncross, S., Korkor, A. S., & Hill, Z. (2012). Motivations and challenges of community-based surveillance volunteers in the northern region of Ghana. *Journal of Community Health*, 37(6), 1192–1198.
- Gaudry-Perkins, F., & Dawes, L. (2012). *mLearning: A powerful tool for addressing MDGs*. London, UK: GSMA. Retrieved from [http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/05/AlcatelLucent\\_120504.pdf](http://www.gsma.com/mobilefordevelopment/wp-content/uploads/2012/05/AlcatelLucent_120504.pdf)
- Ghana Health Workforce Observatory. (2011). *Human resources for health country profile*. Ministry of Health, Ghana. Retrieved from [http://www.hrh-observatory.afro.who.int/images/Document\\_Centre/ghana\\_hrh\\_country\\_profile.pdf](http://www.hrh-observatory.afro.who.int/images/Document_Centre/ghana_hrh_country_profile.pdf)

- Hornby, P., & Sidney, E. (1988). *Motivation and health service performance*. Geneva, Switzerland: World Health Organization.
- Hongoro, C., & Normand, C. (2006). Health workers: Building and motivating the workforce. In D. T. Jamison, J. G. Breman, & A. R. Measham (Eds.), *Disease Control Priorities in Developing Countries* (2nd ed.) (Chapter 71). Washington, DC: World Bank.
- Jha, P., & Mills, A. (2002). *Improving health outcomes of the poor: Report on working group 5 of the commission of macroeconomics and health*. Geneva, Switzerland: World Health Organization.
- Kok, M. C., Dieleman, M., Taegtmeier, M., Broerse, J. E. W., Kane, S. S., Ormel, H., Tijm, M. M., & de Koning, K. A. M. (2015). Which intervention design factors influence performance of community health workers in low- and middle-income countries? A systematic review. *Health Policy and Planning*, 30(9), 1207–1227. doi: 10.1093/heapol/czu126
- Kurowski, C., Wyss, K., Abdulla, S., Yémadji, N., & Mills, A. (2003). *Human resources for health: Requirements and availability in the context of scaling-up priority interventions in low-income countries—Case studies from Tanzania and Chad*. London, England: London School of Hygiene and Tropical Medicine.
- Limaye, R. J., Deka, S., Ahmed, N., & Mwaikambo, L. (2015). Designing eLearning courses to meet the digital literacy needs of healthcare workers in lower- and middle-income countries: Experiences from the Knowledge for Health Project. *Knowledge Management & E-Learning (KM&EL)*, 7(4), 601–615.
- McGough, L. J. (2013). *Report on maternal and child health knowledge and perceptions in Gomoa West for MOTECH*. Grameen Foundation, Ghana.
- Mechael, P., Batavia, H., Kaonga, N., Searle, S., Kwan, A., Goldberger, A., Fu, L., & Ossman, J. (2010). *Barriers and gaps affecting mHealth in low and middle income countries: A policy white paper*. Washington, D.C.: mHealth Alliance. Retrieved from <http://cgsd.columbia.edu/files/2012/11/mHealthBarriersWhitePaperFINAL.pdf>
- Mwaikambo, L., Avila, M., Mazursky, S., & Nallathambi, K. (2012). Utilizing eLearning to strengthen the capacity of global health practitioners and institutions around the world. *Knowledge Management & E-Learning (KM&EL)*, 4(3), 293–309.
- Nyonator, F. K., Awoonor-Williams, J. K., Phillips, J. F., Jones, T. C., & Miller, R. A. (2005). The Ghana community-based health planning and services initiative for scaling up service delivery innovation. *Health policy and planning*, 20(1), 25–34.
- Pacqué-Margolis, S., Muntifering, C., Ng, C., Noronha, S., & IntraHealth International. (2011). *Population growth and the global health workforce crisis (Appendix: Projected population and health worker needs in 2050 for the 57 human resources for health crisis countries)*. Washington, DC: IntraHealth International/CapacityPlus. Retrieved from <http://www.intrahealth.org/files/media/population-growth-and-the-global-health-workforce-crisis/population-growth-global-health-workforce-crisis.pdf>
- Peters, M. (2010). The idea of openness: Open education and education for openness. In M. Peters, T. Besley, A. Gibbons, B. Žarnić, & P. Ghirdelli (Eds.), *The Encyclopaedia of Educational Philosophy and Theory*. Retrieved from [http://eepat.net/doku.php?id=open\\_education\\_and\\_education\\_for\\_openness](http://eepat.net/doku.php?id=open_education_and_education_for_openness)
- United Nations. (2015). *Sustainable development goals*. Retrieved from <https://sustainabledevelopment.un.org/topics>
- UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA Population Division). (2014). *Mortality rate, infant (per 1,000 live births)*. World Development Indicators. Retrieved from <http://data.worldbank.org/indicator/SP.DYN.IMRT.IN>
- WHO, UNICEF, UNFPA, The World Bank, and the United Nations Population Division. (2015). *Trends in maternal mortality: 1990 to 2015*. Geneva, Switzerland: World

- Health Organization. Retrieved from [http://apps.who.int/iris/bitstream/10665/194254/1/9789241565141\\_eng.pdf?ua=1](http://apps.who.int/iris/bitstream/10665/194254/1/9789241565141_eng.pdf?ua=1)
- Willis-Shattuck, M., Bidwell, P., Thomas, S., Wyness, L., Blaauw, D., & Ditlopo, P. (2008). Motivation and retention of health workers in developing countries: A systematic review. *BMC health services research*, 8, 247.
- World Health Organization. (2006). *The world health report 2006: Working together for health*. Geneva, Switzerland: World Health Organization.
- World Health Organization. (2014). *Maternal mortality*. Fact sheet. Geneva, Switzerland Retrieved from <http://www.who.int/mediacentre/factsheets/fs348/en/>
- World Health Organization. (n.d.). *Global strategy on human resources for health: Workforce 2030 (Draft for consultation)*. Geneva, Switzerland: World Health Organization. Retrieved from [http://www.who.int/hrh/resources/glob-strat-hrh\\_workforce2030.pdf](http://www.who.int/hrh/resources/glob-strat-hrh_workforce2030.pdf)
- World Health Organization/World Bank. (2004). *Health workforce challenges: Lessons from country experiences*. High-Level Forum on Health Millennium Development Goals (MDGs).