

Providing Mobile Health Anywhere

ClickDiagnostics Inc.

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Abstract—ClickDiagnostics provides access to trained medical professionals and health risk assessments for remote rural populations in developing countries, through its mobile health platform. ClickDiagnostics offers governments, national-level NGOs and private health providers an entire “health eco-system” composed of a variety of mobile healthcare services including: health information services, health risk assessment services and remote medical advice services. The management of electronic health data is at the core of the ClickDiagnostics mobile health platform, and the business regularly confronts a number of issues on the use of data - from technical to social and medical – in its operation. In fact, addressing concerns about the privacy, integrity and security of electronic data are of central importance to the functioning of the business.

Keywords—mobile health services; health information; health risk assessment; remote medical advice; electronic medical record; data privacy; data integrity; data security; data analytics.

I. INTRODUCTION

ClickDiagnostics provides turn-key mobile health services to on-the-ground users of our mobile-phone software with a web-based mobile health platform in developing countries. Our business enables affordable and sustainable mobile health services that expand medical services to hard-to-reach areas. ClickDiagnostics offers governments, national-level NGOs and private health providers an entire “health eco-system”—an end-to-end service chain—composed of a variety of healthcare services including: health information services, health risk assessment services and remote medical advice services. The management of electronic health data is at the core of the ClickDiagnostics mobile health platform, and the business regularly confronts a number of issues on the use of data - from technical to social and medical – in its operation.

II. THE VENTURE

A. The Concept

ClickDiagnostics is a social venture formed by business professionals, international development specialists and technology experts from Harvard University and the Massachusetts Institute of Technology (MIT) to address three main health care issues affecting over one billion people in rural communities of the developing world.

These issues are:

1. Limited health outcomes
2. High cost/no access to trained medical professionals
3. Increased health system costs due to limited real-time health information

The venture provides health workers, nurses or doctors on the ground with access to a range of mobile health services via its mobile health platform. The mobile health platform is rapidly scalable and provides an end-to-end service chain that:

1. Enables the creation and analysis of electronic patient records;
2. Provides the mobile phone user with medical protocols to perform real-time health risk assessments to prioritize interventions; and
3. Gives the mobile phone user access to remote medical advice after entering patient symptoms into the mobile phone.

The venture is currently operating pilots in Africa, Asia and North America with expansion plans to South America and Central America.

B. The Need and Opportunity

More than 1 billion people in rural communities of the developing world are victims of major deficiencies in their respective public health systems, from lack of access to trained doctors, to ineffective allocation of scarce healthcare resources due to a lack of information and communication channels. As access to mobile communication has increased dramatically throughout the developing world, the provision of healthcare by mobile phones in remote and resource-poor areas has become an increasingly viable solution.

C. The Solution

Mobile health services can be provided through a mobile phone capable of capturing patient information, images of patient symptoms, as well as audio and video patient information. Patient information transmitted through the system is uploaded to a secure, web-based medical record system, where doctors can provide remote medical advice, and automated algorithms can help determine patient risk profiles for a host of ailments, schedule clinic appointments and improve preventative care provision.

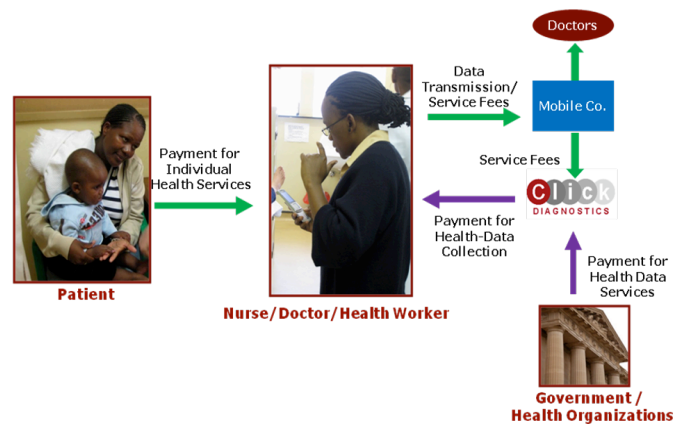
The service can be used in the following ways:

1. By health workers to capture patient information to detect ailments requiring medical attention and to monitor chronic ailments. For example, health workers can periodically survey vital patient health information. The mobile health platform would flag significant changes in data points and flag specific patients for follow-up visits and automatically schedule appointments at local clinics.
2. By nurses at local clinics for triage and medical record entry purposes. For example, nurses can use the phone to step through a standard protocol that takes patient medical history and reported symptoms into account when making an assessment of the patient's likely risk profile, and determining the appropriate next step for triage.
3. By primary physicians to obtain remote medical advice from a specialist. When a patient visits the primary physician for ailments requiring specialist advice such as skin disorders or infectious diseases, the primary physician can use the phone to capture and send patient information to a remote specialist for medical advice. The specialist can review patient case via a secure website and relay their advice as a text message back to the referring physician's phone. The physician can then consider the advice and determine an appropriate treatment plan for the patient.

D. Revenue Model

The venture provides a sustainable service by generating profit and cost-saving incentives for all stakeholders involved. The patient pays a service fee to use mobile health services instead of paying for transportation costs to see a remote medical professional which would be \$5-10, not including the opportunity cost due to time spent traveling and potential for lost wages. The fee collected goes to the nurse, health worker, or physician providing the service. The service fee is split among the medical staff, the mobile company for data transmission and ClickDiagnostics (<\$1) for providing the service. For government-run or NGO-run health intervention programs, the health workers would be compensated by the intervention programs. The program would pay for the use of mobile transmission and ClickDiagnostics's service.

The following diagram describes the sustainable revenue model of the ClickDiagnostics system:



III. DATA STRATEGY

At the heart of the ClickDiagnostics system is the creation, transmission and use of electronic health data. The system faces key challenges in the form of data privacy, data integrity and data security. ClickDiagnostics has formed a data strategy that focuses on meeting the requirements partnerships specific to the countries in which it operates. In principle, all patient information and health data collected are owned and maintained by the organization contracting ClickDiagnostics's services. Often, this represents a government entity, and experience has shown that meeting a government's needs for privacy and security of data, are among the most important concerns to meet in deploying the system.

A. Data Privacy

Privacy of patient health data is a paramount concern to ClickDiagnostics' clients. As with any system involving medical records, the privacy of patient information is a core component of the ClickDiagnostics system. Medical data is tagged with authorizations such that only the referring health worker and reviewing specialist have the ability to access the data collected during that specific referral. Referring health workers and reviewing specialists only have access to a patient's relevant prior medical history if specifically authorized by the patient. In addition health workers and reviewing specialists tagged on a particular referral only have access to the referral data for a period of 1 week. Patient health information uploaded to the mobile platform by community health workers is erased from the device upon successful synchronization with the central server.

Health workers or doctors are authenticated via password and required to change their credentials on a monthly basis. Any read/write actions on a record are recorded with user ID and cannot be deleted. Reports are run on a regular basis to look for suspect access patterns.

B. Data Integrity

The integrity of data originating on the mobile health platform is critical to ensuring accurate medical advice and complete reporting of patient health information. The system relies on packetization and data verification technology (e.g., checksum) that triggers alerts and re-synchronization actions in the event of an incomplete data transmission.

If data synchronization failed during upload the referring health worker is alerted and the record is marked as incomplete and cannot be accessed by remote specialists.

C. Data Security

In dealing with data security issues, robust identity verification and secure access are the most relevant challenges faced by ClickDiagnostics. The ClickDiagnostics system does not rely on the existence of a patient identification system and is flexible to accommodate variations in existing identity mechanisms.

In locales where unique electronic identities do not exist, we provide access to mobile health services based on ClickDiagnostics's own unique identifiers. Where pre-existing unique identification mechanisms are widespread, the system provides universal medical record functionality, inter-operating with other medical record systems in a country to increase the value of the service. In either case, the ClickDiagnostics system works such that each patient has a unique patient ID as well as critical information to authenticate a patient and their association to the medical record.

Secure access to patient information is another core component of the ClickDiagnostics system. Access to data is secured through authentication and encryption mechanisms; all data transmitted is encrypted for privacy protection. Typically, medical record data transmissions are kept in the country via locally-hosted web servers and databases, and in the event a consultation to foreign experts is requested by the in-country physician, the consulting doctor logs into a secure web server to access patient information stored in-country.

D. Data Analytics

In principle, data reports and other macro-level public health analyses enabled by the ClickDiagnostics system belong to the hosting organization. For example, NGOs contracting ClickDiagnostics to provide mobile phone-based survey collection services can access databases containing survey results, generate reports as needed, as well as view analyses of data collected. ClickDiagnostics facilitates the customization of reports and analyses of data per the needs of the requesting organization, and we ensure both privacy and security of data by aggregating at a sufficiently high level that individual identification is not possible.

E. Regulatory Issues and Constraints

ClickDiagnostics regularly confronts regulatory hurdles in the use of electronic health data. Chief among these is security of data: clients often mandate that web servers and databases are hosted at client-owned sites within the countries where the mobile health service is being provided.

In addition, ClickDiagnostics is currently helping clients define where liability resides in a mobile phone-based referral chain. In some respects, the ClickDiagnostics mobile health platform can enhance clarity of medical liability: in the absence of this system, general physicians provide medical advice about conditions for which they are not specialized; and nurses and other health workers perform triage and prescribe basic treatment plans frequently without the assistance of any standardized health protocols. It is often the case that ClickDiagnostics's innovation in healthcare delivery forces stakeholders to confront medical liability issues anew.

IV. FURTHER DEVELOPMENT

To date ClickDiagnostics has established pilots in seven countries that are using its mobile health platform, and has provided this paper to serve as an overview of the venture and current data strategy. ClickDiagnostics hopes this paper facilitates discussion and would appreciate any comments on further development of the data strategy presented.