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Research Article

DREPANOMRS©, A Combination of E-Health and M-Health for Sickle Cell Disease in Madagascar

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Abstract

In Madagascar, sickle cell patients are found in almost every region. Many of them are lost to sight. In addition, high-prevalence areas are remote and almost inaccessible, which hampers exchanges between health care providers in charge of these patients. The objective of this study is to promote access to care for patients and sickle cell families in Madagascar by the innovations brought by ICTs.

The study is based on the use of the DrépanoMRS© digital platform. With its functionalities, it makes it possible to open up doctors and patients. The research towards this is a study in progress. A new facial recognition device is currently under study for this application that continues to evolve. These solutions have been used to lower the frequency of the loss of sight in patients. Thanks to its synchronization function, the application can be used offline during medical consultations. This project can be used as a model for other health programs in Madagascar as well as in other developing countries.

Keywords: *Anemia; Sickle Cell; Medical Records Systems; mHealth; Telemedicine*

Background

Health promotion and disease prevention are the main challenges of global health programs [1,2]. In Madagascar, sickle cell disease is one of the real public health problems and it affects 18% of the population, including 7% of children. Many of them are lost to sight. In addition, some areas are remote and almost inaccessible, therefore, care and monitoring of these patients is hampered. The establishment of a digital system [3] to monitor sickle cell patients wherever they are and to have a means to ensure a recall and ongoing communication with patients is essential [4].

Objective of the Study

The objective of this study is to promote access to care for patients and sickle cell families in Madagascar through the innovations brought by ICTs. Also, this application is used as a panel to determine the best method of remote medical data reporting [5].

Method

The combination of digital and mobile phone for the healthcare and health network [6] in Madagascar requires a topology consisting of an application server, database management systems and an SMS gateway. This gateway is used for communication with patients while the exchanges between doctors and health personnel are generally done through the Internet.

The study is based on the use of the DrépanoMRS© open-source digital platform [7] which is a medical patient management application, initially created by the NGO LCDM SOLIMAD and LARTIC, with the aim of having patient files accessible remotely and offering an easy storage, centralization and exploitation of data [8] for the program to fight sickle cell disease in Madagascar. Updates have been made to its old version. Essentially, it consists of creating a new web module to send standard or personalized SMS to all homozygous sickle cell patients subject to systematic monthly follow-up consultations to ensure automatic recall of their medical appointments.

For material resources, the NGO's Doctors are equipped with a desktop computer. For the hosting of the application, we used a local Web server using a Cloud Computing [9,10] with CPU Intel core i7, 16GB DDR3, 2x HDD SATA 2TB Enterprise Class Soft RAID for unlimited traffic at 100Mbps bandwidth, which has a link interface with an SMSC central USB modem that will serve as a gateway for automatic consultation SMS reminder SMS sends [11]. This server is connected to an ADSL Modem Router where any external entry in the database is blocked for security reasons.

Results

Due to promptness and completeness of the data collected, the Sickle cell disease program has reliable and realistic data for the analysis and control of activities related to the care and follow-up of patients and families with sickle cell disease in the country.

Generally, sickle cell patients must have at least one meeting a month with their doctors. Many of them do not attend their medical check-up. Thus, the appointment reminder module is created to remind these patients, via an SMS, their check-up with a doctor. This module is also created to give an overview of the medical visits of patients who are supported by the Health Program.

In the updated version of the application, the "Send Messages" menu presents a web interface for sending a particular message to patients. It provides administrators of the application a way to send messages to one or more patients, especially in case of urgent reminders.

The "Set reminders" menu is the main menu of the Reminder module. It allows the monitoring of the active visits to the application, in order to send the respective reminders messages automatically and at the agreed time. These instructions are executed by the simple click of a button.

Research done has brought new features to the DrépanoMRS© application. Through this project, we have added to the Health and Care Network of the Sickle Cell Disease Program: 1) an SMS service via Gateway Kannel, 2) a file sharing module, 3) a data synchronization module, for centralized backups of data, 4) a reminder module for medical appointments, (an agenda for doctors, an SMS for patients).

The only thing remaining is the step necessary for the strengthening of the security of the entire system to ensure the confidentiality of information exchanged.

This project has also confirmed the value of medical informatics, especially in developing countries [12]. From the analysis to the realization of the project, we became familiar with the most used software in the field of telemedicine. To migrate to the digitization of patient care records, it is essential to train managers (referring physicians and specialists) on the different functions of the application.

Knowing that the confirmation of the diagnosis and screening results is often based on Laboratory examinations, our idea is to set up a tele-diagnostic tool in the network. Moreover, biological analysis can be carried out remotely by only using a PC digital microscope and a computer application, allowing the remote expert team to access the data captured by the microscope during the observation.

The study is a study in progress. We are about to test a new device for facial recognition of patients [13] in order to 1) avoid any risk of overlap or duplicate medical record 2) decrease the study of the doctor at the time of creation of his medical folder, this which allows him to save any time 3) conduct a research which focuses on the automatic analysis of the facial expression [14] that could show a sign of pain that can immediately alert the doctor without even asking the patient. Very effective for children who do not speak much.

Discussion

The network has initially been installed in 10 cities of high prevalence where a problem of access and internet connection has been encountered. Opening the application is time-consuming and it is impossible to retain the patient. Moreover, some data redundancy and security deficiencies were identified. Our research has focused on these areas for improvement. Data synchronization helps avoid problems with internet [15,16] and the new experimentation of a facial recognition system avoids duplication and overlap of patient record. These factors indicate that it is necessary to install a local application including all EMR services and SMS modules to better facilitate its use and make it more efficient and secure. The facial recognition device has a dual role of securing the file against overlap and is also usable for the assessment of the pain scale, an ideal paediatric tool. The challenge is to operate at a lower cost for a maximum service.

Conclusion

The proposed solutions have allowed a presence of new features to the DrépanoMRS© platform. They were used to decrease the frequency of lost views in patients. Moreover, due to its synchronization function, DrépanoMRS© can currently be used in offline mode during medical consultations. This project can be used as a model for other health programs in Madagascar as well as in other developing countries. The facial recognition study will be completed within six months.

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