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# SECURITY OF ELECTRONIC HEALTH RECORDS IN A RESOURCE LIMITED SETTING: THE CASE OF SMART-CARE ELECTRONIC HEALTH RECORD IN ZAMBIA

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## Abstract

*This paper presents a case study of security issues related to the operationalization of smart-care, an electronic medical record (EMR) used to manage Human Immunodeficiency Virus (HIV) health information in Zambia. The aim of the smart-care program is to link up services and improve access to health information, by providing a reliable way to collect, store, retrieve and analyse health data in a secure way. As health professionals gain improved access to patient health information electronically, there is need to ensure this information is secured, and that patient privacy and confidentiality is maintained. During the initial stages of the program there were security and confidentiality concerns arising from lost cards and unlimited access by clinical staff. However, the introduction of pin numbers for patient cards and clinical staff access cards with passwords helped address some of the concerns. Nonetheless, public health information technologists still advocate for security that provides more reliable measures that protect devices, networks, transmission, and applications. Since its inception in 2004, Smart-care has expanded to integrate more than 500 health facilities by the end of 2009. In rural and remote locations without internet, smart cards and mobile devices such as laptops are used to transfer data for onward merging with the national database.*

## Keywords

Electronic Medical Records, Smart-Care, Security, Confidentiality, Zambia.

## INTRODUCTION

Zambia is a developing country located in the southern part of Africa, with a population of 13 million people living across an area of 152000 square kilometres (Central Statistics Office [CSO], 2012). It is estimated that 14.3% of those in the age range of 15 to 49 years old are HIV positive (Centers for Disease Control and Prevention [CDC], 2010; Ministry of Health [MOH], 2012). Since the year 2000, the MOH (2012) with support from CDC and other international agencies have been running a national HIV program that focuses on HIV prevention, treatment, care, and support.

As the HIV program continued to expand, it became clear in 2004 that there was need for a better and efficient system of managing information to replace the paper based system in use at the time, so as to improve the management of large amounts of health information if the program was to succeed (CDC, 2010; Nucita & Bernava, 2009). Based on this need, the MOH (2012) and CDC (2010) developed an electronic medical record and called it smart-care. Smart-care is the largest electronic medical record in Africa that has since been adopted by other countries including Ethiopia and South Africa (Tassie, Malateste, Pujades-Rodriguez, & Poulet, 2010).

Following the discussion of an overview of the smart-care program, this paper will indicate the rationale for using EMR in health care. Although the use of electronic medical records such as smart-care is associated with questions about security, privacy and confidentiality, the utilisation of some security features may help address some of the concerns. The program in Zambia uses pin numbers for patient smart cards and staff access cards that have passwords in order to guarantee security of confidential patient records. Finally, before concluding, the paper will outline the advantages and disadvantages of using smart-care as observed in the context of EMR and smart-care operations in Zambia.

## Justification for Using Smart-Care

In the past ten years, there has been a rapid development in information systems in the health sector (Australian Institute of Health and Welfare [AIHW], 2012; Miller & Sim, 2004). Public health professionals hope that these developments will significantly improve the collection, sharing and usage of health information better than paper based systems and enable clinicians to practice evidence based medicine (Hornbrook, 2010; Lesk, 2013). Lesk (2013) notes that countries that have had full coverage of EMR such as Denmark and the Netherlands have reported benefits for close to ten years now. The use of EMR as opposed to traditional information systems has accorded clinicians the opportunity to have on-line knowledge connections and access for guidance on treatment

options, drug dictionaries, coding definitions and access to online health literature (Hornbrook, 2010). Lesk (2013) states that Denmark has the lowest percentage of prescription errors, compared to other western countries that are not using EMR because the EMR database alerts clinicians on possible drug interaction and reactions based on the patient records contained in the data base. In addition, EMR is vital for health research because it improves access and makes the analysis of health data contained in one database easier.

### **Smart-Care use in Zambia**

Smart-care was developed to meet the needs of the Ministry of Health in the care of HIV patients, taking into consideration, the level of infrastructure development in the health sector in Zambia (CDC, 2010). In 2006, following two years of successful pilot tests, MOH (2012) approved smart-care as the sole electronic medical record to be used for public and private health care in Zambia. The main aim of the smart-care program is to link up services for HIV clients and improve access to health information regardless of location, thereby, reducing delays in initiation of treatment, duplication of investigations, risks and errors, expenses and improving HIV data standards, security and confidentiality in the country (Neame, 2013). Neame (2013) argues that storing health records using information technology (IT) improves the sharing of patient data among healthcare providers, a factor MOH thought could improve quality of care for HIV patients.

The smart-care software contains electronic forms that clinicians use to record patient information that include counselling and testing, initial history and physical examination, investigations, medication and long term follow up (World Health Organisation [WHO], 2013). The presence of these structured forms help clinicians to collect all the necessary information as opposed to paper-based systems where some relevant information may be omitted (WHO, 2013). After entry of all the information, the data is copied to a smart card that has a unique pin number.

In rural and remote areas where there is no access to electricity and internet, smart-care is supported by paper-based files and registers (Topp et al., 2011). Paper based data collection uses forms that are identical to electronic data entry forms for easy harmonisation of information (Kotzye & McDonald, 2010). Information officers and data entry clerks from district health offices visit these rural centers once every two weeks to enter the paper based records onto lap tops and copy individual patient information on smart cards for onward merging with the district and national database (MOH, 2012). Kotzye and McDonald (2010) describe the process of running parallel systems in rural areas as an expensive duplication of work. Furthermore, they found that the information gathered from paper based information systems in rural areas are often incomplete. Once data is entered into the smart-care database on a mobile device, it is then copied onto a smart card that is given to the patient (Topp et al., 2011). The use of smart cards is appropriate in developing countries where there is limited access to internet in rural areas because the EMR of a patient can still be accessed using the smart card in a secure manner because only the patient has the unique pin number needed to access patient information (WHO, 2013). Topp et al. (2011) argues that without smart cards, about one third of the rural population would not have access to the use of EMR. Therefore, smart cards not only improve security but also access for remote dwellers.

The CDC (2010) indicates that by the end of 2009, smart-care electronic health records were in use at more than 500 health facilities in the country and had resulted in the harmonisation of data for 308000 HIV positive clients receiving care, treatment and support across Zambia.

### **Security, Privacy and Confidentiality**

The health sector is faced with increasing demands for improved access to patient records (Neame, 2013). Nonetheless, even as health institutions work towards improved access, they have an obligation to ensure that ethical, privacy and confidentiality standards are met (Neame, 2013). Because patient information is confidential, there should be a balance between privacy and having the data readily available to those authorised to access it (Lee, Chang, Lin, & Wang, 2013).

The process of safeguarding the confidentiality and integrity of patient information is now a legal requirement that healthcare institutions should fulfil (Neame, 2013). However, doing so still remains one of the main challenges associated with EMR. Patient privacy is important because disclosure of personal health information such as HIV status in the case of smart-care could result in social stigma, loss of employment and denial of medical benefits (Lee et al., 2013). In addition, unauthorised access to billing information may result in patients suffering financial losses from illegal transfer of finances.

EMR such as smart-care should incorporate security features that protect against misuse by authorised users, hackers and those who steal the identity of patients (Lee et al., 2013). These are provided in Table 1. The smart-care EMR meets the physical safeguards because all hardware are stored in lockable offices and screening rooms (MOH, 2012). However, the program still has challenges to address technical safeguards. In view of the many

different staff categories who work in the program, there are concerns about misuse of patient information by authorised health personnel. To address this need, Neame (2013) advocates for role based access control (RBAC) to limit access to information that is only relevant to each cadre, for example, only demographic data for a registry clerk.

Smart-care has no security feature to address data transmission such as secure socket layer or encryption. The use of ordinary antivirus as opposed to specialised software based on security information and event management (SIEM) that can protect the network and the system infrastructure against cyber hackers remains a major security concern for smart-care.

*Table 1 Security issues and how smart-care meets these needs*

<b>Area of security concern</b>	<b>Example of category</b>	<b>How Smart-care meets the security need</b>
Physical safeguards	Screening rooms and other offices where computer software is kept	All offices and screening rooms are lockable
Administrative safeguards	Preventing misuse of patient information by authorised user	Staff training and monthly user auditing
Technical safeguards	Unauthorised access (privacy and confidentiality)	Staff access passwords Automatic account logoff after inactivity
	Those who steal patient identity and their smartcards (privacy and confidentiality)	Patient access pin numbers
	Back up and device disposal	Standard device disposal protocols available and all data is backed up
	Backup and duplication	Access to backup and duplication restricted to senior staff members only
	Hackers or large security breach (Firewalls and transmission modes)	No transmission mode Uses standard anti viruses that are not recommended for this purpose
Policies and procedures	Access procedures	User protocols in place
Organisational requirements	Notification for breach	Breach notification protocols in place

Furthermore, the smart-care electronic patient record is safeguarded using staff cards with passwords, and client smart cards with pin numbers (Lee et al., 2013). In addition, the smart card gives the patient control of access to records because the card acts as an index and access key to the smart-care database (Neame, 2013). Before the introduction of pin numbers in 2006, information on a lost card could be accessed if inserted into a computer network that had a smart-care soft copy. In view of this security concern, Lee et al. (2013) suggested that in addition to using a smart card, there should be a secret key that should be entered before access to data on the smart card is granted. It was these concerns that resulted in the introduction of pin numbers as safe guards for lost cards. The security features used to safeguard electronic medical records should be acceptable to the patients; otherwise, they often resort to avoiding the seeking of care or withholding important personal information from health care providers.

To enhance the security features of smart-care as an EMR, the MOH and software developers should improve security by covering all layers of information including device, network, transmission, and application.

### **Advantages of Using Smart-Care**

The smart-care EMR program, used for the HIV program in Zambia, has a lot of advantages. These include: supporting quick access to patient records, which saves physicians time; sharing of patient HIV records is made easier through integrated national databases and updated patient smart cards; and the presence of national, provincial and district databases has made monitoring and evaluation of HIV programs easier (CDC, 2010; Neame, 2013). Other advantages include cost savings from less paperwork, and the elimination of repeated investigations. Smart-care has made data use easier because health professionals can quickly filter and select relevant reports to make quick decisions (Hornbrook, 2010).

Another advantage of using smart-care is that it is now easier to compile the list of patients booked for review by simply running a summary report of the database as opposed to the paper based system where nurses had to compile the list manually from the case register (WHO, 2013). A comprehensive list of patients booked for

review also helps to identify and follow up those who miss their appointments, in order to reduce the number of those who default treatment and reduce the emergency of drug resistance (MOH, 2012). Smart-care has made it easier to analyse the entire cohort of patients at a hospital instead of sampling, as it occurs with paper based records in most cases since it is usually not feasible to analyse all the case files in a given period (Tassie et al., 2010). Finally, the lessons learnt will be used to improve the program before the planned rolling out of EMR to other service areas in 2020 (AIHW, 2012).

### **Disadvantages of Smart-Care**

One of the major disadvantages of any EMR is the issue of privacy and security (Neame, 2013). Maintaining privacy and confidentiality by ensuring that access to health information is restricted and only allowed to those authorised by the patient is still a major challenge (Neame, 2013). The addition of pin numbers for smart cards and staff access cards with passwords have improved security of the smart-care program in Zambia. However, some scholars advocate for inclusion of encryption as a key security feature to prevent hackers. The other challenge relates to the extent to which the shared information is free of errors and retains meaning (Ash, Berg, & Coiera, 2004). It is hoped that using international standards and coding systems will address these problems (CDC, 2010).

Another disadvantage of smart-care, and other EMRs are the high initial cost; slow and uncertain financial rewards; some doctors operating in the private sector are hesitant to share health information about their patients to other individuals or hospitals if they perceive them as competitors; and in rural health centres without electricity or other sources of power, there is often a backlog of paper based health records that are not yet entered into the smart-care database. This backlog is a cause of concern about the completeness of the national database used for analysis (Miller & Sim, 2004; Richards et al., 2012; Tassie et al., 2010). However, using mobile devices with smart-care database such as lap tops to capture the information at facilities without electricity has helped reduce the backlog of patient information not entered into the national data base. Furthermore, the use of smart cards ensures that even patients from these rural and remote locations have their medical history available once transferred to higher levels of care where electricity is available.

## **CONCLUSION**

This case study has critically analysed the EMR called smart-care that is used for the management of HIV health information in Zambia. Developed due to the identified need to handle large amounts of health information in a secure manner, the smart-care software is the largest EMR in Africa. In Zambia, smart-care has expanded since its initiation in 2004 to integrate more than 500 health facilities and has harmonised patient records of more than 308000 individuals across the country. The uses of smart cards with pin numbers and staff access cards with passwords have alleviated some of the concerns about privacy and security of confidential patient information and made smart-care a more secure electronic health record. However, health informatics specialists are advocating for use of RBAC, specialised firewalls such as SIEM, and secure socket layer or encryption to protect patient information from cyber-crime. Smart-care has improved evaluation, monitoring and follow up of HIV cases in Zambia. In addition, HIV information stored in one database has made it easier for researchers to analyse the data and inform clinicians, thereby, promoting the practice of evidence based medicine. Having noticed the benefits of smart-care, the ministry of health in Zambia is now mobilising resources to expand the program to other service areas in health.

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