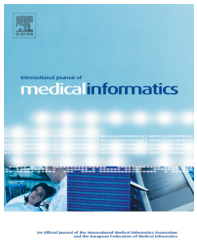
INTERNATIONAL JOURNAL OF MEDICAL INFORMATICS 84 (2015) 349–354

journal homepage: www.ijmijournal.com



Implementation of a cloud-based electronic medical record for maternal and child health in rural Kenya

John Haskew[a,*,1], *Gunnar Rø*[a,b], *Kaori Saito*[c], *Kenrick Turner*[d], *George Odhiambo*[e], *Annah Wamae*[e], *Shahnaaz Sharif*[e], *Tomohiko Sugishita*[c]

[a] *Uamuzi Bora, Kakamega, Kenya*
[b] *University of Durham, UK*
[c] *Japanese International Cooperation Agency, Tokyo, Japan*
[d] *British Antarctic Survey Medical Unit, Plymouth, UK*
[e] *Ministry of Health, Kenya*

ARTICLE INFO

Article history:
Received in revised form
11 January 2015
Accepted 12 January 2015

Keywords:
Electronic medical record
Maternal and child health
Resource-constrained settings
Data verification
Medical informatics

ABSTRACT

Background: Complete and timely health information is essential to inform public health decision-making for maternal and child health, but is often lacking in resource-constrained settings. Electronic medical record (EMR) systems are increasingly being adopted to support the delivery of health care, and are particularly amenable to maternal and child health services. An EMR system could enable the mother and child to be tracked and monitored throughout maternity shared care, improve quality and completeness of data collected and enhance sharing of health information between outpatient clinic and the hospital, and between clinical and public health services to inform decision-making.

Methods: This study implemented a novel cloud-based electronic medical record system in a maternal and child health outpatient setting in Western Kenya between April and June 2013 and evaluated its impact on improving completeness of data collected by clinical and public health services. The impact of the system was assessed using a two-sample test of proportions pre- and post-implementation of EMR-based data verification.

Results: Significant improvements in completeness of the antenatal record were recorded through implementation of EMR-based data verification. A difference of 42.9% in missing data (including screening for hypertension, tuberculosis, malaria, HIV status or ART status of HIV positive women) was recorded pre- and post-implementation. Despite significant impact of EMR-based data verification on data completeness, overall screening rates in antenatal care were low.

* *Corresponding author at*: Uamuzi Bora, P.O. Box 2153, 50100, Kakamega, Kenya.
E-mail address: john.haskew@uamuzibora.org (J. Haskew).
[1] Present address: World Health Organization, Amman, Jordan.

http://dx.doi.org/10.1016/j.ijmedinf.2015.01.005

Conclusion: This study has shown that EMR-based data verification can improve the completeness of data collected in the patient record for maternal and child health. A number of issues, including data management and patient confidentiality, must be considered but significant improvements in data quality are recorded through implementation of this EMR model.

1. Introduction

Complete and timely information is essential to inform public health decision-making and improve health service delivery, including for maternal and child health [1,2]. Data quality in resource-constrained setting is often compromised by incomplete data and untimely reporting, however, and local health information systems may be the only data sources available for the continuous, routine monitoring [3,4]. Few studies have assessed data quality and completeness for maternal and child health. A study of routine primary care data in South Africa showed 26% of data in prevention of mother to child transmission of HIV (PMTCT) records was complete and only 12.8% of those data recorded was accurate [5].

The paper-based mother and child health booklet has been a successful and integral tool of maternity shared care in Kenya and is an important source of data for routine and continuous monitoring of maternal and child health [6]. The pregnant woman carries and retains the paper record with her and the care provided is documented at each community outpatient or hospital visit. Paper records can increase women's engagement in care [7] but a limitation of using the handheld booklet in Kenya is that no individual patient record is kept by the health service provider. Other forms of patient information are retained at the clinic, for example as registers.

Electronic medical record (EMR) systems are increasingly being adopted to support the delivery of health care in a variety of settings in resource-constrained settings, including for HIV, tuberculosis and child health [8–11]. EMR system implementation is also particularly amenable to maternal and child health, in which the pregnant mother must follow a continuum of care, starting with routine antenatal visits until delivery and then through postnatal and neonatal follow-up, including provision of routine immunisation [12]. An EMR system can enable both the mother and child to be tracked and monitored throughout this continuum and could also be used to improve access to and use of health information at different levels of shared care both between outpatient clinic and the hospital, and between clinic, district levels and above to inform clinical and public health decision-making.

Few studies have focused on the application of EMR systems in maternal and child health [12], or their application in resource-constrained settings, where unique challenges and barriers to implementation are encountered, including limited human resources and financial costs [13,14]. Traditional models of EMR implementation have installed local systems infrastructure, such as a server and network in each clinic, which can be costly to implement and maintain [9], and which require specialised human resources [13]. These limitations underscore the need for innovative solutions that are appropriate for resource-constrained settings [9].

In this study, we describe the implementation of a novel cloud-based EMR system for maternal and child health in Western Kenya, its impact on completeness of the antenatal record and implications for shared maternity care in resource-constrained settings.

2. Methods

2.1. Study setting

Maternal and child health care in Kenya is provided in outpatient clinic and hospital settings, through which antenatal, delivery and postnatal care and support services are provided to the mother and newborn child. This study was conducted between April and June 2013 in five outpatient clinics in Kisumu County, Western Kenya.

2.2. Electronic medical record

The EMR system – called Uamuzi Bora [15] (a Swahili phrase meaning "the right choice") – was built using free, open source software and builds on common platforms and previous work, notably that of the Open Medical Record System (OpenMRS) [16]. The system was approved for use in Kenya by the Ministry of Health and adheres to national EMR standards [17]. The electronic patient record replicates information currently collected in the paper-based mother and child health booklet [6].

The EMR system implemented a cloud-based model, rather than a local clinic model, which removed the need for local clinic infrastructure and enhanced data access and sharing at different levels of health care. In using the term "cloud-based" we refer to the fact that the server and data are hosted centrally and not by the individual clinic, and that all processes (including the EMR software, analysis and reporting) is run on the server not locally on individual clinic computers. The system used a secure virtual private network (VPN), provided by a mobile phone operator in Kenya, to which the server and clinic computers connected via a mobile data network. Google Chromebooks were used in the clinic, with built-in mobile data connection, to connect directly with the VPN. Clinic computers were air gapped from the internet and only those using SIM cards registered by the project could access the VPN. Daily copies of an anonymised version of the patient database were used to provide health information to different users at different levels of care. The server and data were hosted for the Ministry of Health at the Uamuzi Bora project office, located in Kakamega, to provide maintenance, security, and reliable