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Assessing and improving EHRs data quality through a socio- technical approach

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Abstract

The implementation of Electronic Health Records (EHRs) in developing countries is considered a means for improving data quality and high quality care. However, existing research, indicate that EHRs have recorded greater quantity of bad data instead of improving the quality of data. The reasons for this is not exactly clear. Accordingly, this paper takes a broader socio-technical approach to explore the issues in more detail. The paper explores the relationship between EHRs and quality at the Pentecost Hospital Madina-Ghana by using an interpretative research approach. The result of our study indicates that the EHRs introduced at the hospital have so far had limited effect on data quality and that context-related challenges are the major pitfalls identified in the study. Based on a socio- technical approach the paper discusses the need to; consider users and technology as intertwined, how technology changes practice and how it formalizes roles and responsibilities in the process, why it requires collaborative work and why realistic goals as opposed to exaggerated expectation.

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1. Introduction

The implementation of Electronic Health Records (EHRs) in developing countries is considered a means for improving data quality and high quality care. Owing to this, governments in developing countries are investing hugely in EHRs in an attempt to improve healthcare and the general performance of public healthcare facilities¹. However, evidence from the growing body of literature has suggested that the introduction of EHRs, has led to the recording of a greater quantity of bad data instead of improving the quality of data being recorded.^{2, 3, 4} Essential to

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the problem appears to be that EHRs is implemented and used in a variety of different and complex systems made up of different users with different data interest to generate information that serves as input to healthcare decision. Hence, in order for higher quality to be achieved, the web of interactions always entails humans (social systems) solving problems with limited resources (technical systems) and working around imperfect processes⁵ to enhance overall outcome. Along these lines, several studies have shown that defining the data quality seems to be almost as elusive as measuring it, hence there is no single accepted definition for data quality and seems to be shaped by various use contexts. In this study, we take a socio-technical approach to examine the problems more broadly where we also take into account the particular context the EHR is implemented.

We zoom in on one developing country Ghana in Africa, being one of the few African countries that have implemented a substantial amount of EHRs the recent years. Some projects produced both locally and international with the ultimate goal of generating health information to facilitate health intervention and policy building.⁶ However, with no existing studies in Ghana as at October 2015, pinpointing exactly how the EHRs has improved quality in healthcare data. The following research questions were addressed by the study: What is the relationship between EHRs, quality and the contexts where it supposed to be used? And how has EHRs been a data quality enabler to healthcare delivery in Africa-Developing countries and what are the implications for implementation strategies of EHRs?

2. Literature review on quality, EHRs and socio-technical systems

Defining and describing EHRs data quality is a key to maintaining and improving it. Ever since the Institute of Medicine⁷ described the so-called “quality chasm” in health care, data quality improvement has become an important policy issue. However, studies have shown that there is no clear definition for data quality because quality itself is not straightforward not to think of defining quality for data. There are a variety of views on its meaning and some debate as to what degree quality is measurable. The World Health Organization (WHO) suggests: Quality is a process of meeting the needs and expectations of patients and health service staff.⁸ However, while some authors delineate data quality as “Fit for Use” others see data of high quality when it accurately represents what is constructed in the real world it referring to. For example, Chisholm⁹ argues that the extent to which the data actually represents what it intended to represent”, is more appropriate for defining data quality as “Not just Fitness for Use”. This can also be recognized with Orr k.¹⁰ who delineates data quality as “the measure of the agreement between the data views presented by an information system and that same data in the real-world”. Deducing from this, the current study although agrees to the above definition, adds to suggest that; data quality is the degree to which the data reality in use evenly meets data expectation, its intended user needs and objective with Conformance to establish quality Standards or properties. In this definition, data reality represents how data exists in the real world settings, evenly of data means free from biased and, data expectation represents the desired features that are required by users for the various operations and decisions. Lastly, the conformance to establish quality standard represent the data ability to comply with established standards and properties. However, based on this description, data can be referred to as poor if the reality of the data does not meet it purposes hence not in usage. As such, the EHRs quality data requirements are also a reflection of data quality properties and component. In much of the literature, quality has been defined through properties including: relevance, accuracy, timeliness, reliability and completeness.

However, a socio-technical approach to the notion of quality also includes the human dimension. A socio-technical approach acknowledges that the system is made up of people, tools, and conversations joined together.¹¹ Hence, organizational or technical systems cannot be designed independently of each other.⁵ The reason being that, the health care environment is multifaceted, implying that different groups use various technologies in complex ways.¹² As such, AHIMA¹³ identified that with the introduction of EHRs unlike the PBRs (Paper Based Record system), the role of data quality no longer rest largely on Health Information Management (HIM) professionals, but everyone from administrative and support staff responsible for specialty applications to direct caregivers who document inpatient records will be tasked with ensuring data quality.¹³ Again, in a study of three interconnected organizational EHR systems, Payton¹⁴ also concluded with a clear emphasis on the significant role played by physicians in achieving EHR data quality. However, studies suggest that users are often thwarted with apprehension emanating from shift from PBRs to EHR. Hence, users’ reluctance to adapt to new technology¹⁵ has led to the poor usage leading to EHRs inability to achieve data quality. This, in turn, suggests that an EHRs should be educated in the lens of the ANT (Actor Network Theory) which delineates information system (EHRs) as an actor with proactive role and users being the other actor within which the EHRs is used so as to better integrate with users’

working practices.¹⁶ In this regards, Chau and Hu¹⁷ suggested that in other to enhance EHRs users' acceptance, management in the health facility needs to work out a plan for cultivating positive attitudes toward using the technology. In many developing countries like Ghana, the concerned for data and quality of care has not been overlooked at, yet quality improvements interventions such as EHRs have been slow in implementation partly because quality improvement activities have received inadequate priority by some care providers. Hence, a socio-technical will help cultivate a plan that will enhance the role of everyone from administrative and support staff responsible for specialty applications to direct caregivers who document inpatient records by aligning their interest on the work required in order to facilitate the meeting between the technology and the work practices to meet quality expectations.

3. Methodology

The empirical data stem from a case study conducted in Ghana. Ghana healthcare system is mainly provided by two actors-the public institutions and the private institutions (private commercial and faith-based or religious institutions). Health care is mainly financed by the National Health Insurance Scheme (NHIS) which requires that people to pre-register with the NHIS. Like most developing countries, Ghana, unlike in the past can now boast of a nationwide electronic health management projects, including DHMIS (District Health Management Information System), which generate electronic information from all districts, based on the International Statistical Classification of Disease and Related Health problems (ICD10).⁶ Other EHRs include; Health Administrative Management system (HAMS), District Health Information System (DHIS), Healthfore and others. However, there is no standard regulatory framework for e-health practices in Ghana hence affecting assessment bases. In July 2010, the National e-health strategy was launched to provide a framework for the design and rolling out of e-health projects in the Ghanaian health sector.¹⁸ The four main strategies that were outlined in the National strategy includes; Streamline the regulatory framework for health data and information management, Build sector capacity for a wider application of e-health solutions in the health sector, Increase access and bridge the equity gap in the health sector through the use of ICT and to Achieve a paperless records and reporting system in the health sector of the country.¹⁸ However, based on certain data quality criteria, the current study was conducted in the Pentecost Hospital-Madina (Ghana). Established in May 1997 the hospital was one of the few, which adopted EHRs in its early stages experiencing over 8 years of it, operation. It is currently the La Nkwantanang Municipal Hospital, receiving referrals from other clinics in the municipality and beyond with attendance increased from 17,794 in 2005 to 89,336 in 2011 and the number currently is much higher than in 2011 necessitating the expansion of the facilities. Currently the Key staffs include 12 medical officers, 56 nurses, 18 midwives, 9 community health nurses, 28 enrolled nurses, 24 health assistance, 4 anesthetists and 98 others.

A qualitative research method in which Interpretative case study approach according to Klein and Myers¹⁹ was used to explore the complexities of data quality from users of the EHRs and the system administrators using in-depth semi- structured and unstructured interviews, observations, documentation and photographic analysis without any preconceived hypothesis to research the phenomena and to describe the complex socio-technical aspect EHRs at the hospital. In all a total of 20 participants including 4 doctors, 6 nurses, 4 record management workers, 1 data manager, 1 administrator, 1 pharmacist, 1 medical director, 1 laboratory technician and 1 insurance manager were recruited for the study. This approach was chosen with the aim to gaining an in-depth understanding of problem under study by investigating the various roles and behavioral perspective of the users of the EHRs and the context within which they acted to contribute to data quality with the system.

Purposive sampling was used to identify actual users from the dimensions (various departments) since not all members within the dimensions are actual users of the EHR system. In addition, the researcher used convenient non-probability sampling to include as much users as possible due to the shift system in the various user departments.

Analysis from the study involves words in the form of narratives or accounts from respondents²⁰. To easily analyze the data generated from this study, interviews and informal discussion used in study were structured according to themes to reflect the main objectives of the study and this aid an easy way of analyzing transcribed data. The themes, which were a set of inter- related topics, were all directed at overall data quality assessment with the introduction of the EHRs. The data generated from the study was hence analyzed based on the themes that includes; impact assessment of EHRs as a data quality enabler at the Pentecost hospital, ways and implementation strategies to improve the quality of healthcare data through EHRs. Comments as well as reflections were added to

the labels. The data collected were then focused into small sets of context by identifying similar phrases, patterns, themes, sequence and relationships between the various phrases, paragraphs or words to form a sort of network of data consistency. This was use to reflect what is already in literature and supported by existing theories.

4. Case

4.1. Introduction of HAMSTM at the Pentecost Hospital

In 2007, Pentecost hospital with the vision to provide a more quality healthcare to its customers through quality information management and also to meet the National Health Insurance Authority (NHIA) campaign on the general changes in technology to address insurance claim issues implemented an EHRs known as HAMS. The goal here was to help improve the entire record system of the hospital and also to achieve quality data to meet the need of it stakeholders (individual, groups, organizational bodies and other users) such as NHIA. According to the hospital administrator, the reason for the purchase and implementation of HAMS was based on its efficiency, user friendly and contributing innovative nature in some major hospitals in Ghana to meet their administrative and management challenges.

4.2. The implementation of the EHRs (HAMSTM)

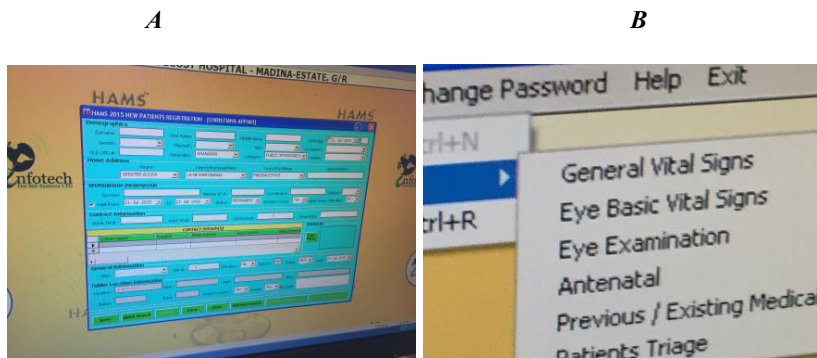


Fig. 1. (A) Background display of HAMS; (B) some record taking via HAMS

Developed by InFotech Dot Net System Limited (IDNS) Ghana, HAMS is a client server solution, which is designed using a Microsoft Visual Studio and a Microsoft Dot Net framework that serves as the front-end portion of the system. This is purposely designed to serve the administrative setup and structure of hospitals. The introduction of HAMS at the Pentecost Hospital came with an expected working routine at the hospital in order to achieve its objective. However, the implementation based on the various responses from various department, can be said to be a top management approach. This is because management took the decision and communicated to the various heads of department and was subsequently through staff meetings about the managements' intention to purchase the system, the reason behind the purchase was communicated to the staffs. Hence, training was giving as such, the training lasted for one month based on level of IT experienced and user needs. According the Administrator, the change was very necessary as a result of the challenges identified in the hospitals data management system though the system was perceived to be quite expensive. This was very significant as the board identified the implementation as the only way of solving the administrative and data management issues at the hospital based on a visit and survey to some bigger hospitals like Eastern Regional Hospital and others already using the system in Ghana. When a participant was asked why the direct users were not added in the decision making to know their readiness? The participants stated that;

The decision was made by board of directors and communicated it to the heads of department of various units and engaging the heads to a larger extent reflects the engagement of all users though they could not

give their suggestion but people in the board of directors are more knowledgeable since most of them are professional in healthcare. We just can't include everybody you know? (Three participant)

Also, out of the twenty respondents only four were included in the decision to purchase the system. Fourteen out of the remaining sixteen respondents at the various departments were not worried about their absence in the decision-making. Among them, twelve believe that such decision is the job of management and not them and the other two delineated how they will have absolutely nothing to have contributed even if they were invited in the decision making because they have no prior idea to ICT and EHR. However, the two who disagreed were senior staffs that indicated their level of readiness was poor in the initial stage because they were not oriented and employed with that and suddenly had to learn its usage within few weeks. Hence the fear of running into unknown errors caused some users to leave the systems' usage to those who felt comfortable with it. This was a bit unclear especially when the system providers highlighted that quality output from the system depended on usability. Surprisingly, most of such users were nurses and some physicians who are the key to recording patient information. Hence the researchers further interviewed users about their satisfaction with the system. However, eleven out of twenty respondents indicated that they were satisfied with the system with reasons related to the ability of the system to reduced costs and facilitating insurance claim, reduce errors, enabling quick access to patient records, privacy and safer prescription enhancement. Observation and further responses indicated they did not trust the data from the system. For example, some of such respondents delineated that with some user's attitudes contributing to wrong entries, transcribing challenges and new errors arising, there can be more mistakes than in the PBRs, so they preferred the manual one where they use to see in their hand writing and be certain about validity. Hence, the researchers notice that some respondent only wanted to give positive response with no tangible reason. However, others who were dissatisfied indicated the over exaggerated expectation they had from the system thinking it was coming to make their work so easier but the system has rather increased work load.

4.3. Impacts assessment of EHRs as a data quality enabler

Result from most participants indicated that higher data quality from the EHRs has yet not been achieved. According to participants of the study, the possibility of the retrieving the whole patient health information from the system is yet to be achieved. Also the participants were not certain about accuracy validations in local data entries and storage. This is because of the uncertainty in the level of truth over false information in data elements collected from the system a result of some missing data, omissions, local data entry process, and validity checks. They reiterated that, the data at the record section indeed represent majority of the patients in terms of bio data and other basic information but not always the case. Also, incompleteness of the record currently in the department was affiliated to originate from the fact that some patients are not consistent with the information they provided such as names, age, marital status and others causing us to enter information that was later rectified from their insurance claim as false. According to a participant this has been our major problem these days. It was further described by two participants that:

Sometimes, I encounter issues where patient come here and they are either not sure or don't know their age, house address and other personal details but need medical attention hence I just go ahead to register the patient without complete demographic details, others to reduce their age because of insurance claims or they being shy of a particular health problem like pregnancy.

Nevertheless, the few respondents who indicated the assurance of data *completeness and accuracy* were not able to provide accurate reasons for their answer. These include;

It is user friendly, it is easy to use; I like it because it is fast and flexible, why will the information on patient not be for the patient? Whose name is there...who will it be for then?

Moreover, most participants indicated the lack of consistency in data is causing poor *reliability* and dependency from the system. Also relating to *timeliness*, most participants indicated that often data is recorded along with clinical care and this makes data more current which is supposed to meet the current need of users. However, they

further indicated that though this information maybe current it may contain false validation because of all other inaccuracy challenges. Relating to *availability and accessibility*, the issue of information exchange difficulties prior to the implementation of HAMS was acknowledged to have improved unlike the use of paper record at the hospital. Others also delineated the challenges of the system supporting only internal sharing among various department and providers and still need to do manual work in case of transfers to other bigger hospitals. Also, the sharing ability was limited by privacy reasons and users who don't trust to used and share data. Furthermore, with *Relevance* most participant indicated that currently, the data collected is more focused with the primary aim of achieving quality of care and insurance claims in the hospital but did not acknowledged any obligatory to data quality.

4.4. Data quality-related challenges relating to the EHRs at the Pentecost hospital

Respondents from the Pentecost hospital delineated on the data quality related challenges constraining HAMS to achieve more accuracy in the hospital data. According to participants the hospital lack consistency standards in the form of abbreviations used in all departments, especially with the young and new nurses who like to write short hands. Also, poor user participation and acceptance related challenges was identified, Here, they delineated majority of the users were not involved in the decision making to purchase the system and was not thoroughly involved in the implementation stage. In addition, the issues of exaggerated expectation of EHRs was noted among respondents as they expected more from the system and made them felt relaxed this was because of the perception that this system would replace the paper documents, and result in a perfect work set up at the hospital. The researchers also identified that the problem of "I have more important duties" indicated by most respondent causes most of the data quality related problems the hospital faces. According to some respondent the time spent on a patient is not enough for typing unnecessary patient details, this is because there are a lot of patients to attend to and the main aim of the hospital is to save lives and not to do research or manage data. This was express by a participant as;

Imagine only me during night shift with about 15 patients, do you think even if I was a machine I could record all that happens here during the night? NO. I just can't after all that was not why I was employed. But it would have been better if we were many you know?

Moreover, poor role definition toward data management at the introduction stage was another challenge. This was a result of the lack of education on the need for proper data documentation. Hence causing data discrepancies issues as well. This was express by a participant as;

I am not paid to be typing unnecessary information; I cannot type everything a patient says to me because I don't have that time so I write what I can. If you talk about data accuracy that should be the problem of record keeping and transcribes to check the entries made and those we are not able to put on the system directly because of some reasons.

5. Discussion

From the recent study, data quality indicators such as relevance and a level of user satisfaction were acknowledged to be on course by some users. However, definition data quality entails that the reality of the data in use should meet user expectation with conformance to data quality properties. Nevertheless, most of the properties acknowledge in the study along with the user's expectations were not met. In addition, real time data from the system were not in total usage by most users. However, several challenges such as exaggerated expectation, inadequate staffs, conformance to standards, poor user participation, poor role definitions, resistance to change and others were identified as EHRs data quality limitations. This is not surprising considering the virtue of the fact that quality-related issues are everywhere in the health care system.⁷ Although these challenges exist in previous literature, in this study all the challenges identified relates mostly to users and the implementation context. Hence, the need to involve users in decision-making in the development or technological introduction is very significant looking at the

various users with different need, understanding and interests to data quality. As such, there is the need to analyse the relationship between EHRs, quality and the contexts, by focusing on aligning users interest and roles on the work required in order to facilitate the meeting between the technology and the work practices to meet their expectations. In that regard, Orfanidis et al.¹⁶ suggests that an EHRs should be educated as should an actor with proactive role and users being the other actor within which the EHRs is used so as to better integrate with users' working practices. A such, a socio-technical approach acknowledges that the system is made up of people, tools, and conversations joined together,¹¹ and organizational or technical systems cannot be designed independently of each other.⁵ Hence, the following need to be considered:

The need to consider users and technology intertwined: The role of users in this intertwined change of technology and practices, and healthcare institutions is very significant in achieving quality data from the system. However, the result indicates that the link between the users and the EHRs was not properly coiled. Hence users felt that the line of work could be separated from the system. However, as noted in previous research, users or technical systems cannot be designed or used independently of each other.⁵ This assertion also reflects in the opinions of Coeira¹¹, who considered the physiognomies of human-computer dealings or interactions in a system as essential for a successful telemedicine implementation program.

The need to change practice: The study results reveal that there were some users who resisted to change their working culture because of familiarity or the fear of the unknown hence were not receptive to the system. For example, some participant indicated they still used folders because it makes them faster which was later supposed to be transferred by transcribers who often had challenges with handwriting, abbreviations or not being recorded at all. However, studies support that users are often thwarted with apprehension emanating from shift from PBRs to EHR. Users' reluctance to adapt to new technology¹⁵ has led to the poor usage leading to poor data quality. Hence there is the need for management in the health facility to work out a plan for cultivating positive change attitudes toward using the EHRs to prevent the challenge of the fear of the unknown by users.

The need to formalize roles and responsibilities: Inadequate role definition towards the EHRs data quality was a major challenge in the study. For example, some participant mostly physicians and nurses indicated in the study that data quality was the work of the data manager and the record department. However, AHIMA¹³ identified that with the introduction of EHRs unlike the PBRs, the role of data quality no longer rest largely on HIM professionals, but everyone from administrative and support staff responsible for specialty applications to direct caregivers who document inpatient records will be tasked with ensuring data quality. Hence there is the need to formalize roles and responsibility in collaborating arena to ensure continuity of record keeping. Also, Crownower and Rosenbaum²¹ conclude that the best way to achieve acceptance from users is by enhancing their participation and role in the user community in the development cycle of the EHRs. Hence, users will see the need to recognized formalizing their informal responsibilities such as oral or manual practices in the course of care giving with the EHRs.

The need for Collaborative Work; Throughout this study, poor role definition and understanding among the various users with different interest towards EHR data has been a major challenge. However, the concept of *ANT* elaborates that users of the system (EHRs) are different actors including the technology counting on each other because one actor's role influences another.²² Hence ANT enables users to see the important of their abilities as actors in achieving data quality from the system and not just the technological abilities. This can therefore be achieved through a sociotechnical approach with effective collaboration among all users and other social elements involved. Here, the concept of translation in ANT which involves "*creating convergences and homologies by relating things that were previously different*"²³ will assist in such collaboration. As such, *translation* enhances collaboration, compromise, and negotiation between different users with different interest looking at the possibilities and the potentials available.

The need for Realistic goals as opposed to exaggerated expectation: Socio technical aspects enable users to understand the reality of the EHRs as not an automatic data quality enabler by as studies have shown that IT is usually only integrated with pre-existing systems, but not a process which changes existing result to perfection.²⁴ Hence the issues of exaggerated expectation of EHRs will be well understood by staffs to reduce the perception that this system would replace the paper documents, and result in a perfect work set up but a task that has to be achieved by various actors involved. Monteiro²⁵ argues that artifact such as EHRs is always interpreted as an appropriated flexible, and that the notion of an inscription in ANT may be used to describe how concrete anticipation and restrictions of future patterns of use are involved in the development and use of a technology.

6. Conclusion

The study reveals that the ability of healthcare institutions in developing countries to achieve data quality is not just the implementation of the EHRs technology as glorified by policy makers but rather a supporting tool to the existing human interface in which the significant of the implemented context including available resources and working culture cannot be over looked. However, this tends to be farfetched in most developing countries due existing challenges that are unique to the population and environment. Hence, the need to consider the context of implementation by aligning their local individual interest to a common interest through encouraging a form of ownership and responsibility to the users towards achieving quality from the EHRs must be acknowledged through a socio-technical approach.

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