Understanding the Relationship between Staff, Processes, ICT Infrastructure and Data Quality: Experiences from the AIDS Healthcare Foundation Uganda Cares

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Abstract

Millions of health-related records are generated every day from various sources. However, the trustworthiness of the data held within the data management systems has been called to question. Addressing this gap, a study on electronic medical records system and data quality was undertaken at Aids Healthcare Foundation Uganda Cares organization to examine the relationship between the two variables and come up with best practices that organizations could adopt to improve the quality of their electronic databases. A correlational study was conducted on 95 randomly selected employees involved in data management for HIV services. Seven (7) Programme Managers were purposively selected and interviewed to provide in-depth information about the study. Quantitative and qualitative data collection methods were used to obtain data from a total of 102 staff. Additionally, secondary data related to the study was gathered from journals, textbooks and web pages. Descriptive statistics were derived, and correlation and regression data analysis was done. In the study, Pearson's correlation coefficient to establish bi-variate relationships in terms of significance and direction of relationships between electronic medical records system and data quality was used. Regression statistics were done to determine the predictive strength of electronic medical records system on data quality and to describe the distribution of responses in a meaningful way, while descriptive statistics in form of frequencies, percentages, means and standard deviations were also used to summarize and present the study results. The qualitative data gathered through interviews was analyzed and interpreted using content analysis. Patton's six generic steps were used in this process, namely: organization and preparation of data; reading through the data to get a general sense of the meaning; coding; generation of themes; representation of themes and interpretation. The results showed that processes had a higher impact on data quality as compared to staff and ICT infrastructure. The conclusion is that data quality can be improved if processes are strengthened and that ICT infrastructure is not significant in relation to data quality.

Keywords: Data, Data Quality, Electronic Records System, ICT Infrastructure.

Introduction

For organizations to be best served by their information systems, a high degree of data quality is required and the need to ensure this quality has been addressed by both researchers and practitioners for some time (Wang et al, 1995). Data quality is the focus of this article. In today's increasingly complex and competitive world, healthcare systems are grappling with the question of suitability of data to meet the purpose for which it was generated. According to Harris (2009), data has multiple uses with unique fitness requirements and constitutes the basis for decision making at operational and strategic levels. It is imperative that the quality of data is controlled, monitored and evaluated to enable every organization produce such data that is fit for the set purpose. We conceptualize data quality in this study under three dimensions:

accuracy, timeliness and completeness. Since Healthcare Foundation Uganda Cares (AHF) provides HIV/AIDS services to over seventy-five thousand (75,000) patients in Uganda according to the Global Patient report of 2016, the question of integrating accurate, timely and complete information from disparate sources is imperative. In line with the adoption of new ICT technologies in the health sector, AHF also implemented a medical records system aimed at improving the quality of its data. Against this background, this study was undertaken to assess the effect of such an electronic medical records system on the quality of data. We conceptualized our electronic medical system under three dimensions, namely: people, processes and ICT infrastructure. We hypothesized that given the right people placements, combined with adequate and good processes backed by a good ICT infrastructure, the likelihood of improving the quality of data in terms of accuracy, timeliness and completeness at AHF Uganda Cares were high.

The Problem

AHF Uganda Cares uses the electronic medical records system for various functions such as decision making, operations research, management of linkage of patients into care and reporting to donors and stakeholders. In light of the various functions, there are noticeable discrepancies between the data sources and the electronic medical records. For instance, during the regional performance review meetings held in July 2015 at AHF Uganda Cares, the data presented by the health facilities was not the same as data generated in the electronic medical records system, which pointed to a research gap. Related to the above, most of the data extracted from the electronic medical records system for operations research in 2015 could not be used because more than 50 per cent of it was incomplete and the date of the records did not match with the targeted research periods. Since poor quality data could have significant negative impacts on the efficiency of an organization (Haug et al., 2011), this study was undertaken to evaluate the accuracy, completeness and timeliness of clinical data at AHF Uganda Cares.

Study Objective

Specifically, the study aimed at establishing; the relationship between people and data quality at AHF Uganda Cares, the relationship between processes and data quality at AHF Uganda Cares and, the relationship between ICT infrastructure and data quality at AHF Uganda Cares.

Research questions

The researchers sought to answer the following research questions:

1 What is the relationship between people and data quality at AHF Uganda Cares?

2 What is relationship between processes and data quality at AHF Uganda Cares?

3 What is the relationship between ICT infrastructure and data quality at AHF Uganda Cares?

Hypotheses of the study

i. There is a significant positive relationship between people and data quality at AHF Uganda Cares.
ii. There is a significant positive relationship between processes and data quality at AHF Uganda Cares.
iii. There is a significant positive relationship between ICT infrastructure and data quality at AHF Uganda Cares.

Review of related literature

Below we review literature in accordance with the study objectives.

Relationship between people and data quality

A predominant sentiment in the data quality realm is that data quality is not about technology. It is about people (Liliendahl, 2011). Don et al. (2013) conducted a study to explore nurses' knowledge, attitudes and perceptions regarding electronic medical records and ICT in South Africa and found that many nurses clearly knew the potential benefits of an electronic system such as fewer errors, more complete records, easier reporting and access to information. The nurses reported that an electronic medical records system would solve the challenges they identified with the current paper-based records system, including duplication of data, misfiling, lack of a chronological patient record, excessive time in recording and reduced time for patient care. Many researchers, based on their surveys to conclude that health workers have insufficient technical knowledge and skills to deal with electronic records (Meade, Buckley, & Boland, 2009). This general lack of skills hinders the wide adoption of electronic medical records systems (Shachak, Hadas-Dayagi, Ziv, & Reis, 2009). This suggests a potential weak spot that can give rise to poor quality of data in a digital environment. Poor quality data can have significant negative impacts on the efficiency of an organization (Madnick et al., 2004; Haug et al., 2009; Batini et al., 2009; Even & Shankaranarayanan, 2009). Data quality, therefore, cannot be ascertained and improved unless there is evidence of location of errors. This study was carried out to establish if the people involved in data management have the right skills to improve and ensure data quality.

Relationship between processes and data quality

Lee & Strong (2003) conducted a study on data processes and analyzed responses from three roles within data production processes namely data collectors, data custodians and data consumers focusing on the effects of different knowledge modes held by different work roles on data quality. Lee & Strong (2003) found that work roles and the mode of knowledge matter and data collectors with knowledge about the data production process produce good quality data.

According to Don et al. (2013), knowledge, attitudes and perceptions of nurses regarding ICT in South Africa indicated that the point-of-care data entry is likely to improve data completeness and accuracy and is likely to lead to use of the resulting information in nursing practice. This is supported by Bowman (2013) who, in her study, found that the quality of data is dependent on accurate information at the point of capture. The quality of the documentation in the patient record is contingent upon the accuracy and completeness of information entered

into the record by all parties involved in the patient's care. The researchers therefore conducted this study to determine and the extent to which processes cause variations in data quality.

Relationship between ICT infrastructure and data quality

According to Davis et al (1989), assert that one of the significant factors in the planned introduction of ICT is the attitude of the people that will be required to use it. Safran et al (2007) conducted a study on the use of secondary health data and found growing interest in conducting research with data collected and stored in electronic databases, but observed concerns about the data's quality. Due to such concerns about data quality, van der Lei (1991) warned specifically against the re-use of clinical data for research and proposed what he called the first law of informatics: 'data shall be used only for the purpose for which they were collected'. The Beacon Community experience has shown that most data quality issues are related to completeness or correctness; so practices may consider initially focusing on these dimensions. The international review of data quality (2011) conducted by the Health Information and Quality Authority reveals that the current ICT infrastructure in health is highly fragmented with major gaps and silos of information. This results into service users being asked the same information several times.

Previous studies further reveal that more than a half of the health workers who do not use electronic medical records systems doubt that electronic medical records systems can improve patient care or clinical outcomes (Kemper, Uren, & Clark, 2006). The same authors observed that lack of technical training and support from vendors is a barrier to the adoption of electronic medical records systems by physicians, emphasizing that the quality of the system is crucial for data to be accepted by the users. Bodenheimer (1999) stipulated that in the era of globalization and information, healthcare industries are intensely promoting and adopting ICT to improve patient care. When more and more patients as health consumers seek and prioritize quality in their lives through enhanced healthcare treatments and services, it places great demands on the healthcare industry's information-handling abilities and infrastructure. A report by the World Bank (2006) shows that reliable information and effective communication are crucial elements in public health practices. The use of appropriate technologies can increase the quality and reach of both information and communication. This motivated the researchers to conduct the study to establish the relationship between ICT infrastructure and data quality at AHF Uganda Cares.

Figure 1 below illustrates the relationship between the independent and dependent variables

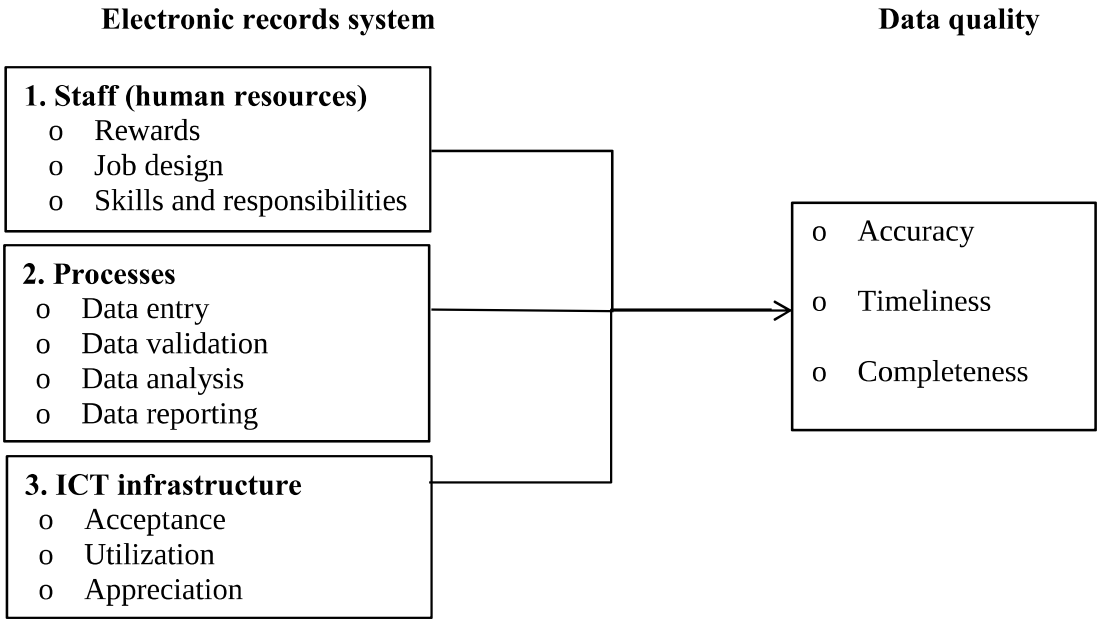

Figure 1: The conceptual framework (Adapted from Ballou & Pazer, 1985)

The conceptualized relationships are explained by the systems theory that looks at data management at AHF Uganda Cares as a system. It shows a combination of inputs such as the staff to manage and use data, processes like data collection, validation and reporting with ICT infrastructure that provides an enabling environment for the staff to manage electronic data in order to ensure good data quality.

Methods

A correlational study was conducted on 95 AHF staff involved in data management for HIV services. The participants were randomly selected to include all categories of AHF staff who had served for at least a year in the organization by the time of data collection. The actual respondents were selected using the lottery method. This was guided by Krejcie and Morgan's table obtained from Amin (2005). In addition, seven programme managers were purposively selected and interviewed to provide in-depth information about the study. Quantitative and qualitative data was collected using a self-administered questionnaire and an interview guide, and additional secondary data related to the study was gathered from journals, textbooks and web pages.

Data collection methods

Inaccurate data collection can impact the results of a study and ultimately lead to invalid results (Amin, 2005). The study therefore used both quantitative and qualitative methods to collect the required data. These included:

Survey method:

A questionnaire was administered to respondents to fill at their convenient time. The questionnaire contained a set of questions about quality of electronic medical records at AHF Uganda Cares. This method was selected to enable the researchers to gather unique and individual information about the quality of electronic medical records at AHF Uganda Cares. It is a quick data collection method (Mugenda & Mugenda, 1999) and ensures confidentiality. The questionnaire took a maximum of 40 minutes to complete.

Interviews:

Face-to-face interviews were done to collect qualitative data from the respondents, each taking a maximum of 40 minutes. This method was chosen because interviews yield in-depth information, provide more accurate results and yield high responses and fewer errors in data collection.

Data collection instruments

Primary data was collected using a questionnaire and an interview guide to gather quantitative and qualitative data respectively. The instruments are elaborated below;

Self-administered questionnaire

A self-administered questionnaire is a data collection instrument designed specifically to be completed by an interviewee or respondent without intervention of the interviewers. A structured self-administered questionnaire was used consisting of interrelated questions about the research problem under investigation. The questionnaire was designed based on the objectives of the study (Amin, 2005). The content, response structure, wording of questions and the question sequence was the same for all the respondents, and the questionnaire was self-administered because the selected respondents were known to be literate and time for data collection was limited.

Interview guide

Before conducting interviews the researchers developed an interview guide to help them direct the conversation towards the topics and issues under investigation. The guide helped the researchers to know what to ask about, in what sequence and how to pose their questions. The interview guide contained broad topics and areas about electronic medical records and data quality dimensions. This instrument also had probe outlines to ensure that the interviewer addresses the salient points of the study.

Data quality

For the instruments to measure what the researchers purported to measure, they were assessed for consistency and accuracy. Quantitative tools were tested for validity and reliability while qualitative tools were pre-tested to confirm their potential to elicit consistent interpretation of questions and accurate answers from interviewees.

Validity

Validity is the extent to which an instrument measures what it is intended to measure (Punch, 2005). To establish validity, the instruments were given to two experts to evaluate the relevance of each item. Each expert rated the items in the questionnaire on a two-point rating scale of relevant (R) and irrelevant (IR). The computation of content validity index (CVI) was done by summing up the experts' rating on either side of the scale and dividing by two to get averages. The CVI is considered valid at 0.70 and above (Amin, 2005). To obtain the necessary computations, the researchers used the formula below:

$$CVI = \frac{\text{Number of relevant items}}{\text{Total number of items}} \times 100$$

Reliability

Reliability is the extent to which items are working in the same direction, that is, internal consistency (Punch, 2005). Reliability tests were done to measure the degree of consistency of the data collection instruments. Tested and re-tested questionnaires containing the same items that were supposed to measure a concept were administered to a set of respondents. Mugenda and Mugenda (1999) recommend up to a 10% of the sampled population to be pre-tested. The instrument was administered to 30-respondents from a sample of 102 people as a pre-test. A reliability analysis scale (Alpha coefficient) was conducted using SPSS after the pre-test. The instruments were found to be consistent, having scored above 0.70. Few adjustments were then made to improve the instruments. SPSS was used because of its automatic ability to fit a rating scale of two or more points.

Analysis

The researchers used Pearson's correlation coefficient to establish bi-variate relationships in terms of significance and direction of relationships between electronic medical records system and data quality. Regression statistics were used to determine the predictive strength of electronic medical records system on data quality and to describe the distribution of responses in a meaningful way (Mugenda and Mugenda, 1999), and descriptive statistics in form of frequencies, percentages, means and standard deviations were also used to summarize and present the study results. The qualitative data gathered through interviews was analysed and interpreted using content analysis. Six generic steps detailed by Patton (2002) were used in this process, namely: organization and preparation of data; reading through the data to get a general sense of the meaning; coding; generation of themes; representation of themes and interpretation.

Results

The relationship between staff, processes and data quality was positive and significant ($r = .371$ and $r = .583$ respectively, $N=95$, $p < .000$) and the relationship between ICT infrastructure and data quality was positive but non-significant ($r = .248$, $N=95$, $p < .015$). Deeper analysis at multivariate level indicated that processes ($b=0.530$, $p=0.000$) were the only important factor in predicting data quality and hence the rest of the factors, staff ($b=0.151$, $p=0.174$) and ICT infrastructure ($b=0.003$, $p=0.983$) were not significant. The coefficient of determination value (R square) stood at .354, implying that 35.4% of the variation in data quality at AHF Uganda

Cares is explained by the electronic medical records system with a standard error estimate of 5.72534. Conversely, 64.6% of the variation in data quality could be explained by other factors other than the electronic medical records system.

Relationship between people and data quality

The dimensions under people as a component of electronic medical records system are presented, analyzed and interpreted using percentages, mean and standard deviation following the Likert scale. A total of 15 items were used to measure this concept of people broken down into rewards, job design, skills and responsibilities. Table 1 below shows the respondents' views.

Table 1: Relationship between people and data quality

People (staff)	Questions	Responses				
		SD (%)	D (%)	DK (%)	A (%)	SA (%)
Rewards	Staff salaries paid in time	17.9%	24.25)	6.3%	23.2%	28.4%
	Staff have running contracts	2.1%	2.1%	9.5%	38.9%	47.4%
	Staff receive recognition	15.8%	21.1%	27.4%	24.2%	11.6%
	The job provides for rest	6.3%	9.5%	12.6%	60%	11.6%
	There is a safe and healthy work environment	3.2%	21.1%	2.1%	49.5%	24.2%
	(Mean= 3.55, Standard deviation = 1.16)					
Job design	Staff know what tasks to do	0%	1.1%	3.2%	48.4%	47.4%
	Staff are capable of doing their job properly	0%	2.1%	3.2%	40%	54.7
	On-job training is provided	5.3%	17.9%	2.1%	50.5%	24.2%
	Support supervision is provided regularly	2.1%	14.7%	7.4%	56.8%	18.9%
	Standard operating procedures are provided	3.2%	7.4%	4.2%	57.9%	27.4%
	(Mean= 4.07, Standard deviation = 0.88)					
Skills and responsibilities	Staff skills/experience are necessary for the job	0%	2.1%	4.2%	38.9%	54.7%
	Staff have basic knowledge on computer use	2.1%	11.6%	11.6%	48.4%	26.3%
	The core responsibilities of the job position are clear	0%	6.3%	3.2%	47.4%	43.2%
	Staff make necessary corrections to data entered	0%	3.2%	16.8%	46.3%	33.7%
	Confidentiality is maintained	0%	0%	7.4%	31.6%	61.1%
	(Mean= 4.24, Standard deviation = 0.78)					

Source: primary data

On average, the respondents rated rewards at 3.55, which indicates that staff are receiving moderate rewards from AHF Uganda Cares.

The statistics also show that there is higher agreement on all the parameters under job design by the respondents as compared to the other two response categories. This signifies that there are good job designs for people involved in HCT data management at AHF Uganda Cares based on the average score of 4.07.

Similarly, many researchers, based on their surveys, have concluded that health workers have insufficient technical knowledge and skills to deal with electronic records (Meade, Buckley & Boland, 2009).

People and data quality

The correlational analysis results ($r=.371$, $p<.000$) show that staff have a positive significant correlation on data quality. This implies that improvement in staff rewards, job designs, skills and responsibilities is likely to cause an improvement in data quality and vice versa. On average, all the respondents felt that rewards at AHF Uganda Cares are moderate and that job designs, skills and responsibilities of staff are high. The findings are supported by Liliendahl (2011) who stated that data quality is not about technology but about people. It is held that people are the sinners of data quality flaws and data quality challenges were introduced when people showed up in the real world.

The findings are also supported by a study on nurses' knowledge, attitudes and perceptions regarding electronic medical records and ICT at three community health centres in the King Sabata Dalyindyebo Local Municipality, South Africa, that was conducted by Don et al. (2013). They found out that the concerns raised by physicians regarding the use of electronic medical records systems were based on their personal issues, knowledge and perceptions. Similarly, many researchers, based on their surveys, have concluded that health workers have insufficient technical knowledge and skills to deal with electronic records and this results in resistance (Meade, Buckley & Boland, 2009).

Relationship between processes and data quality

The processes as a dimension of electronic medical records system were presented, analysed and interpreted using percentages, mean and standard deviation following the Likert scale. A total of 12 items were used to measure this concept broken down into data entry, data validation, data analysis and data reporting. Table 2 shows the respondents' views on processes.

The correlational analysis results ($r = .583$, $p < .000$) reveal that processes have a positive significant effect on data quality and, as a result, the hypothesis of the study was accepted. This implies that an improvement in data management processes is likely to cause an improvement in data quality and vice versa. The respondents felt that data validation, analysis and reporting were above average and that data entry is moderately done. These findings are in line with a study conducted by Don et al. (2013) on knowledge, attitudes and perceptions of nurses regarding ICT in South Africa which found that the point-of-care data entry is likely to improve data completeness and accuracy and is likely to lead to the use of the resulting information

in nursing practice. This is further supported by AHIMA (2012) who, in their study assessing and improving quality of electronic health records (EHR), found out that the quality of data contained in an EHR is dependent on accurate information at the point of capture – data entry. The quality of the documentation in the patient record is contingent upon the accuracy and completeness of information entered into the record by all parties involved in the patient's care. This view is also endorsed by the department of health (DoH) of South Africa that states that all indicators derived from patient data should be captured electronically at the point of care (DoH, 2012).

Relationship between ICT infrastructure and data quality

The correlational analysis results ($r = .248$, $p < .015$) show that ICT infrastructure has a positive non-significant effect on data quality. This implies that an improvement in ICT infrastructure is not likely to cause an improvement in data quality and vice versa. Overall, the respondents rated appreciation and acceptance of ICT in AHF Uganda Cares as moderate and high on utilization. The findings are supported by Holden et al. (2010) who stated that individual users' acceptance of ICT is a crucial factor in determining the success or failure of an ICT system. He further states that the introduction of ICT in an organization does not mean it will be used as intended. Users may reject it, misuse it, sabotage it or work around it. In the United Kingdom, Timmons (2003) found out that nurses had negative attitudes to ICT, and the same findings were registered in Taiwan by Lee et al. (2007).

Conclusion

Staff and processes have a positive significant relationship with data quality whereas the relationship between ICT infrastructure and data quality is positive but non-significant. This implies that data quality could be improved if AHF Uganda Cares and like-minded organizations could focus more on staff development, monitoring and supervision, but most importantly on strengthening the existing data management processes. This finding shows a predominant sentiment in the data quality realm: that data quality is not about technology. It is about people (Liliendahl, 2011). The findings of this study are consistent with previous studies which showed that health workers had insufficient technical knowledge and skills to deal with electronic records, and that this resulted in resistance (Meade, Buckley, & Boland, 2009), thereby compromising the data quality.

Recommendations

Following the results, the study recommended that staff salaries/payments be made in time, especially for the volunteers; a recognition package for staff with outstanding performance be put in place; and, close supervision of staff at the point of care data capture be done to minimize data errors and omissions. The study also recommended that the organization should decentralize data entry to health centres to promote ownership and quality control, conduct mentorship and coaching for the staff in data analysis and provide regular feedback to staff involved in data management process and reporting. The research further recommended that the organization should re-assess the ICT adoption, implementation and data back-up, and conduct staff training in ICT to increase on the effectiveness and efficiency of ICT use.

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