Original Research Article

Technological factors affecting data quality of routine health management information system: Case of Uasin Gishu county referral hospital, Kenya

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Effective and efficient management of today’s health system globally depends on well-functioning Health Management Information System. Health organizations are struggling to adapt to the ever changing environment to provide high-quality data to the right user at the right place and time through health system strengthening. The deficiency of strong information system with weak human infrastructure capabilities to support such systems is a catastrophe in-waiting in addressing health outcomes and resource management. The study was carried out to find out technological factors affecting data quality of routine health management information system. A cross-sectional study design was employed in this study. The results show that majority 68% of the respondents are nurses and a strong association was found between responsibility and accomplishing a task. The key informant interview confirmed a strong relationship between technical factors such as lack of right skills, numbers and appropriate technology to accomplish daily tasks. The significance of the findings could boost stakeholders engagement to strengthen physical and human infrastructure by having good knowledge and information technology expertise to successfully utilize and tolerate any change.

Key words: Technological factors, data, quality, routine, health management information system (HMIS).

INTRODUCTION

The World Health Organisation (WHO) in 2007 acknowledged Health Management Information System (HMIS) as a key building block of the health system. Effective and efficient management of today’s system depends on well-functioning Health Management Information System (HMIS) in design and implementation. Technological factors focus on the aspect that facilitates the delivery of high-quality information effectively by the human resource running the health process using appropriate technology to enhance decision making. Health delivery all over the world demands changes with regard to the rudimentary method of delivering healthcare. The adoption of technology, human resource investment and rights equipment at the various departments is uncertain. With the high demand from the general population in requiring quick delivery of services, health managers require high-quality information to inform their daily decision making within an emerging competitive environment; hence, keeping up with new trends and innovative services which other competitors might be

Abbreviations: German Academic Exchange Service, (DAAD); Government of Kenya, (GoK); Health Information System (HIS); Health Management Information System, (HMIS); Ministry of Health, (MoH); Routine Health Information System, (RHIS); Voluntary Counselling and Testing, (VCT); World Health Organisation, (WHO).

CCC - Comprehensive Care Clinic
offering (Kumar et al., 2013).

Many organizations are struggling to adapt new technology in line with the ever-changing environment in the delivery of information to the right user, in the right form and at the right time. Hence, the potential of information technology advancement affects the health industry in its process when delivering healthcare. Effective and efficient management of today’s health system globally depends on well-functioning Health Management Information System (Global Health Action, 2014; WHO, 2007; 2015). Health organizations are struggling to adapt to the ever changing environment to provide high-quality data to the right user, at right place and time through strengthening of the health system.

The potential of information technology advancement in the health industry is with the emergence of big data where data creation is growing at an unprecedented speed. Investment in aspects such as knowledge, skills, system design, training and deployment of right human resource create value in data quality. The deficiency of not having strong information systems with weak human infrastructure capabilities to support such system is a catastrophe in-waiting in addressing health outcomes and resource management (Schroeck et al., 2012).

Good quality data are the foundation of health systems management in generating information for policy-making, planning, monitoring of health outcomes and evidence-based decision making (WHO, 2007). Taking cognizance of deficiencies in data quality, vital health decision often depends on political speculation, donor demand and studies which are insensitive to changes over time. Kenya’s vision for the health sector is “to provide equitable and affordable quality health services to all Kenyans” (MOH, 2014). To accomplish this, the first Medium Term Plan 2008- 2012 of the Vision 2030 identified the need to ‘strengthen the national health information systems to enable them to provide adequate information for monitoring health goals and empowering individuals and communities with timely and understandable information on health (GoK, 2012). The role of quality data enables the generation of quality information through a good design and align technical capabilities within the system (MOH, 2015). A system without well-trained people and clear norms and standards cannot produce the information needed for making decisions (Mucee et al., 2016). However, the collection, collation, compilation, analysis and reporting of health data in most developing countries is faced with major problems resulting in incomplete, inaccurate and untimely data which is not useful for health management decision-making at any level (Karuri et al., 2014).

Odhiambo-Otieno (2005a) in his study on the development of evaluation criteria identifies HMIS operation with emphasis on the need for the right human resource, both in numbers and skills to collect and process quality data. In his results, he emphasises the lack of technical and human infrastructure which affects the implementation routine of health management information system activities resulting in compromised data quality and an overall erosion of information generated. Similarly, Nicol et al. (2013) noted one that the challenges of RHMS is low and middle-income countries revolves around nurses, whose responsible for and faced with the dilemma of seeing patients and compiling monthly statistics. The results reveals that the major concern was clinic personnel, such as nurses having multiple responsibilities including primary clinical responsibilities, which may interfere with the time they are allocated for data collection, compilation, quality check and even reporting.

On the other hand, clinic staff were cited to value the care of patients over data collection; hence data collection may be completed many days after the event has occurred, and this lag in time may impact on the quality of statistics they produce (Odhiambo-Otieno, 2005b). Changes in the global environment on information driven managers, policy makers and other categories of information users require an adequately trained health workforce in RHMS process. Availability of technically qualified human resource is key in supporting the RHMS process. The need for more recruitment of human resource in its right numbers, skills and regular training on data management and benchmarking for all levels of service can enhance the quality of data being generated (MOH, 2009).

Health care professionals spend a significant amount of their working time collecting large amounts of client and patient data which are rarely analysed and used at the point of collection. Health workers merely collect, aggregate and dutifully pass over this data to the next level. This information is rarely ever used to guide local action at the level at which data is collected. Very little information from the collected data ever reaches health system managers; despite the fact that an HMIS is mainly designed to facilitate the operations of health system managers at various levels. The lack of involvement of information users in the design of these systems hinders the effective and efficient process of addressing data quality. Although data capturing and reporting skills are present, little attention is accorded data quality in routine HMIS; lack of staff self-assessment skills or “epidemiological thinking” needed for analyses, interpretation and use of information for actions. Additionally, even when information users are involved, they often generate data that are not cognisant with the limitations faced to produce all the expected information (MOH, 2009).

Measure Evaluation (2010) indicated that lack of general skills in the basics of monitoring and evaluation not only affects data quality but also the ability to transform data into information for use in decision-making. On the other hand, training on completed data collection forms and data compilation, analyses and presentation were viewed as critical yet often underdeveloped skills. Moreover, the ability to interpret health information and apply it to the programme and policy context requires a skill set that is often never addressed in pre- or post-service training of health professionals. Insufficient skill was universally cited as a key barrier to collecting quality data and eventually using information. Competency, perceived or actual, in
performing RHMIS tasks also affects data quality.

Organizational change is usually difficult especially when a high number of people are involved as routines process in health industry by integrating modern technology solicits identifying the requirements; evaluating the business processes according to its objectives and goals. These changes should benefit the health sector and the consumers (GOU, 2015).

Many organizations are transitioning to more robust information systems mounting pressures and incentives to deploy and enhance quality of care and patient safety, along with a growing array of reports, daily process, training of users; handling of large data using a robust system to capture, store and exchange critical health information. In order to realize the value of investment of information technology to address data quality requires a supported environment that will bring administrative simplification and improve patient care services by providing a continuum of care. The use of information technology and the exchange of electronic health information with limited availability of the requisite skills and equipment at various levels and the high levels of information technology illiteracy remain major significant challenges.

MATERIALS AND METHODS

The study was a cross-sectional study design with the combination of quantitative and qualitative research methods. Quantitative methods were used in collating data on how many respondents represented the criteria when analysed through the process factors like data collection, collation, analyses, quality check techniques, feedback and data display while qualitative measures were employed to generate more in-depth information on the subject matter. In identifying the number of respondents to represent the total population, purposive sampling was utilized to gather data from the health facility while census method was used to obtain data from every health worker participating in data processing on a daily basis. The entire health workforce from each department was assigned unique numbers due to the fact that all population collecting data was the target population (82 participants) with a response rate of 81 (98.8%).

Questionnaire design was guided by research questions and literature review. The instrument was subjected to correction and validity. A structured questionnaire was utilized for the purpose of achieving the objectives of the study. The questionnaire and quantitative analyses were used to examine the variables. Both closed and open-ended interview questionnaires were administered to assess factors such as knowledge of the routine health management information system, data collection, collation, analysis, dissemination, display and use in relation to data quality of routine Health Management Information System. Based on the fact that the study population was heterogeneous and not homogeneous, key informant interview guide was used to obtain more in-depth information on the subject matter based on the research objective. Key Informant Interview guide was used on 2 key focal managers who were purposively selected by virtue of their positions (Facility In-charge and Information Manager) to shed light on data quality status and factors affecting data quality. Key informant interview guide was used as a follow-up to the questionnaire administered to various respondents at various departments to elicit more information.

Data analyses from the responses were treated and thoroughly analysed using Stata and SPPS Version 22. Each data collection instrument and answers were coded to facilitate easier analyses. Categorical data was used for cross tabulation and to test the associations of variables using the Chi-square test. The results are displayed in frequencies, Bivariate and multivariate analyses were used to determine factors influencing data quality. The results of data analyses are presented in tables, graphs and charts.

RESULTS AND DISCUSSION

On the level of education; 57 (70%) of the respondents had attained Middle-level college, 2 (3%) reached the secondary level while 22 (27%) had completed University level (Figure 1). Nicol et al. (2013) revealed that there was a considerable deficiency in the competence of health workers interpreting the data to address any quality issues. Kumar et al. (2013) cited that the adoption of technology, human resource investment and appropriate equipment at the various departments are uncertain. The high demand from a general population cannot be over emphasized in requiring quick delivery of services. For the acquisition and deployment of the right skill set of human resource, therefore, health managers need to be equipped with high-quality information to inform their daily decision making within an emerging competitive environment. Schroek et al. (2012) underscore the investment in aspects such as knowledge, skills, system design, training and deployment of the right human resource create value in data quality. The appreciation of various skills from various academics blends the success of health delivery. Consequently, deficiency of not having strong information systems with weak human infrastructure capabilities to support such system is a catastrophe in addressing health outcomes and resource management.

Kenya’s vision for the health sector is “to provide equitable and affordable quality health services to all Kenyans” (MOH, 2014). The same emphasis is indicated under the Kenya Vision 2030 which recognizes the need to strengthen the national health information systems to enable the provision of adequate information for monitoring health goals and empowering individuals and communities with timely and understandable information on health (GoK, 2012).

The majority of the cadres used to collect, collate, analyse data were 55 (70%) nurses and 26 (30%) account staff. Nicol et al., (2013) noted that one of the challenges in low
and middle-income countries in handling RHMIS revolves around nurses, whose responsibilities are faced with the dilemma of seeing patients and compiling monthly statistics. One of the key informants pointed out that:

**Majority of the data collection, collation, and submission to next level are done by a nurse** (Key Informant, 001).

Respondents were asked about the availability of human resource and skills to execute RHMIS activities. 81 respondents cited that the available staffs, in terms of number and skill mix are inadequate and they are average in accomplishing the expected task (Table 1). The results concur with Odhiambo-Otieno, (2005a) for his emphasis on the need to have the right human resource, both in numbers and skills to collect and process quality data. The Ministry of Health also takes cognizance of the implication of having inadequate technical human infrastructure which results in poor operation in implementing HMIS activities. Thus, resulting in compromise of data quality and an overall erosion of information generated within the health system (MoH, 2009).

Measure Evaluation (2010) shows that the lack of general skills to perform basic monitoring and evaluation at operation level not only affects data quality but also the ability to transform data into information for use in decision-making. Effective and efficient management of today’s health system globally depends on well-functioning Health Management Information System (Global Health Action, 2014; WHO, 2007, 2015). In addition, the Ugandan

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**Table 1. Distribution of respondents by profession (n=81)**

<table>
<thead>
<tr>
<th>Profession</th>
<th>Sex</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Officer</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Data Clerk</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Health Information Manager</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Medical Lab Technician</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Medical Lab Technologist</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nursing</td>
<td>43</td>
<td>12</td>
</tr>
<tr>
<td>Nutritionist</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ophthalmologist</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Physiotherapist</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Psychiatrist</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Public Health</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>VCT Counsellor</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>26</td>
</tr>
</tbody>
</table>

CCC activities only *(Key Informant, 001).*
Ministry of Health (2014) reports experienced shortages of health information personnel and shortages of basic computers and software to facilitate the analyses of routine health data in the Resource Centre in Kampala. The report emphasises that for any success of any program, skilled human resources are a crucial part of the system. It was observed that a small number of trained data managers at the Ministry of Health process the huge volume of data generated from various levels of care impacting on the production of outputs in a timely manner. These were also replicated at all levels of the health system where data managers and record assistants lack training on data transformation. On the other hand, clinic staff were reported to value the care of patients over data collection; hence data collection may be completed many days after the event occurred, and this lag-in-time may impact on the quality of statistics produced.

In a global environment, change in information demands that managers, policy makers and other categories of information users require adequately trained health workforce in RHMIS process (Odhiamb-Otieno, 2005b). This was also supported by Aung and Whittaker (2013) where training on data analyses and presentation were seen as a critical, yet often organized use of unskilled personnel in undertaking its processes. Therefore, uncertainty on the ability to transform data was missing from the training of health professionals.

One of the key informants pointed out that:

“There are a lot of competing tasks which one may be a call from time to time and with acute shortage of key staff in term of number and skill to carry on routine HMIS activities result with a lot of backlogs. The information shared at alater stage will not be useful in making timely decision-making” (Key Informant,001)

Figure 2 shows that 51 (63%) of the respondents had not been trained on RHMIS activities proceeding the study while 30 (37%) reported having been trained. Training/orientation/sensitization of data collectors on the RHMIS is relevant in enabling them to appreciate the importance of quality data for decision making and planning. The comprehensiveness of the training/orientation or sensitization depends mainly on depth/general skills which not only affects data quality but also the ability to transform data into information. Measure Evaluation (2010) underscores the need for continuous training/orientation or sensitization in a continuous process where the staff turnover and task shifting which may affect the completion of data collection forms, data compilation, analysis and presentation (which are critical yet often underdeveloped skills) are used. One of the key informants alleges that:

Table 2. Responsibility and accomplishing task (n=81).

<table>
<thead>
<tr>
<th>Responsibility</th>
<th>No</th>
<th>Yes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td>N (%)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>12 (14)</td>
<td>0 (0)</td>
<td>12 (14)</td>
</tr>
<tr>
<td>Yes</td>
<td>16 (20)</td>
<td>53 (65)</td>
<td>69 (85)</td>
</tr>
<tr>
<td>Total</td>
<td>28 (35)</td>
<td>53 (65)</td>
<td>81 (100)</td>
</tr>
</tbody>
</table>

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“Most training or sensitization done on routine HMIS take less than a week’s training excluding weekend, but not all the health workers are trained; majorly one programme office from the health facility; more shocking most of the training are narrowed to specific programmes such as HIV/AIDS, malaria, and others.” (Key Informant, 001).

The depth and extent of the training duration remain pivotal to creating an understanding of RHIMS. Furthermore, training of data collectors on RHIMS enables them to understand data collection tools for effectiveness and information use.

Figure 3 above shows the duration of training. 4(4.9%) of the respondent reported to have received training for two weeks only, while 26 (32.1%) reported training for less than a week. However, 51(63%) reported having not attended any training/sensitization or orientation. The study agreed with a study carried out on factors associated with data quality of routine health information system in Benin. The study repelled interesting fact that health workers had unsuitable approaches in dealing with RHMS training. Important facts outlined are that training and retraining done during the previous twelve months had a positive impact on the quality of data. Its emphasises that the quality of training was a tool produced to improved results, particularly by tailoring it according to the trainer, the health worker being trained and the tool being taught (Ahanhanzo et al., 2014; Hamre and Kaasbøll, 2008).

A chi-square test of was performed on training/orientation/sensitization and duration to determine their association \(X^2(2, N = 81) = 2.362, p < .000\).

Table 3 shows that 27 respondents were trained on data collection and collation, 18 on data presentation and collation, 16 on HMIS databases while 11 were trained on information use. Aung and Whittaker (2013) noted that the organization was using un-skilled personnel in undertaking its processes. Therefore, uncertainty on the ability to transform data was missing from the training of health professionals and even the study site still faces the same challenge. Health facility management offer training on
Table 3. Areas of training (n=81).

<table>
<thead>
<tr>
<th>Training areas</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collection and collation</td>
<td>27</td>
<td>33</td>
</tr>
<tr>
<td>Data presentation and analysis</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>HMIS databases</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>Information use</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

Figure 4: Availability of data collection tools with job aids

The availability of adequate data collection with constant supply is key and hence the most supply of data collection tools focus on disease-specific especially those supported by partners. It further alleged that the job aid used in some data collection tools have conflicting terminology and difficult to understand by those using them if there is no proper training and mentors put in place. Most national governments introduce new data collection without involving the users of information and end up with no training on their use” (Key Informant, 001).

WHO (2007) emphasizes that societal change requires the organization to adopt dynamic ways of addressing various processes using minimal dataset and indicators. Furthermore, availability of minimum dataset contains agreed data element that allows users to find interest to collect, understand how data is created, what is being measured, and assess data quality. Hence, data should meet the need of the user at the right time and right form. Good data instruments (tools) encourage users to fully comprehend datasets without having to consult the data producers. On the other hand, Nicol et al. (2013) revealed that training was not usually provided for clinic staff involved in data collection processes who often times, have very limited data quality checking skills, use of existing tools and do not understand the value of the data being collected; as such data captured into the RHIS may be of low quality. Consequently, MoH (2009) and Odhiambo-Otieno, (2005a) reveals the availability of varied numbers of data collection tools which were being used by already overburdened health care staff. The lack of coordination in data collection resulted in duplication of effort and competition from various data collecting units lead to poor quality in term of incomplete, inconsistent and timeliness of data being generated by HMIS.

Figure 5 shows the 46(57%) of the participants percept that the existing data collection tools are too many, 43(53%) reported they are user-friendly, 39(48%) not user-friendly, 10(12%) indicated they are complex while 8(10%)
indicated they are not comprehensive enough to address their needs. Additionally, Odhiambo-Otieno, (2005a) stress that Kenya HMIS had varied numbers of data collection tools which were being used by already overburdened health care staff. The lack of coordination in data collection resulted in duplication of effort and competition from various data collecting units leading to poor quality in terms of incomplete, inconsistent and timeliness of data being generated by HMIS. Another concern identified at the facility level was the existence of heaps of registers and tally sheets that need to be collated, summarized and sent to the next level of care.

Additionally, Measure evaluation (2008) identified the existence of complex reporting tools and reporting procedures to negatively affect data accuracy, timeliness, and completeness. Also, the need to complete multiple reporting forms resulted in data backlogs and decreased the amount of time available which also affected staff motivation. One of the key informants cited that:

"Most of the data collection tools are not user-friendly and are too many especially those related to partners’ support. Most health facilities are having one staff and they are expected to see patients or clients; the existence of many registers to be filled and summaries to be compiled and submitted to the relevant officers by the end of the month. The ministry currently is not employing staff and partners rather, it is employing and deploying staff in areas they are supporting. Most of the staff used are either data clerk with no medical background therefore find filling of the required forms difficult resulting in error if no proper induction training is done" (Key Informant, 001).

Figure 6 shows that 19 (24%) of the respondents reported the availability of a computer for managing routine HMIS activities while 62 (77%) reported a lack of computers. The
poor quality of data in a more complex management environment has been cited to attribute to the quality issues based on technology complexity, including mobile health information exchange and the expansion of uses and users. The result indicates that staff was completing the reporting forms manually which increased the frequency of errors and contributes to poor data quality (Measure evaluation, 2008).

Figure 7 shows the perception of those able to access any computer at the workplace. Out of 19 respondents able to access a computer, 0% stated that they are not user-friendly, 13 (68%) reported not easy to maintain, 10 (53%) stated not integrated with other information systems. The result agree with Measure evaluation (2008) which shows a common shortage of computers as tools for strengthening data quality and indicates that staff was completing the reporting forms manually which increased the frequency of errors and contributes to poor data quality. Additionally, Measure evaluation (2008) on the other hand observed a common shortage of computers as a tool for strengthening data quality and the result indicates that staff were completing the reporting forms manually which increased the frequency of errors and contributes to poor data quality.

Simba (2005) on another hand, masks the poor quality of data in a more complex management environment attributing the quality issues to technology complexity, including mobile health information exchange and the expansion of uses and users. One of the key informants highlight that:

“The availability of computer as a tool for improving effectiveness and efficiency in data processing is limited. The available computer is disease specific and most donors come with a conditionality on the use of computer and can not be used for other routine HMIS within the health institution. For instance, if the computer is to be used in CCC Clinic for example another work cannot be used on the same computer except CCC activities” (Key Informant 001).

healthcare presents a different set of challenges to management in working with competent staff responsible for technical innovation in routine use as they are much better equipped by education and experience to guide the development of innovation. Strengthening the know-how of users on existing technologies towards data quality backbone will improve the understanding of data quality issues in a more effective and efficient manner. The government and stakeholders are essential to strengthen physical and human resource infrastructure and pay attention to capacity building with appropriate technologies that are simple to use and sustainable in addressing data quality.

RECOMMENDATIONS

The results of this study on routine health management information system highlight the need and demand for collective responsibility from all players in the health industry to achieve high-quality information generated from data produced on daily bases. Addressing fundamental RHMIS issues, need for technological practices, increase health services management responsiveness to time-sensitive information is critical to sustaining progress related to health service delivery in health systems. In addition to high-resource initiatives, such as investments in information technologies and adoption that is effective within one health platform, controlling data and reporting systems of other drivers is a real-world approach for strengthening RHMIS and improving data quality. Globally, technological change in

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**Conflict of Interests**

The authors declare that there is no conflict of interests regarding the publication of the paper.

**REFERENCES**


