Original Research Article

Process factors influencing data quality of routine health management information system: Case of Uasin Gishu County referral Hospital, Kenya

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Global health agenda faces a challenge of ensuring sustainability of a high performing system in the context of evolving pressures, growing demand for timely and reliable information for planning. Effective and efficient management underpinnings on well-functioning health management information system design and implementation. Lack of strong system processes is a tragedy in achieving right measurement and accountability on health outcomes. The study was carried out to identify process factors influencing data quality of routine health management information system. A cross-sectional study design was employed in this study. Quantitative was used in collating data from health workers who were responsible for data collection, compilation, quality check and feedback while qualitative was employed to generate more in-depth information of the subject matter. The results show that 3(4%) of the respondents knew about system processes through formal comprehensive training with 81(98.8%) response rate. A strong association was found between data collection and collation with a chi-square of X2 (1)=32.934, n=81, p<.05. Data collection (p = 0.000), compilation (p = 0.000), feedback (p < 0.000). The key informant interview confirmed a strong relationship between process factors such as lack of technique for carrying data quality check and lack of data quality protocol place. Consequences of the results could enhance strategic decision in improving the health system process design and implementation

Key words: Process factors, data, data quality, routine, health management Information System

Abbreviation
DAAD: German Academic Exchange Service; GoK: Government of Kenya; HIS: Health Information System; RHMIS: Routine Health Management Information System; HMN: Health Metrix Network; MoH: Ministry of Health; PRISM: Performance of Routine Information System Management; WHO: World Health Organisation.

INTRODUCTION

A well-functioning health management information system requires a well-coordinated mechanism to collect, process, report data to be used to generate information for use for decision-making at the point of generation by healthcare providers, individuals, policy makers, planners and other stakeholders. Informed decision-making at all levels of a health system requires reliable data. Decision-making demand for timely and reliable information to effective and efficient resource allocation to address measurement and accountability on sustainable health outcome (WHO, 2007, 2015). It is noted that information systems need to be simple and sustainable and must not overburden staff or be

too costly to operate. In an ideal system, health workers are empowered to use the routine information they collect and understand the importance of good quality data for improving health outcome (Bill & Melinda Gates Foundation, 2015).

Effective and efficient management depends on quality data to generate critical information in policy-making, planning, monitoring of health outcome and evidence based decision-making. Relevant, timely, accurate, comprehensive and relevant information is critical for effective coordination of health system pillars in ensuring availability of adequate resources in strengthening health system (WHO, 2007). Therefore, data sources, data collection tools, and responsibilities for collection need to be identified and documented. Data validation procedures and data quality assurance need to be enhanced to ensure that data is not just timely but also accurate, complete, comprehensive and relevant to realize what the system was designed for (HMN, 2008). The current HMIS is experiencing broad problems such as existence of overlapping data collection tools, different number of health professionals such nurse as the majority, physicians, Health records and information officers, data clerk, and other profession who have varied levels of training and skills and who participate in data collection, collation, analysis and information use (MoH, 2009, 2014b). There are numerous deficiencies where decisions are based on political or surveys which are insensitive to change over time (Evaluation, 2009).

According to Health Sector Indicators and Standard Operating Procedures for Health Workers in Kenya MoH, (2008a) take cognizant of the inability to generate reliable information needed to make decisions based on evidence to public health services. Public health decision-making is critically dependent on the timely availability of sound data. The role of the Health Management Information System is to generate, analyze and disseminate Information generated over these systems which are perceived as an authoritative for enhanced decision-making processes and strengthening measurement and accountability that underpin the delivery of Healthcare. Therefore, data collection is one of the important components of health systems processes. These echo by Health Metrix Network(HMN), (2008) that the Problems with data quality undermine the planning and assessment of activities within the health system globally.

MATERIALS AND METHODS

The study was a Cross-sectional study design with the combination of quantitative and qualitative research were used in this study. Quantitative was used in collating data on how many respondents represented the criteria when analyzed through the process factors like data collection, collation, analysis, quality check techniques, feedback and data display while qualitative was employed to generate more in-depth information of the subject matter.

In identifying the number of respondents to represent the total population, non-probability sampling, specifically purposive sampling was utilized to gather data from the health facility while quantitative sampling, particularly census method was used to get data from every health workers 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%) obtained.

The study used researcher's made questionnaire which development was guided by research questions, literature review and was subjected to the correction and validity of the instrument. A structured questionnaire was utilized for the purpose of meeting the objectives of the study where the questionnaire was design coupled with quantitative analysis to examine the variables. Both closed and open-ended interview questionnaire was administered to assess the process 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 data routine Health Management Information System. Based on the fact that the study population was heterogeneous and not homogeneous, key informant interview guide was used in this study to obtain more in-depth information on the subject matter based on the research objective. Key Informant Interview guide was used on two (2) key focal managers who were purposively selected by virtue of their positions (Facility In-charge and Information Manager) to shed light on present data quality status and factors affecting data quality. Key informant interview guide was used as a follow-up of the questionnaire administered to various respondents at various departments to elicit more information.

Data analysis from the responses were treated and thoroughly analyzed using Stata and SPPS ver 22. Each data collection instrument and answers were coded to facilitate easier analysis. Categorical data was used for cross tabulation and to test the associations of variables through the Chi-square test. The results were displayed in frequencies, Bivariate and multivariate analysis used to relate data quality and factors influencing data quality. The result of data analysis has being presented in a form of tables, graphs and charts.

RESULTS AND DISCUSSION

Table 1 below shows 3(4%) of the respondents knew about HMIS from the formal comprehensive training. 27(33%) knew from co- worker through briefing about HMIS. Only 10(5%) reported to knew HMIS through their own initiative. However, majority 38(47%) of the respondents knew about HMIS through a training workshop.

On other hand, 78(96%) of the respondent participate in the production of RHMIS data while 3(4%) didn't participate in data collection. The result shows the health facility use untrained staff in the production of data

Table 1. Crosstab showing source of knowledge of HMIS and data Collection (n=81)

Know-how about RHMIS	Collect Data				Total	
	No		Yes			
Briefed by Co-workers	0	(0%)	27	(33%)	27	(33%)
Formal Comprehensive Training	0	(0%)	3	(4%)	3	(4%)
HMIS Training Workshop	0	(0%)	38	(47%)	38	(47%)
On my Own	3	(%)	10	(12%)	13	(16%)
Total	3	(4%)	78	(96%)	81	(100%)

Table 2. Cross tabulation on participation on data collection and data Collation, (n=81)

Collect Data	Collate data		
	No	Yes	Total
No	3 (4%)	0(0%)	3 (4%)
Yes	4 (5%)	74 (95%)	78(96%)
Total	7 (7%)	74 (91%)	81 (100%)

Table 3. Crosstab between the data collation and standard summary tools (n=74).

Collect Data	Collate data			Standard tools for summary data		
	No	Yes	Total	No	Yes	Total
No	3 (4%)	0(0%)	3 (4%)	7 (4%)	0 (0%)	3 (4%)
Yes	4 (5%)	74 (95%)	78(96%)	8(11)	66 (89%)	74 (91%)
Total	7 (9%)	74 (91%)	81 (100%)	7 (8.6%)	66 (89%)	74 (91%)

which may result to poor data quality.

Table 2 above shows 78 (96%) of the respondents collect routine data, while 3(4%) does not participate in data collection. 74 (91%) of the respondents participate in the collation of data and 4(5%) of the participants who collect data does not participate in the collation of data. There is statistical significant between data collection and the collation χ2 is 32.934 chi-square with the degree of freedom is 1 and the exact probability is 0.000 which is less than the critical value 0.05. This indicates that there is a relationship between data collection' and collation of data.

All the data collection should accrue from its process then collated within the point of collection. Therefore, the process of data compilation and tabulation require a careful undertaking by performing simple plausibility and consistency checks. This is carried out to assess how robust and credible the aggregated dataset is and what it can be used for, before being released to the other users either within the health facility or another management level. The results resonance by Health Metrix Network (HMN), (2008) that the Problems with data quality undermine the planning and assessment of activities within the health system globally.

The respondents who participated in data collation were asked if they used standard summary tools. 74(95%) participated in the data collation while 66 (89%) of those collating data reported to have used standard summary tools as shown in Table 3. However, 8(11) reported to collate the data without using standard summary tools. This

result shows the implication on the availability of data collection tools.

The health workers cited majority of reporting tools were having duplication. Data collected and not collated and not analysed and shared for use is a waste of time and other resources. There is statistical significant between data collation and standard tools for summarizing data (x^2 = 56.006, df=1, p=0.000). This agreed with (Ahanhanzo et al., 2014; Odhiambo-Otieno, 2005 and Hamre and Kaasbøll, 2008); varied numbers of data collection tools with already overburdened health care staff. Also, Odhiambo-Otieno, (2005a); Abouzahr and Boerma, (2005) identified collected data was being done in a haphazardly and irregularly, incomplete and unreliable used to generate information.

Furthermore, Odhiambo-Otieno, (2005a); underscore that he design of HMIS and it implementation at the various level of health system require users expectation to inform data collection tools design. The tools being used in HMIS can either be paper-based or a combination of electronic data collection tools at facility level based on minimum dataset. The ministry of health in the year 2005 (2008a) made a great attempt to reduce the number of registers from 45 to 11 by integrating them and reduce duplication. Also, the summary form were also reduced by integrating them which goes along way in improving the quality of data been collected. The Ministry of health on data quality audit (MoH, 2014a) find out that there were need for continuous enhancements of data collection systems are vital in order to accommodate the various needs of stakeholders to

Table 4. Crosstab between the standards summary tools and data transmission (n=74)

	Standard tools for summary data			Data Transmission		
Collect Data	No	Yes	Total	No	Yes	Total
No	7 (3.7%)	0 (0%)	3 (3.7%)	7 (8.6%)	0 (0%)	3 (3.7%)
Yes	8(10.8)	66 (89.2%)	74 (91.4%)	4 (5.4%)	70 (94.6%)	74 (91.4%)
Total	15 (8.6%)	66 (89.2%)	77 (91.4%)	11 (5.4%)	70 (94.6%)	77 (91.4%)

mitigate against parallel systems. Additionally it was noted that redefinitions especially for Immunization and HIV/AIDS, Family Planning, Malaria, and underweight with staff not sure what to count, chronic lack of tools resulting to improvising, lack of instructions especially on summary tools; some facilities not utilizing the standard tools and using those of partners, no written guideline available on data collection, aggregation, and manipulation procedures . Moreover, data compilation situation is made worse by the health workers minimal skills and competencies in the area of data analysis and interpretation; the lack of training on how to use health information for planning and other decision-making; and the complex process usually required in accessing the processed health data. Another concern that has been raised by HIS experts is that most developing countries also lack an information culture which would focus on strengthening the supervision, feedback and support aspects for the overall HMIS (Karuri et al., 2014). Nevertheless, Kenya health sector on data quality protocol spell out institutionalization of data quality assurance to achieve good quality. Emphasis is place on the need for clear procedures of data analysis to detect errors. The analysis of data was facilitate errors detection and loop process to the source of data (MoH, 2014c).

The transmission of Data from various service points to designated point is key in ensuring data is available. The respondents were asked if the data they collect and collated are transmitted to the designated office in the Health Information department. 70(94.6) of the respondents reported to submit data they summaries while 5(4.5%) of the respondent participated in collation but they don't submit the data as shown in Table 4. These is echoed by Aqil et al. (2009) which focus on Timeliness as submission of the reports by an accepted deadline transmission from various unit of data generation as RHMIS processes. Odhiambo-Otieno, (2005) pointed out that strong HMIS is a key component of any health system. Its role is not just routine collection of health service data and dutiful conveyance of the same to higher levels, but to facilitate evidence-based decision-making at all levels of the health pyramid and especially at the point of collection. On other hand, HMN, (2008) indicated that health workers are overburdened by excessive data and reporting demands from multiple and poorly coordinated sub-systems. The process of reporting the data should be based on standardized report formats and period from various department or clinics.

Data transmission according to study, conduct in Liberia

reveal data quality varies from facility to facility, depending on the implementing partners with which they were associated. It indicates 91% (Table 4) of the health facilities submitted monthly reports to the county health offices, 75% of these reports were submitted by the reporting period deadline. However, less than 20% of health facilities received feedback on their monthly reports. With the cognizant on the mechanisms of reporting posed challenges because it does not follow the hierarchical lines of communication, hence reports often do not reach their destination. The process of transmitting, compiling, analysing, and presenting the data is usually viewed by health workers as tedious and by the time a report is prepared, the data are frequently obsolete and decisions are often made any information input. (USAID, 2011, HMN, 2008); Ahanhanzo et al. (2014) similarly pointed out that, facility manager were still insufficient in term of handling the data and most of the analysis was still rudimental.

Also, Ahanhanzo et al. (2014); (Hamre and Kaasbøll, 2008). Revealed availability of varied numbers of data collection tools which were being used by already overburdened health care staff was noted. It is frequently the case that there are long delays between the compilations of the micro data into summarized data where the availability of data was missing even during the study period. The support supervision and leadership is key in addressing quality issues by helping to promptly track any significant variations that might have occurred, and that may need to be investigated further for quality purpose. This agreed also with Odhiambo-Otieno, (2005) that strong HMIS is a key component of any health system. Its role is not just routine collection of health service data and dutiful conveyance of the same to higher levels. Also USAID, (2011) and HMN, (2008) agreed that the process of transmitting, compiling, analysing, and presenting the data is usually viewed by health workers as tedious and by the time a report is prepared, the data are frequently obsolete and decisions are often made any information input. Ahanhanzo et al. (2014) similarly pointed out that, facility manager were still insufficient in term of handling the data and most of the analysis was still rudimental.

The respondents were asked if the carry out data quality check in their various service points. 51(63%) indicated that they carry data quality check, but the frequency of carrying out the checks was varying from one respondent to another with majority indicating every quarterly 18(22%). Beside data been collected, compiled and reported on monthly basis, only 11 (14%) respondents

Table 5. Crosstab between Data quality check and the frequency of conducting quality check (n=81)

Response	Frequency for carrying data quality check						
	Regularly	Daily	Weekly	Monthly	Quarterly	Yearly	Total
No	30(37%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	30(37%)
Yes	3(4%)	12(15%)	3(4%)	11(13.6%)	18(22%)	4(5%)	51(63%)
Total	33(41%)	12(15%)	3(4%)	11(14%)	18(22%)	4(5%)	81(100%)

Table 6. Areas to consider when carrying data quality Check (n=81)

Areas of data quality Check	Frequency
Inconsistent data	16 (20%)
Duplicates	43 (53%)
Incorrect values	38 (47%)
Missing values	31(38%)
Outliers	8 (10%)

Table 7. Technique for checking for data quality of RHMIS (n=81)

Data quality Technique	Frequency	
Time trend consistency	10	(12%)
Time trend variation	8	(10%)
Minimum Maximum	7	(9%)
Part verse Whole	14	(17%)
End digits	5	(6%)

indicated to carry data quality on monthly as shown in Table 5 above.

Respondent were asked to list areas they considered in addressing data quality check as. Table 6 above shows 43(53%) of the respondents mentioned that they check for duplicate data, 38(47%) check for incorrect values, 31(38%) check for missing values, 16(20%) check for any data inconsistencies while 8(10%) check for outliers. There is statistical significance between data quality check and data collection ($x2$ =69.305, df=5, p=0.000). The result agreed on a report from MoH, (2014c) underscore the need to place in place clear procedures of data analysis to detect errors. The analysis of data was facilitate errors detection and loop process to the source of data. Based on assessment done by the ministry of health alluded that there were need for development and institutionalization of regular data quality checks mechanism at facility level are necessary to identify and address data issues such as inaccurate records, incomplete data, double counting, and aggregation errors(MoH, 2014a).Nevertheless, (Evaluation, 2009) explain that on the gap between self-perceived capacity and real competencies to carry out the functions of the RHIS among HMIS staff at health facility level existed. The RHMIS task competencies in terms of checking data quality, analysis and use of information were limited in most countries. It highlighted that most Managers at higher levels had limited knowledge on data quality review methods. Lack of problem identification and solving skills were identifying as common issues observed among health workers in the majority of the countries.

The respondents were asked for any techniques they used to detect any errors in data from RHMIS. Table 7 above shows 14(17%) cited that part and whole, 10(12%) of the respondents used time trend consistency; while 5 (6%) of the respondents used to check for preferential digits. These findings have an implication on the technical capacity of health workers on techniques of enhancing the detection skills of errors and make appropriate corrective mechanism before generating information for use. One of the key informant commended that "the comprehensiveness of the standard operating procedure on RHMIS does not address the technique for carrying data quality check. Also, the institution does not have data quality protocol place."(Key Informant, 001)

The checking of data quality is the responsibility of all health workers participating in the data management. The respondents were asked of the stages they go through in carrying out data quality. Figure 1 shows 15(19%) of the respondents carry data quality check at all stages of data management especially at recording, compiling/analysis and reporting stages; 51% (41) reported to check during reporting; 34(42%) reported to carry during reporting, while 7 (9%) of the respondents carry data quality check during data compiling and analysis. The results show crossly varied approaches to data quality check hence the limitation on the technical skills of the health workers. Good data management require data quality check at all stages including data quality review of the micro data been
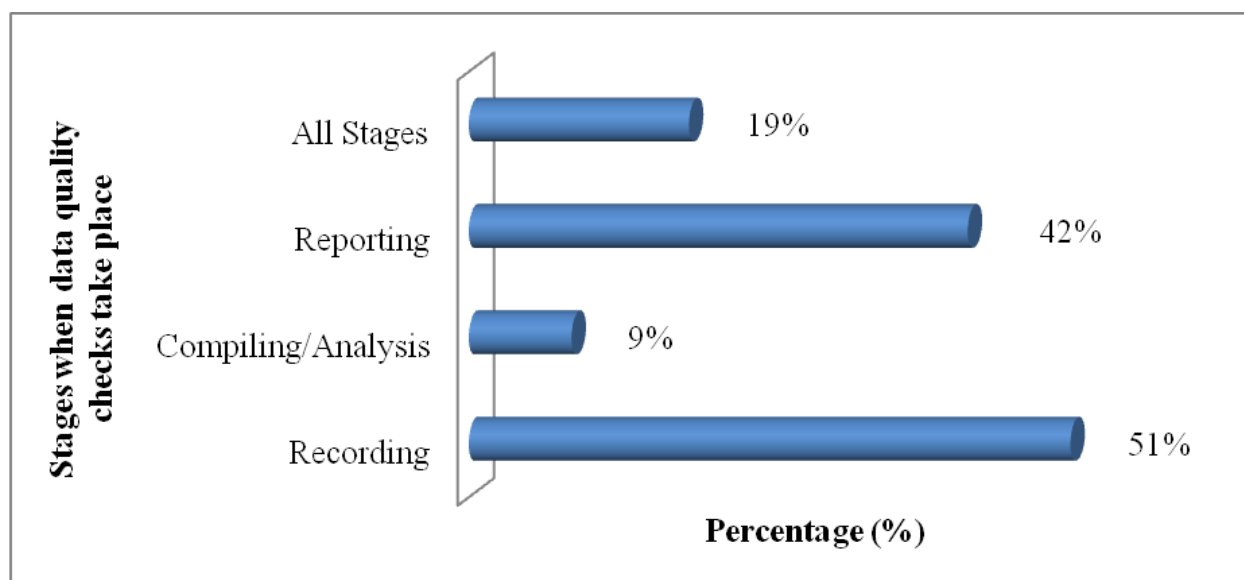
Figure 1: Stages when data quality checks take place (n=81).

collected. Moreover, it's essential for design of simple and useable Routine HMIS data collection tools with Job aids to assist the producer data. The personnel who participate in the collection at various section of healthcare need continuous capacity building to conduct quality review of RHMIS at every stage for in-depth understanding of the stages where quality of data can occur.

The Data quality check skills by observing records based on set gold standard for measuring HMIS monitoring of performance. Based on a study carried on human factors affecting the quality of routinely collected data in South Africa suggest that 64% of the respondents have poor numerical skills and limited statistical and data quality checking skills (Nicol et al., 2013). While the average confidence levels at performing RHIS tasks is 69%, only 22% actually displayed competence above 50%. Personnel appear to be reasonably motivated but there is considerable deficiency in their competency to interpret and use information. This may undermine the quality and utility of the RHMIS (Nicol et al., 2013). The use of graphical presentation of data assists to show abnormal trend of data. The technique used to improve the data quality such as time trend variation; part and whole, time trend consistency improve data quality check skills.

The use of data display is one way of identification of errors on data. The respondents were asked on type of charts used to identify data quality. 45(56%) of the respondents preferred use of graph, 39(48%) reported to use table, 4(5%) use map while 22(27%) did not apply any type of data display (Figure 2).

The display of data on a prescript period assist to identify any abnormally on data. The respondents were asked how often they update the data presentation, 37(46%) of the respondents to display their data on quarterly basis, 25(31%) on monthly, 6(8% on annul basis while 13(16%)

mention they don't display any of their data as shown in Table 8 below. This result has implication on the quality on data identification and correction. This agreed with Nicol et al. (2013). The use of graphical presentation of data assists to show abnormal trends of data. The technique used to improve the data quality such as time trend variation; part and whole, time trend consistency improve data quality check skills.

There is statistical significance between data display and frequency of display ($x2 = 42.286$, df=3, p=0.000). Data generated require right format for presentation, communication and sharing in formats that help users to understand the key issues. Therefore, providing summaries of the data, interpreting key findings and presenting complex information in simple charts and maps will greatly assist users to identify key priories to be address.

The respondents were asked if they have ever receive any feedback from their immediate supervisor or any other level. 58(72%) reported to have receive feedback while 23(28%) of the respondent reported they have not receive any feedback on data they generate and submit compiled data or information routinely on month, quarterly without any adequate feedback. The current state of data quality in Uasin Gishu County Hospital is lack of motivation by the respondents who produce and submitted ending up with no feedback on the data reported.

Furthermore, 36(44% of the respondent didn't receive any feedback on any report submitted, Table 9 below shows 20(25%) of the respondents received feedback only on annually basis while 13(16%) of the respondents indicated the feedback received were unscheduled .There results has statistical significant between feedback of data and frequency of feedback ($x2 = 40.151$, df=3, p=0.000). It is evident that feedback constitutes an integral component of the health information cycle as this is necessary for
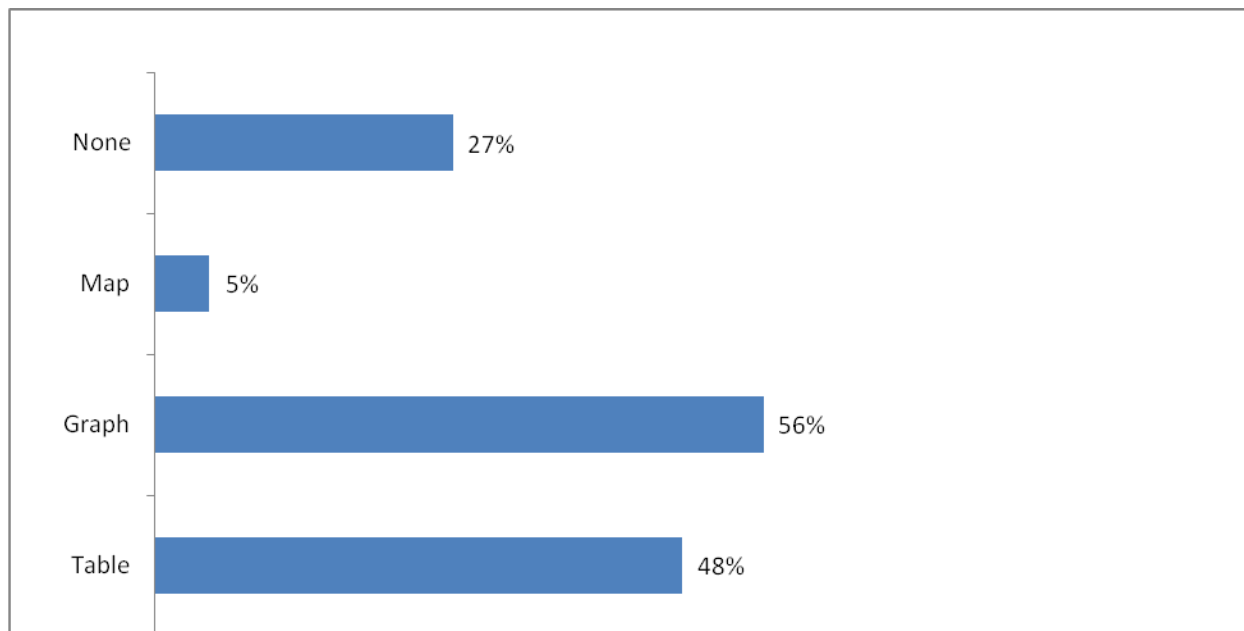
Figure 2. The frequency of data display (n=81)

Table 8. The frequency of data display (n=81)

Frequency of data display	Frequency
None	13 (16%)
Monthly	25 (31%)
Quarterly	37 (46%)
Annually	6 (7%)

Table 9. The frequency of data display (n=81)

Feedback received	Frequency of Feedback				
	Unscheduled	Monthly	Quarterly	Yearly	Total
No	23(28%)	0(0%)	0(0%)	0(0%)	23(28%)
Yes	13(16%)	16(20%)	9(11%)	20(25%)	58(72%)
Total	36(44%)	16(20%)	9(11%)	20(25%)	81(100%)

keeping communication lines open to discuss and resolve problems in the system leading to improvements in the entire HMIS (Karuri et al., 2014).

Odhiambo-Otieno, (2005) also pointed out that general trend on data was aggregated by information personnel in the district and sent directly to the ministry headquarters with little or no feedback provided to the districts or point of generation. It noted data collected on routine basis was not sufficient for purposes of planning and evaluation of district level health services. The most frequent problem is the lack of feedback to local districts and health care workers were observed. A PRISM study carried out in Uganda showed that, although the health facilities received a number of supervisory visits which were not schedule, less than 45% had received feedback (Hotchkiss et al., 2010).

RECOMMENDATION

In order to strengthen the data quality of routine health management information system therefore, call for a truly multidisciplinary approach to a pressing health issue affecting organizational processes. The backbone of a proactive data quality assurance and management framework with controls, standard operating procedures, rules and processes that can enable an organization to identify and address data flaws before they cause negative institutional consequences. The Ministry of Health and its stakeholders therefore need to enforce institutional documentation like availability of standards, guidelines, capacity building, constants supply of data collection tools with minimum dataset with clear requirements and associated rules to support the improvement of data quality

check mechanisms. A strategic implementation will enables the rules and mechanisms to achieve high quality data which can be used by all.

Conflict of Interests

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

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