บทความวิชาการ

An assessment of the effects of behavioural factors (competence, confidence, and motivation) and technical abilities of health professionals on the performance of health information systems: A case study in Kenya.

Angela C Rotich*
Kanida Narattharaksa**
D. S. Briggs***

Received: February 3, 2022
Revised: February 23, 2022
Accepted: March 30, 2022

บทคัดย่อ

The primary objective of a health information system is to scale up the effectiveness of services by ascertaining that health managers and service providers use health data to make informed decisions. Human behaviour largely affects the produced by the Routine Health Information Systems (RHIS). This research aimed to assess howhuman behavioural factors:competence, confidence, motivation, and the technical abilities: knowledge of routine health information systems rationale, data quality checking skills, and problem-solving skills of District Health Information System (DHIS) staff affected the health system performance.

The cross-sectional design was used to collect data from Bomet county, Kenya. Descriptive statistic was used to analyze the data using percentages, frequencies, mean and median. The Chi-square test was used to test the population variance. T-test and F-test were used to explore the differences in mean for the different variables. Cross tabulation was used to examinethe performance of participants on the competency test.

Confirmatory factor analysis was used to reduce the number of variables. Thelinear regression analysis showed that years of service could predict the ability of staff to provide feedback, competence to execute tasks, confidence to perform the duties.

ร่วมเฉลิมฉลอง 30 ปี มหาวิทยาลัยนเรศวร
• Internationalization
• Innovative Products
• Integrative Team & Networking

Out of 223 questionnaires distributed, 209 were correctly completed and returned, giving the research a 94% response rate. Most participants were nurses (40%). Majority of the participants were between 30-40 years (48.5%). Diploma holders constituted 75.12%. Untrained staffon RHIS constituted 89.95%. The overall level of knowledge of the study participants was analyzed using the sum score of each outcome based on Bloom's cut-off point.Trained staff were more competent than untrained staff ($p = .000$). Respondentsrated themselves at above 70% inthe performance of RHIS tasks. There was astrong correlation between competence and confidence (correlation coefficient = 0.893, $p < 0.001$). Trained staff were more knowledge able than untrained staff ($p = .000$), and they also had better data quality checking skills ($p = .001$). 20-30 years old staff were more competent in problem-solving processes than those above 41 yearsof age.

The county government should encourage the training of trainers to speed up staff trainingon effective collection of data and use of data to make informed decisions. Staff involvement through regular meetings should occur to ensure information sharing and resolution of any out standing operational challenges.

Keywords: Human behavioral factors, Technical abilities, the Performance of health information systems, District health information systems

**Corresponding author: KanidaNarattharaksa: ckanida@yahoo.com

*College of Health Systems Management, Naresuan University

**Faculty of Medicine, Naresuan University

***Faculty of Medicine and Health, University of New England, Australia

***ASEAN Institute of Health Development, Mahidol University, Thailand

Introduction

Kenya is a country situated in the east of Africa. It is divided into 47 counties which are further divided intosub-counties. The population is about 52.6 Millions in 2020 and is growing at a rate of 2.3% yearly (United Nations, Department of Economic and Social Affairs, & Population Division, 2019). The health function is devolved to the county governments. Kenya's health structure has the community, county, and national levels (Ministry of Health, 2009). This study was conducted in Bomet county, with five sub-counties:Bomet East, Bomet Central, Konoin, Sotik,and Chepalugu.

The District Health Information Systems [DHIS] was developed with theintention of supporting devolved decision-making and management of health services by collecting health data from all health facilities in a country (Heywood & Rohde, 2001). The RHIS is the facility-based health information system that collects routine health information to be analyzed by the DHIS. Routine Health Information Systems (RHIS) deliver information at different time intervals usingtools created to collect information. Currently, some of the tools used for data collectionare in paper form,while others are in electronicform, which is similar to a study done in the neighboring country Uganda (Hotchkiss, Diana, & Foreit, 2012). RHIS helps to improve primary health care by ensuring good information-based decisions on health policies and delivery of appropriate health care (Gimbel et al., 2011). However, the HISs face challenges that lead to the generation of poor quality data,leading to limited use of information. One of these challenges is human behavioural dimensions (Nicol, Bradshaw, Phillips, & Dudley, 2013). These dimensions encompass three elements ofcompetence levels,confidence levels, and staff motivation. The technical abilities that hinder the proper use of HIS include knowledge of routine health information systems rationale, data quality checking skills, and problem-solving skills (Aqil, Lippeveld, & Hozumi, 2009; Hotchkiss, Aqil, Lippeveld, & Mukooyo, 2010).

Competence

Competence refers to the ability of the health staff to accomplish tasks at the facilities which included calculating frequencies, plotting graphs, and using data. Competence helps ensure that minimal errors occur during the transfer of data to the DHIS from the paper forms (Nicol, Bradshaw, Phillips, & Dudley, 2013). The research participants were given a competence test (basic questions)whichhadmathematical calculations related to RHIS processes, such as collection, analysis, interpretation, and use of data.All the correct responses were marked with 1 while incorrect responses were marked with 0. Results were derived by evaluating the responses against the results of the written test

Confidence

Confidenceis the supposed self-assurance in conducting tasks associated with the health information system. The respondents were asked to rate their confidence in percentage on how they can accomplish DHIS activities. They were asked to rate their self-efficacy for various RHIS tasks on a scale of zero to one hundred. For each dimension, all indicators and their ratings were added together and then divided by the total number of indicators and multiplied by one hundred to obtain a percentile score.

Motivation

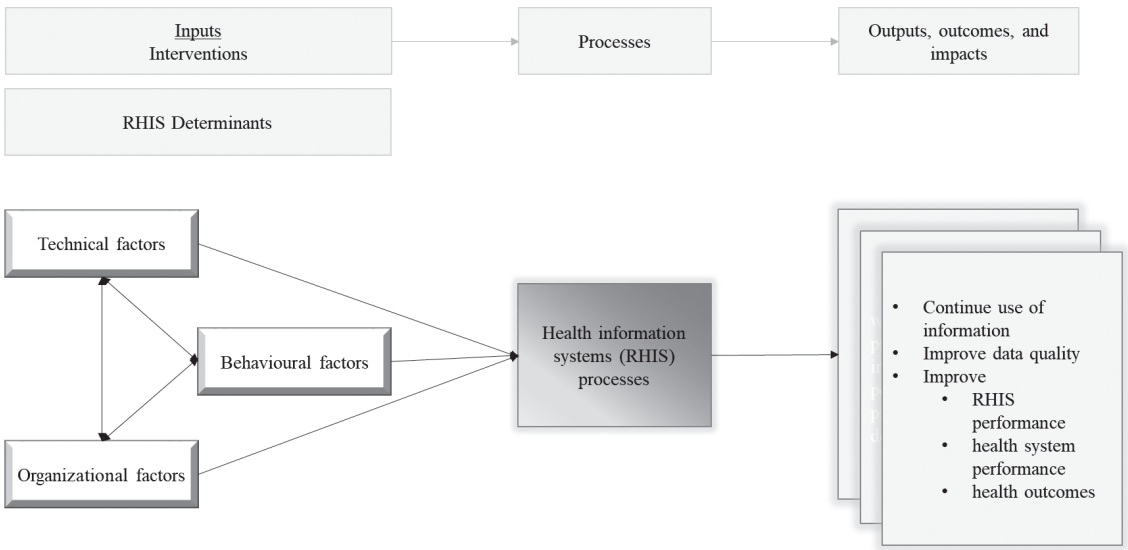
Negative attitudes of staff that view data collection as a task of no importance hinderthe undertaking of RHIS related tasks (Aqil et al., 2009). If data collection registers and form sare complicated, staff had low motivation for data collection tasks, and staff failed to understand the utility of the data. The level of motivation of the DHIS staff was tested using 18 statements on a 7-point Likert scale with minimum and maximum values of 18 and 126 scores respectively. Using mean and standard deviation, the levels of motivation were categorized into 3 groups: high, medium, and low. Bloom's cut off point (60%-80%) formula was used to measure the level of motivation whereby, having a score of above the cut-off point was equated with high levels of motivation (Yimer, Abera, Mulu, & Bezabih, 2014).

The challenge of HIS studies in Africa is that they have discussed the shortage of staff and lack of training resulting from poor financing without focusing on behavioural dimensions such as competence, confidence, and motivation (Nicol et al., 2013). Herbst, Littlejohns, Rawlinson, Collinson, and Wyatt (1999) noted in their study that despite the vast resources allocated, evaluation of the systemsis hardly conducted in low and middle-income countries, including Kenya

A study by Harikumar (2012) in Kerala, India, suggests that upon implementation of health management information systems, its processes should be evaluatedto ensure that the system functions optimally and meets its desired objective as set out by the country's Ministry of Health. Evaluation helps fine-tune the system,and subsequent evaluations should be scheduled to sustain results achieved (Harikumar, 2012).

No evaluation has been done on the DHIS in Bomet county since its implementation in 2011. This study highlights RHIS human behavioural weaknesses and enablesmanagers to strengthen the human dimensions that help generate acceptable dataquality and improve evidence-based decision-making.This research assessed the human behavioural dimension and the technical abilities of the DHIS staff affecting RHIS processes in Bomet County. The study used anadapted and modified Performance of Routine Information System Management (PRISM) framework (Aqil et al., 2009) developed by MEASURE Evaluation as described in Figure1below. The PRISM framework and tools provide user requirements that result in improved health information systems through a logic framework of inputs, processes, output, outcome, and impacts (Nicol et al., 2013). The PRISM framework and its tools have undergone testing in different settings;therefore,its validity and reliability have been tested (Aqil, Lippeveld, Moussa, & Barry, 2008; Aqil et al., 2009; Boone & Aqil, 2008; Hotchkiss et al., 2010).

Figure 1: PRISM Framework, MEASURE Evaluation



Source: Adapted from Aqil, A., T. Lippeveld, and D. Hozumi, 2009

PRISM Framework

The PRISM framework allowsmodification to consider local context and allows personalized analysis as per selected indicators. It has a tool named Organizational and Behavioural Assessment Tool (OBAT). The OBAT tool has a user guide and an instruction manual, which was used to highlight the strengths and weaknesses of the RHIS system. It indicates strategies to improve system performance (Aqil, Lippeveld, Moussa, & Barry, 2012).

Strengths and weaknesses of the OBAT tool

The tool has beenviewed as resource-intensive (Belay, Azim, & Kassahun, 2013) and does not allow qualitative data. Also, some questions were unclear, as observed by the review experts. However, this was managed by modifying the tool and rephrasing the questions to make them more suitable for the study.

Technical factors

Knowledge of RHIS rationale is the measurement of the perceived level of knowledge of the staff on the importance ofdata collection and data use. Data quality checking skills are described as the ability of data collectors and users to identify and spot any irregularities or outliers in the process of data collection and processing (Aqil et al., 2009). Shiferaw, Zegeye, Assefa, and Yenit (2017) define problem-solving skills as the ability of the staff to use the HIS to gather data and use it to detect the causes of health problems, use it for services by medical practitioners; and use it to manage epidemics (Narattharaksa, Speece, Newton, & Bulyalert, 2016).

Behaviouralfactors

Competence is the ability of the DHIS staff to accomplish tasks at the facilities,such as calculating frequencies, plotting graphs, and using data. Confidence

levels are the supposed self-assurance in conducting tasks associated with the health information system. Motivation: the study by Aqil et al. (2009) highlighted that if data collection registers and forms are complicated, staff had low motivation for data collection tasks, and staff failed to understand the utility of the data.

Organizational factors

Organizational factor is the organizations' abilityto put in place the mechanisms to generate demand for data and knowledge management. The organizational factors include policies, human,and financial resources based on the infrastructure and health of the organization.

Methodology

Stratified random sampling was used in this study to find a sample from the population that would represent the whole population under study (Bernard, 2017). The population sample was calculated using the Taro Yamane formula(Yamane, 1967).

The study population included 223 DHIS staff from the total population of 414 people. They were stratified by job groups and included health records information officers, health facility managers, clinical practitioners, and data collectors at the facility and county level's maternal and child health programs section. Out of 223 questionnaires distributed, 209 of them were correctly completed and returned, giving the research a 94% response rate.

This study used a cross-sectional design and questionnaire survey to collect data usinga modified questionnaire from the PRISM framework's Organizational and Behavioural Assessment Tool (OBAT).

Research tool

A structured questionnaire was designed in three sections. Section A was used to collect data on the demography. Section B had the 7- point Likert scale with the different dimensions of RHIS processes and elements of the behavioural factors. Section C had a competence test where the study participants solved mathematical equations that were scored and analyzed. There were four questions in the test with minimum and maximum values of 1-4,respectively. The test helped to assess the level of competence of the staff on roles such as data collection, data analysis, data interpretation, and data use. The staff also did a self-assessment whereby they rated themselves in percentage for different RHIS roles.

Data collection tool validity

The instrument's content validitywas determined by four experts using the index of consistency (IOC). The experts were composed of one practitioner and three academicians from Kenya and Thailand. The result of the IOC test was between 0.7 and 1. Further, Cronbach's alpha was tested for the instrument's internal consistency, which resulted in 0.841. The human behavioural dimensions of the DHIS staff were assessed using a 7-point Likert scale (1-strongly disagree, 2-some what disagree, 3-disagree, 4-neutral, 5-agree, 6-some what agree, and7-strongly agree).

Data analysis techniques

- Descriptive statistics wereused to analyze the data using percentages, frequencies, mean and median. The Chi-square test was used to test the population variance.

- T-test and F-test were used to explore the differences in mean for the different variables.
- Cross tabulation was used to explore the performance of participants on the competency test and analyze the respondent's five levels of education and attend training (Trained and not trained).
- Confirmatory factor analysis was used to reduce the number of variables(competence, confidence, motivation, and technical abilities - knowledge of RHIS rationale, data quality checking skills, problem-solving skills)
- Linear regression using coefficients of determination (R2) to measure the proportion of the variance of the dependent variables about its mean explained by the independent predictor variables.
- The overall level of knowledge of the research participants was examined usingthe total score of each result based on Bloom's cut-off point (60%-80%). The low knowledge level is < 60%, score ? 75.5, medium knowledge level is 60-80% with a score 75.6-100.7, and high knowledge level is > 80% with a score ≥ 100.8. The total score is 126.

This study was reviewed and approved by the Naresuan University Institutional Review Board (IRB), Thailand (IRB No. 0668/61 and COA No. 505/2018) and National Commission for Science Technology and Innovation, Kenya (Permit No. NACOSTI/P/18/26346/ 26791).

Results

Demography

Most of the participants (N = 209) were nurses (40%), followed by facility managers (30%). While most of the respondents were between 30and 40 years old (48.1%), the least were above 51 years at 3.8%. Diploma holders constitute 75.12%, and the above diploma is at 15.31%. Those who have below diploma constitute 9.57%. Samples of staff who have worked for up to 10 years account for 67.9%, and more than tenyears account for 32.1%. We found that years of services relate to getting trained (Chi-Squares Tests was significant at (p = .008), the KMO and Bartlett's test for sampling adequacy is .902.

Amongthe study participants, the majority were respondents without prior training, accounting for 89.95% or 188 persons. (Using Pearson Chi-Square to test the population variance results for 2-sided Asymp. Sig = .008).

The facility managers have a higher level of knowledge on RHIS processes than the rest of the staff but without statistically significant difference. There was a significant difference in the level of knowledge between staff who have been trained and those not trained. Trained staff have more knowledge than untrained staff (p < .001).

Using Communalities (Over 0.5 applied), all questionnaire items had commonalities above 05, indicating that the majority of variance in each item was captured,and 19 items have Eigenvalues greater than 1 and account for 95.97%.

Human behavioural dimensions

The study participants were issued self-administered questionnaires. The domains had eighteen statements about knowledge of RHIS rationale, skills for data quality checking, problem-solving skills for HIS tasks, competence in performing HIS tasks, confidence levels for HIS tasks, and motivation.Table 1 shows the overall mean score for the human behavioural dimensions and the average level for each behaviour. Table 2 shows the differences in means of the Behavioural factors according to different variables such as job titles, age, level of education, and years of service.

Competence

The research participants were given a competence test (basic questions) which was scored and analyzed. The test questions were used to measure the competence levels of the DHIST in executing some mathematical calculations related to RHIS processes such as collection of data, analysis of data, interpretation of data,and use of data. According to the competence test, the average research participant's competence level is 85.5%. There was no statistically significant difference in the level of competence for participants in the different job groups ($p = .646$). Most participants answered at least more than two questions correctly. Trained staff are more competent than untrained staff ($p = .000$).

Confidence

The confidence level of the participants was considered relatively good. According to the results, the participants rated themselves at over 70% for all the different RHIS tasks, including collecting data, analysis of data, interpretation of data, and use of data. With adequate training, their score could improve, which would mean that they have higher confidence in performing RHIS tasks.

Correlation between confidence and competence

Most participants answered more than three questions correctly. There was a strong correlation between competence and confidence (correlation coefficient = 0.893, $p < 0.001$). The higher the competence level, the higher the confidence level.

Motivation

All participants had a medium level of motivation despite the differences in job titles. Motivating district health information system staff remains a challenge despite training

Table 1: Level of competence, confidence, and motivation of respondentson RHIS tasks (N = 209)

Human behaviouraldimension	Number	Mean	S.D.	Behavioural factor level	p-value
Competence	209	95.76	15.20	Medium	$p < .001$
Confidence	209	96.77	15.57	Medium	
Motivation	209	92.64	15.19	Medium	

Technical abilities of staff

The linear regression analysis shows that the number of yearsin services could predict the ability of staff to provide feedback, competence to execute tasks, confidence to perform the duties. It was also found that the number of yearsin servicecould help staff to improve their data quality checking skills, together with data collection and analysis skills. Using correlation, we found that years of service correlated with training and the staffs' level of education.

Knowledge of RHIS rationale

Although facility managers have a higherlevel of knowledge on RHIS processes than the rest of the staff, was no statistically significant difference ($p = .885$). There was a significant difference in the level of knowledge between staff who have been trained and those not trained. Trained staff have more knowledge than untrained staff ($p = .000$).

Data quality checking skills

Although all staff has a medium level ofdata quality checking skills, staffabove 51 years of agehavea lower level of knowledge than the rest (p = 0.31). Staff who have been trained on DHIS have better data quality checking skills than those not trained (p = .001)

Problem-solving skills

The research found a significant difference in age differences in those research participants of the younger generation. 20 to 40-year-old participants had a higher level of competence and problem-solving skills than participants more than 41 years of age (p = .026).

Table 2: Analysis of levels of knowledge of RHIS rationale, data quality checking skills, andproblem solving skills by age and training (N = 209)

Dimension	Number	Mean	S.D.	Knowledge level	p-value
Knowledge of RHIS Rationale					
DHIS Training					.000
No	188	99.08	15.76	medium	
Yes	21	113.05	10.54	high	
Data quality checking skills					
Age					.031
20-30 years	56	96.07	14.21	medium	
31-40 years	101	97.61	17.49	medium	
41-50 years	44	92.86	12.71	medium	
> 51	8	80.75	12.75	medium	
Problem-solving skills					
Age					.026
20-30 years	56	98.19	12.48	medium	
31-40 years	101	100.57	14.97	medium	
41-50 years	44	94.58	12.54	medium	
> 51	8	87.25	17.45	medium	

Discussion

Health workers in Kenya face challenges in using the systems after beingimplemented (Aqil et al., 2012, Ministry of Health, Division of Health Information Systems: Terms of Reference for Software Acquisition, 2009). Some of the challenges include lack of capacity to use the systems due to lack of training and shortage of staff, leading to high work burden. This study found that indeed the human element is critical in implementing health information systems,as suggested by Buntin, Burke, Hoaglin, and Blumenthal (2011). On a positive aspect, we found that facility managers had a high level of knowledge of RHIS processes and medium level competence and confidence, contrary to Ahanhanzo et al. (2014), who noted in a study in Benin that facility managers had low levels of knowledge and skills to execute RHIS tasks.

Lack of knowledgeanalysis skillsand use of data hinders RHIS performance. Low data quality and poor use of information result from limited awareness of the usefulness of RHIS data (Kamadjeu, Tapang, & Moluh, 2005; Odhiambo-Otieno, 2005; Rotich et al., 2003). Low levels of data processing, analysis,and data quality checking skills were observed in staff above 51 years of age, whichis consistent with the findings from a study carried out in South Africa where it was suggested that 64% of the respondents have poor numerical skills and limited statistical and data quality checking skills. This may undermine the quality and utility of the RHMIS (Nicol et al., 2013). Similar findings were observed by a study in Kenya thatindicated that the HIS staff had low levels of skills and competencies in data analysis and interpretation of data (Cheburet & Odhiambo-Otieno, 2016). This circumstance needs to be improved as it affects the quality of data produced. Although the DHIS staff are reasonably motivated, incentives should be put in place to optimize their motivation level. Highly motivated staff are more efficient in their tasks,and they produce a better quality of data. The study shows that personnel hasa medium level of confidence.

It was expected that the level of education would have an impact on knowledge of RHIS rationale. However, this was not the case as staff with secondary school, and diploma level of education had a high level of knowledge of RHIS rationale, same as participants with the highest level of education in this study-Master's degree. This research found that training had a significant impact on all RHIS processes, whichis consistent with a study in South Africa whereby trainingscould help to improve the RHIS processes and data (Mphatswe et al., 2012).

In their study, Cheburet and Odhiambo-Otieno (2016) and Kuyo, Muiruri, and Njuguna (2018) found that some health facilities in Kenya had untrained staff performing data production duties, leadingto poor data quality. Similarly, 90% of this study's participants claim that they had not attended any RHIS related training in the last year before this research was conducted. During training, mathematical skills content should be integrated into RHIS training to improve the staff's numerical skills at all levels of the HIS. The study observed that in most health facilities, nurses compile monthly reports, whichleads to a high burden of work and can result in loss of motivation.

Recommendation

From the results, it is evident that more training is required for health information staff on the RHIS processes, especially data processing and analysis, data display, and feedbackthatwould increase their knowledge on RHIS tasks. Having more knowledge will increase their competence and confidence levels, thereby

improving the quality and use of data for decision-making. Improved skills will increase theircompetence and confidence levels. Strategies should be put in place to improve the level of motivation of the staff to a higher level. Staff involvement should be encouraged through regular staff meetings and refresher training to give them a sense of ownership and accountability of the health information system.

Limitations of the study

Since this study was focused on one county and 14 facilities per Sub County (5 Sub counties), the results cannot be generalized for all counties in Kenya. However, the study can be used as a model for future studies,and the results can be used to help enhance skills to improve information systems.

Conclusion

The DHIS staff have a reasonable motivation level and feel confident about RHIS tasks, but most havea medium level of knowledge and importance of RHIS and its use. The county health management should embrace training of the trainers to increase training capacity in the county. Numeracy skills should be emphasized when recruiting HIS staff.

Acknowledgments

The authors would like to thank the Thailand International Cooperation Agency (TICA) for the prestigious scholarship through Naresuan University, Thailand, Bomet County Health Management, and staff in the selected facilities for the permission to collect data. Finally, the authors would like to express gratitude to Associate Professor Dr. Phudit Tejativaddhana, Mr. Reggie D. Hinoguin, Mr. Supawat Yotnarin, and all the staff of the College of Health Systems Management, the Graduate School, and Naresuan University, Thailand.

Conflict of interest

The authors declare that there is no conflict of interest.

References

Ahanhanzo, Y., Ouedraogo, L. T., Kpozèhouen, A., Coppieters, Y., Makoutodè, M., & Wilmet-Dramaix, M. (2014). Factors associated with data quality in the routine health information system of Benin. *Archives of public health, 72*(1), 1-8.

Aqil, A., Lippeveld, T., & Hozumi, D. (2009). PRISM framework: a paradigm shift for designing, strengthening and evaluating routine health information systems. *Health policy and planning, 24*(3), 217-228.

Aqil, A., Lippeveld, T., Moussa, T., & Barry, A. (2008). *Research methods in anthropology: Qualitative and quantitative approaches*. MEASURE Evaluation, USAID.

Aqil, A., Lippeveld, T., Moussa, T., & Barry, A. (2012). *PRISM tools user guide: the performance of routine information system management (PRISM) framework.* Chapel Hill, NC: MEASURE Evaluation, Carolina Population Center.

Belay, H., Azim, T., & Kassahun, H. (2013). *Assessment of health management information system (HMIS) performance in SNNPR, Ethiopia.* Measure Evaluation..

Bernard, H. R. (2017). *Research methods in anthropology: Qualitative and quantitative approaches:* Rowman & Littlefield.

Boone, D., & Aqil, A. (2008). *Haiti HSIS Evaluation Report.* MEASURE Evaluation, Haiti Ministry of Health, USAID. Chapman, A. D., Principles of data quality. 2005: GBIF.

Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: a review of the recent literature shows predominantly positive results. *Health affairs, 30*(3), 464-471.

Cheburet, S., & Odhiambo-Otieno, G. (2016). *Process factors influencing data quality of routine health management information system: case of Uasin Gishu County Referral Hospital,* Kenya.

Gimbel, S., Micek, M., Lambdin, B., Lara, J., Karagianis, M., Cuembelo, F., ... & Sherr, K. (2011). An assessment of routine primary care health information system data quality in Sofala Province, Mozambique. *Population health metrics, 9*(1), 1-9.

Harikumar, S. (2012). *Evaluation of Health Management Information Systems-A Study of HMIS in Kerala.* (Doctoral dissertation, SCTIMST).

Herbst, K., Littlejohns, P., Rawlinson, J., Collinson, M., & Wyatt, J. C. (1999). Evaluating computerized health information systems: hardware, software and human ware: experiences from the Northern Province, South Africa. *Journal of Public Health, 21*(3), 305-310.

Heywood, A., & Rohde, J. (2001). *Using information for action: a manual for health workers at facility level.* South Africa: EQUITY Project., 123.

Hotchkiss, D. R., Aqil, A., Lippeveld, T., & Mukooyo, E. (2010). Evaluation of the performance of routine information system management (PRISM) framework: evidence from Uganda. *BMC health services research, 10*(1), 1-17.

Hotchkiss, D. R., Diana, M. L., & Foreit, K. G. F. (2012). *How can routine health information systems improve health systems functioning in low-and middle-income countries? Assessing the evidence base.* Health information technology in the international context.

Kamadjeu, R., Tapang, E., & Moluh, R. (2005). Designing and implementing an electronic health record system in primary care practice in sub-Saharan Africa: a case study from Cameroon. *Journal of Innovation in Health Informatics, 13*(3), 179-186.

Kuyo, R. O., Muiruri, L., & Njuguna, S. (2018). Organizational factors influencing the adoption of the district health information system 2 in Uasin Gishu County, Kenya. *International Journal of Medical Research & Health Sciences, 7*(10), 48-57.

Ministry of Health, Division of Health Information Systems. (2009). *Terms of Reference for Software Acquisition.* Nairobi, Kenya.

Mphatswe, W., Mate, K. S., Bennett, B., Ngidi, H., Reddy, J., Barker, P. M., & Rollins, N. (2012). Improving public health information: a data quality intervention in KwaZulu-Natal, South Africa. *Bulletin of the World Health Organization, 90,* 176-182.

Narattharaksa, K., Speece, M., Newton, C., & Bulyalert, D. (2016). Key success factors behind electronic medical record adoption in Thailand. *Journal of health organization and management, 30*(6),985-1008. Retrieved from https://www.emerald.com/insight/content/doi/10.1108/JHOM-10-2014-0180/full/html

Nicol, E., Bradshaw, D., Phillips, T., & Dudley, L. (2013). *Human factors affecting the quality of routinely collected data in South Africa.* In MEDINFO 2013 (pp. 788-792). Ios Press.

Odhiambo-Otieno, G. W. (2005). Evaluation criteria for district health management information systems: lessons from the Ministry of Health, Kenya. *African Health Sciences, 5*(1), 59-64. Retrieved 5April 2020 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1831895/pdf/AFHS0501-0059.pdf

Rotich, J. K., Hannan, T. J., Smith, F. E., Bii, J., Odero, W. W., Vu, N., ... & Tierney, W. M. (2003). Installing and implementing a computer-based patient record system in sub-Saharan Africa: The Mosoriot Medical Record System. *Journal of the American Medical Informatics Association, 10*(4), 295-303.

Shiferaw, A. M., Zegeye, D. T., Assefa, S., & Yenit, M. K. (2017). Routine health information system utilization and factors associated thereof among health workers at government health institutions in East Gojjam Zone, Northwest Ethiopia. *BMC medical informatics and decision making, 17*(1), 1-9.

United Nations, Department of Economic and Social Affairs, Population Division (2019). *World PopulationProspects 2019, Volume II: Demographic Profiles (ST/ESA/SER.A/427).* Retrieved 5 April 2022 from https://population.un.org/wpp/Graphs/1_Demographic%20Profiles/Kenya.pdf

World Health Organization. (2019). *Violence and Injury Prevention, Data Collection. 2019.* Retrived 6 March 2019 from https://www.who.int/news-room/fact-sheets/detail/injuries-and-violence

Yamane, T. (1967). Statistics: *An introductory analysis.* (No. HA29 Y2 1967).

Yimer, M., Abera, B., Mulu, W., & Bezabih, B. (2014). Knowledge, attitude and practices of high risk populations on louse-borne relapsing fever in Bahir Dar city, north-west Ethiopia. *Science Journal of Public Health, 2*(1), 15-22.