

**Developing an Intervention Model for Data Quality
Management and Health Information Use at Community
and District Levels in Rwanda**

**Submitted in fulfillment of the degree Doctor of Philosophy at the School of
Nursing and Public Health, University of KwaZulu-Natal, South Africa**

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Developing an Intervention Model for Data Quality Management and Health Information Use at Community and District Levels in Rwanda

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DECLARATION

I, Eléazar Ndabarora declare that:

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4. Dr Jennifer Chipps, the Co-supervisor, for her advices, patience and encouragement.

ABSTRACT

The purpose of this study was to develop an intervention model for health data quality management (DQM) and health information use at community and district levels in Rwanda and similar settings, based on a situation analysis of current practices and performance in Rwanda and existing evidence found in similar settings. This thesis is by publication and comprises three research papers based on the findings of three evaluation studies conducted, and reports on the study four which describes the model developed.

Methods

The study was initiated based on a systematic review of health DQM and best practices at community and district levels in low-and middle-income countries (LMIC). A retrospective design was used to evaluate the quality of clinical and community health data, and a survey of health information users was conducted. The mixed methods approach was adopted to collect quantitative and qualitative data, and the teamwork in “Group Model Building” (GMB) process through a workshop was used to develop the model.

Findings

Poor health DQM and health information use at community and District levels in Rwanda and other LMIC was found, particularly at the sources of data. Best practices were also found, but several issues hindering the quality of health data and utilization namely poor management of District Health Information System, lack of institutional support to all stakeholders involved in DQM, and lack of information culture. Variables that influenced the quality of health data and use included the training of the staff and community health workers (CHWs), regular formative

supervision and monitoring and evaluation, involvement of all stakeholders, Data Quality Audit (DQA), feedback initiatives, understanding and perception of data usefulness, use of electronic and computerized systems, and proper leadership and coordination. Those variables were included in the model developed.

Conclusion

Based on the identified barriers to high quality data systems, an intervention model for health DQM and health information use at community and District levels in Rwanda was developed as the main achievement of this study.

LIST OF ACCRONYMS

ANC	Antenatal consultations
CDC	Centres for Disease Control and Prevention
CHWs	Community health workers
DH	District hospital
DHIS	district health information systems
DQA	data quality audit
DQM	Data quality management
EDPRS	Economic development and poverty reduction strategy
ERM	electronic medical records
GMB	Group Model Building
HIS	Health Information Systems
HMIS	health management information system
LMIC	low- and middle-income countries
MDGs	Millennium Development Goals
PMTCT	Prevention of mother-to-child transmission of HIV
SISCom	Système d'Information Sanitaire Communautaire
SOP	Standard Operating Procedure
USA	United States of America

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CHAPTER 1: THE RESEARCH STUDY

1.1 General Introduction

Data quality management (DQM) and health information use are important components of the Health Information Systems (HIS) that aim to ensure that the right information is available to the right users at the right time and in the right format (Kerr, Norris and Stockdale, 2007). Health data needs to be accurate and reliable enough to serve as evidence for decisions and planning interventions that could improve the quality of health services (Mettler, Rohner & Baacke, n.d, Laux, Nothacker, Weinbrenner, Stork, Blozik and Peters-Klimm, 2011). Health data is also used to measure the performance of health care programs and disease outcomes. Only quality information can generate health indicators which reflect and inform on what the situation truly is, and assist potential stakeholders in health services delivery to make better decisions and plan appropriately for better health (Tomasi, Facchini and Maia, 2004). Globally, research findings have reported poor health DQM and low health information use as a major concern in low- and middle-income countries (LMIC) (Kerr et al., 2007, Rowe, Kachur, Yoon, Lynch, Slutsker and Steketee, 2009, Mate, Bennett, Mphatswe, Barker and Rollins, 2009, Heunis, Wouters, Kigozi, Engelbrecht, Tsibolane and Van Der MerwHeunis, 2011).

This is the PhD report of several studies conducted to develop an intervention model for health DQM and health information use at community and district levels in Rwanda. The work was completed in the School of Nursing and Public Health, at the University of KwaZulu-Natal, South Africa. This thesis is submitted as a compilation of papers published or under review in

peer-reviewed journals, as per the University's rules. The first chapter provides a background to the study and an outline of the methodology used in this study.

1.2 Background to the Study

Daily health professionals need to plan and make dynamic decisions and plans in health care settings to improve quality health services delivery (Lium, Tjora and Faxvaag, 2008). "An indicator is only as good as the action it provokes" (Heywood, n.d p.42), and if it gives the information it was intended to give (Sun, 2003). This problem has been specifically described in the studies that were conducted in LMIC, where good decisions and planning in the health sector are most needed as these countries are striving to achieve the millennium development goals (MDGs) (Murray, 2007, Garrib, Stoops, Mckenzie, Dlamini, Govender and Rohde, 2008).

Globally, DQM and health information use has been given particular attention in order to improve decisions and planning processes and improve health care delivery (WHO, 2003). High income countries have implemented electronic health information technology (HIT) to manage their health information systems (HIS), and this has exceeded expectations as compared to the paper-based health information systems (Feero, Bigley and Brinner, 2008). Both health and financial benefits were found, despite the barriers to its adoption that have been identified across different countries (Hillestad, Bigelow, Bower, Girosi, Meili and Scoville, 2005). Those systems include a routine reporting system for the population-based health services, the use of computers for medical research using online reference data-bases, differential diagnostic tools in individual case management, such as electronic medical records (EMR), and computers use for the

management of medical practices and hospitals (Wilson cited in Lippeveld et al., 2000). It follows that health information technology (HIT) is considered to be the best health information model to improve the quality of health data and improve the use of health information. Health information technology is efficient and overcomes the limitations of paper-based health information management (Chaudhry, Wang, Shinyi, Maglione, Mojica and Roth, 2006).

In the United States of America (USA), disease assessment can be done using electronic health records containing family health history information held in the electronic medical records (EMRs) database. Data is collected and interpreted so that it can support clinical decision making (Tang, Ash, David, Bates, Overhage and Sands, 2006). In their evaluation of EMRs, it was found that the interoperability of health data allowed health information to be shared between health care entities involved in the continuum of care. This allowed patients to be active participants in their own care (Hillestad et al., 2005). The USA also registered potential savings and cost effectiveness in health care since the adoption of the EMRs system. Annually, the system saves more than \$81 billion by improving health care efficiency and safety. When using a health information technology-enabled system for prevention and management of chronic diseases, these savings tend to double.

However, DQM remains a matter of concern even among high income countries. It has been reported that in the USA, there is not yet a national consensus on data collection and further processes that are required to have reliable information on race and ethnicity (Bierman et al., 2002). The health care system is highly fragmented between private, public and nonprofit entities, which means sharing health information between health institutions becomes difficult (Burk, 2010). However, a study conducted in the USA, the Netherlands and Australia (Ash, Berg

and Coiera, 2004) has identified unintended medical errors throughout the implementation of patient care information systems (PCISs).

Several research findings have reported poor implementation of district health information systems (DHIS), which are the cornerstones for DQM and health information use in LMIC(Sun, 2003). The DHIS were reported as failing to deliver reliable health information (AbouZahr et al., 2007, Odhiambo-Otieno, 2005a). In addition, poor data quality causes great concern due to the current increasing demands for health care, the need for accountability and adequate response to funders' demands (Powell, Davies and Thomson, 2003, Boerma and Stansfield, 2007).

To measure the quality of health data, Bosch-Capblanch, Ronveaux, Doyle, Remedios and Bchir (2009) conducted a large study across 41 low income-countries using immunization programs. Approximately half of these countries obtained 80% of the verification factor (VF), as a measure of accuracy, and only nine (22%) countries showed consistency in the reported health data. Poor DQM and low health information use were found where a data quality audit (DQA) was not used as a tool for DQM. Some countries such as Haiti, Madagascar, Mauritania, and Nigeria were identified to have had consistently poor performance and many inconsistencies in data reported at all levels of their reporting system.

In Mozambique a study that evaluated the quality of an immunization reporting system (Mavimbe, Braa and Bjune, 2005) found that none of the reports submitted to a district level was consistent with the reports available at health facilities and with vaccine tally sheets. Furthermore, none of the supervision sessions considered this matter and no feedback was given in this regard. In the same country, the national health management information system (HMIS) failed to report on pregnant women who do not attend health facilities for antenatal consultations

(ANC) or for delivery (Songane and Bergström, 2002). Under-registration of pregnant women and home deliveries was identified by this study and it showed health facilities failed by 86% to record maternal deaths. This testifies to poor DQM and poor health information use, with implication for health care delivery.

A study conducted in the Free State, South Africa, showed that data contained in hardcopies differed from electronic data reported at a provincial level by 21%. Highest disparities were on treatment start dates (44%) and treatment end dates (41%). In addition patient referrals to another health facility were inconsistent at 30% (Heunis et al., 2011). In the same country, the study that evaluated the prevention of mother-to-child transmission of HIV (PMTCT) data from 316 sites, found their completeness was only 50.3%, with variations between districts. Missing data ranged between 4.5% and 41%. The summary sheets observed at a clinic level were more concordant with values contained in the district health information systems, but the values in registers differed greatly from the summary sheets prepared by the clinics (Mate et al., 2009). These studies reported very low use of health information for decision making and health care interventions planning at all the surveyed health facilities.

In Kenya, an evaluation conducted in three districts found that the health management information systems (DHMISs) were fragmented and none of them were computerized, making health information inaccessible to intended users. Also key resources for DHMIS operation were inadequate. Adequacy of personnel was only 47%, working space 40%, storage space 34%, stationery 20%, and 73% of DHMIS personnel were not trained (Odhiambo-Otieno, 2005b). This study, like other study findings (Sun, 2003, Boerma and Stansfield, 2007) shows that structural

and technical problems are at the core of the lack of information culture, the poor quality of data and the low health information use in LMICs.

Best practices in health data management and health information use at both community and district levels were however documented in several studies. The evaluation of immunization data reported to the National Expanded Program of Immunization in Kyrgyzstan (Soviet Union) has revealed that 95% of health facilities had maintained data accuracy and up-to-date records. This was made possible by giving Community Health Workers (CHWs) basic knowledge and skills for data monitoring and management. This improved the quality of data collection and data processing (Weeks, Svetlana, Noorgoul and Valentina, 2000).

Using health information was found to be useful in evaluating disease outcome and performance of public health programs. An example of this is using data in malaria control in Ethiopia and Rwanda. Routinely collected data as well as survey data played a central role in reducing malaria extensively during recent years (Rowe et al., 2009). Health data utilization has also proven very useful also in clinical settings whereby HIV/AIDS patients were followed up from remote areas in South Africa, Haiti and Rwanda using electronic medical records (Amoroso, Akimana, Wise and Fraser, 2010, Kotze and McDonald, 2010).

These findings testify that the use of facility-based health data is central in measuring the impact of interventions aimed at managing health-related issues, particularly in reducing the disease burden among low and middle-income countries. Of great concern is the lack of quality throughout data collection, processing, analysis and health information use (RTI International, 2006).

1.3 Problem Statement

Reported health data from communities and health facilities in most of LMIC were found to be not accurate or reliable enough to inform the performance of health care programs and diseases outcomes (Bosch-Capblanch et al., 2009, Garrib et al.,2008, Heunis et al., 2011). Several studies have reported poor management of district health information systems and lack of health information culture for better health data and use across LMICs (Odhiambo-Otieno, 2005b, Lima, Schramm, Coeli and Da Silva, 2009, Akande and Monehin, 2004). Since the district health management information system (DHMIS), which is the main level for health information management, fails to deliver data with quality, it makes the health management information system (HMIS) as a whole failing to deliver reliable health information (AbouZahr, Adje and Kanchanachitra, 2007, Evans and Stansfield, 2003), which hinders making better decisions and planning for better health services delivery (Burk, 2010).

This problem was found to be a matter of concern across LMIC. As above seen, one study among many others showed that out of 41 evaluated countries, only 9 (22%) had consistent data, and all countries had weaknesses in their monitoring and evaluation in their district health management information systems, which hinder the use of health information (Bosch-Capblanch et al., 2009). As elsewhere in LMIC, problems with DQM and health information use have been reported in Rwanda, where the study was carried out (RTI International, 2006). Inconsistencies in reporting health data from the communities and health facilities were documented in the recent annual reports of the Ministry of Health of Rwanda (Mitsunaga, Hedt-Gauthier, Ngizwenayo, Farmer, Karamaga and Drobac, 2013). However, there was no formal evaluation of DQM and health information use at community and district levels.

There was a need of an intervention model that could facilitate addressing issues related to health DQM and health information use, especially at community and district levels, in resources limited contexts such as Rwanda, in order to make “better health information” an achievable objective, for better health.

1.4 Overall Purpose of the Study

The overall purpose of this study was to develop an intervention model that facilitates health DQM and health information use at community and district levels in Rwanda, based on existing evidence found in similar settings and on a situation analysis of the current practices and performance.

1.5 Objectives of the Study and Research Questions

The overall objectives of the study and research questions are summarized in the table below:

Table 1.1: Summary of overall objectives of the study

Studies to be conducted	Objectives of the study and Research questions
Phase 1: Evaluation Phase	
<p><u>STUDY 1:</u> Systematic review of health DQM and best practices at community and district levels in LMIC</p>	<p><i>Objectives of the review were:</i></p> <ol style="list-style-type: none"> 1. To identify and review studies that evaluated or described health DQM and health information use at community and district levels in LMIC; 2. To summarize reported best practices and identified associated problems with health DQM and health information use at community and district levels in LMIC; 3. To critique research methods used in those studies; 4. To make recommendations for future studies in response to the

Studies to be conducted	Objectives of the study and Research questions
	<p>identified associated problems with health DQM and health information use at community and district levels in LMIC.</p> <p>Research questions:</p> <ol style="list-style-type: none"> 1. What are the elements of best practice that should be incorporated in a DQM and health information use? 2. What are the criteria for quality data management and utilization?
<p><u>STUDY 2 &3:</u></p> <p>Evaluation of clinical and community health DQM and health information use in Rwanda</p>	<p>Objective 2.1: To describe and analyze the current data management system in the DHMIS in the selected district of Rwanda;</p> <p>Research Questions:</p> <ol style="list-style-type: none"> 1. What is the quality of reported clinical data contained in the SIS of the DHMIS in the selected district of Rwanda? 2. What is the quality of reported community health data contained in the SISCom of the DHMIS in the selected district of Rwanda? <p>Objective 2.2: To explore the information system as a support to health workers at community, health centres and district hospital for health data management and use in the selected district of Rwanda;</p> <p>Research Question:</p> <ol style="list-style-type: none"> 1. What is the institutional support that is given to health centres and district hospital in the selected district of Rwanda? <p>Objective 2.3: To identify the current use of health information at community and district level in the selected district of Rwanda;</p>

Studies to be conducted	Objectives of the study and Research questions
	<p>Research Question:</p> <ol style="list-style-type: none"> How is health information currently used at community and district level in the selected district of Rwanda? <p>Objective 2.4: To explore views/perceptions of health data management and information use among health workers at community and district level in the selected District of Rwanda;</p> <p>Research Question:</p> <ol style="list-style-type: none"> What are the views/perceptions on health data management and information use among health workers at community and district level in the selected District of Rwanda? <p>Objective 2.5: To identify problems associated with DQM and health information use at community and district levels in the selected district of Rwanda.</p> <p>Research Question:</p> <ol style="list-style-type: none"> What are the problems associated with DQM and health information use at community and district levels in the selected district of Rwanda?
Phase 2: Model Development Phase	
<p>STUDY 4:</p> <p>Developing the model for DQM and health information use</p>	<p>Objective 3.1: To develop an intervention model that could facilitate DQM and health information use at community and district levels in Rwanda.</p> <p>Research Question</p> <ol style="list-style-type: none"> What variables are linked to facilitate health DQM and health information use at community and district levels in Rwanda?

1.6 Research Settings and District Health Information Systems in Rwanda

The study was conducted in the Bugesera District of Rwanda. The country is located in the great lakes region in central Africa, east of the Democratic Republic of Congo; in the North is Uganda, in the south, is Burundi, and in the East, is Tanzania. Rwanda is one of the smaller African countries, with 26,338 square kilometers, among which 24,668 sq km of land with mountainous relief, and water occupies 1,670 sq km (USAID Rwanda, 2010). The country has four provinces, the Northern, Southern, Eastern and the Western Provinces, and Kigali City which is considered as the 5th Province. There are 30 districts in these provinces and Kigali City (EDPRS, 2007).

Except for health information systems for specific programs, Rwanda has two main parallel health information systems; those are the SIS (Système d'Information Sanitaire) or Health Information System (Figure 1) whereby health data is collected from health facilities and compiled (paper-based health data management) and entered into the computer and reported to district level for verification of compiled data, and the central level has access to the entered data into the computer. The second is the SISCom (Système d'Information Sanitaire Communautaire) or Community Health Information System (Figure 2) for community-based health interventions, whereby health data is collected by volunteers CHWs (CHWs) in their village, they compile and send it to the cell level, this level sends it to sector level where this data is aggregated in one report that will be sent to district level its entry into the computer, and the central level has access to it. These two HIS were the main focus of this study.

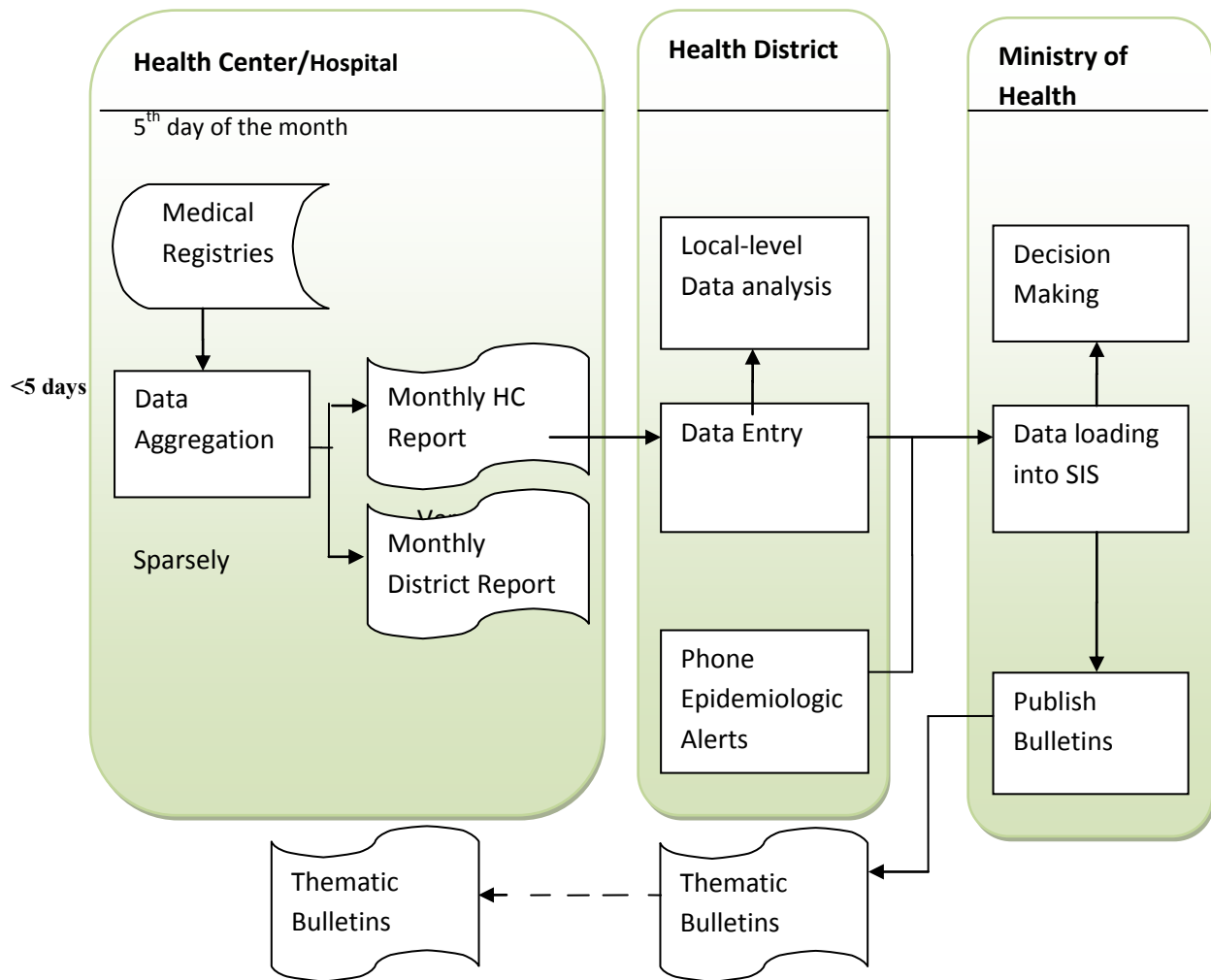


Figure 1: Health Information Flow in Rwanda (SIS- Système d'Information Sanitaire)

Source: RTI, Rwanda Health Management Information System (HMIS) assessment Report 2006.

Community Health Information System Data Flow Chart

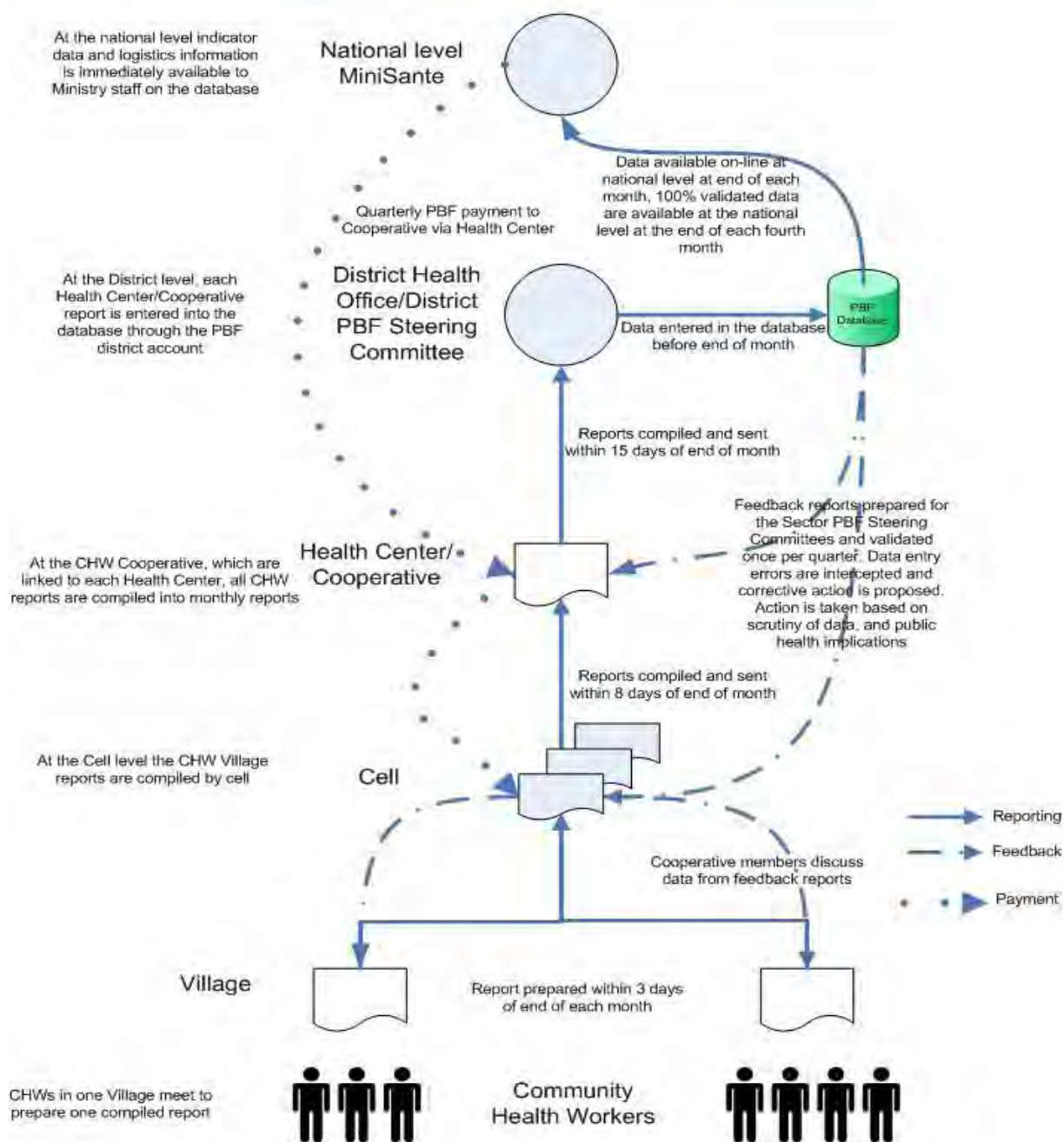


Figure 2: Community Health Information System (SISCom) Data Flow Chart

Source: Community Performance-Based Financing User Guide, 2008.

1.7 Research Methodology

The research comprised two main phases, four research studies and three submitted papers. Phase 1: The evaluation phase, included three studies (Figure 3): (1) a systematic review of health DQM and best practices at community and district levels in LMIC, (2) an evaluation of clinical DQM and health information use in the Bugesera District, Rwanda, (3) an evaluation of community health DQM and health information use in the Bugesera District, Rwanda. Phase 2: Model development which included one study: (4) the development of an intervention model for health DQM and health information use at community and district levels in Rwanda. The methodology used in each of those studies is summarized below and detailed in each paper.

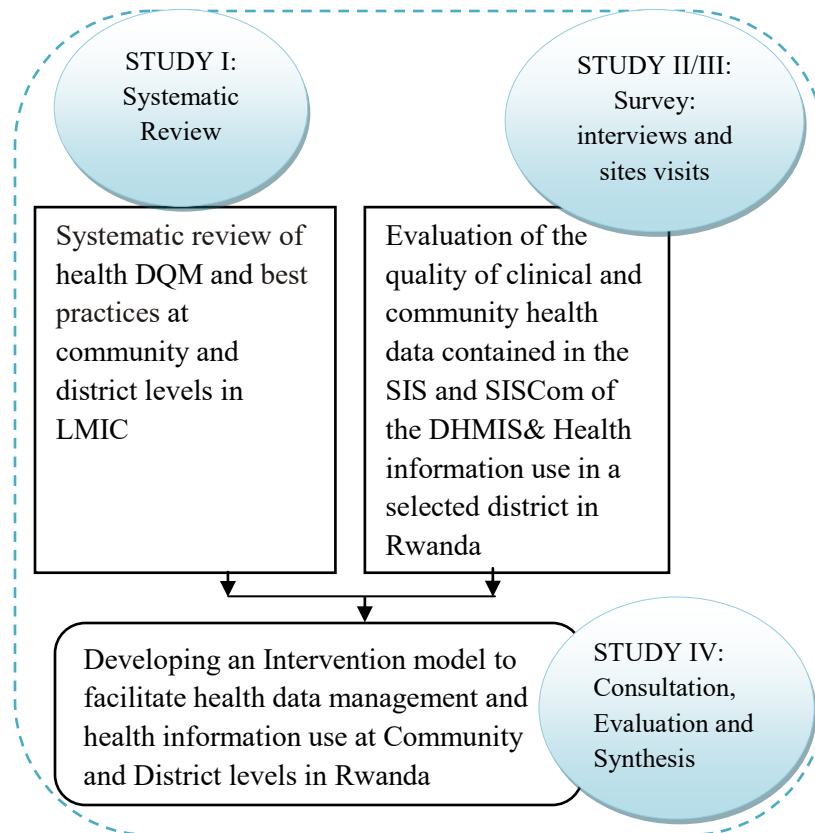


Figure 3: Summary of studies conducted in the model development for DQM and health information use at community and district levels in Rwanda.

1.7.1 Study one

A systematic review of health DQM and best practices at community and district levels in LMIC was done through searching, selecting, abstracting accessed references, critique of their methodology rigor, and synthesizing their findings by three reviewers.

1.7.2 Study two and three

This study design included two studies conducted simultaneously (Denscombe, 2007). The first study was a retrospective design to evaluate the quality of health data. The second study was a survey of health information users to collect quantitative and qualitative data on their experience of the data collection processes.

A post-positivism paradigm was used to accommodate quantitative and qualitative data from research subjects (Alasuutari et al., 2008), using a mixed methods approach to collect quantitative and qualitative data, to potentially provide valid and reliable data and wider understanding of the phenomenon being studied (Chong Yee-Lee et al., 2011). A mixed methods extends to also those research projects that use two or more quantitative or qualitative methods (Gilbert, 2008). Contexts where mixed methods are suitable for use are *triangulation*, to measure a phenomenon using different ways for having more accurate information; *complementarity*, by gathering data collected using two or more mixed methods; *development*, the development of a questionnaire to collect quantitative data at larger scale from qualitative data of smaller scale; *Initiation*, when the researcher initiates a further investigation by being inspired by obtained data from the first part of their study; and *expansion*, to deepen the inquiry by using different methods

within one study (Gilbert, 2008). In this study triangulation, complementarity and expansion were mainly the reasons for the mixed methods.

In Study 1 the target population and research subjects were the health data contained in the SIS and SISCom databases of the district health information system. In Study 2, the target population was all people involved in health data management and health information use at two levels, namely community and district level.

At the community level, the target population included CHWs in their villages, health centres and units nurse managers, community supervisors and data managers. In the Rwandan context, in the Bugesera District, the community consists of a 4 sectors. Each sector is made up of a number of cells (around 8 villages) and each village is the smallest administrative boundary with around 150 households. To collect community level data, individual and focus group interviews were conducted at the following levels:

1. Nurse Manager Interviews: All nine (9) nurse managers were interviewed individually.
2. Community Health Workers (CHWs) Focus Group: One sector was randomly selected from four sectors in the community and 15 CHWs from one cell were randomly selected from this sector to form one focus group.
3. Health Centre Staff Focus Groups (2): Two (2) two health centres were randomly selected and their nurse managers, services managers, supervisors, and data managers formed two focus group interviews. Each Health centre had 9 respondents.

At district level, the target population included data managers, supervisors, unit nurse managers, and doctors. To collect district level data, individual and focus group interviews were conducted at the following level:

4. District Health Level Focus Group (1): All nurse managers within the district hospital, supervisors, data managers, and medical doctors, heads of each department were included to form the third focus group with 11 respondents.

Data Collection Tools

Data was collected using adapted questionnaire from two questionnaires that were used in two previous studies that evaluated health DQM (Mate et al., 2009, Heunis et al., 2011). Other questions were added to cover all objectives: questions to CHWs (see appendix H).

Data collection tool was made of the fact sheet that gives instructions on the use of the questionnaire and four forms:

Form 1: it was the Monthly Summary Sheet Review made of six reported indicators as exist at health facility or at village level;

Form 2: it was the questionnaire for the survey to collect data with 20 questions to collect quantitative data;

Form 3: was the questionnaire used to collect qualitative data in individual and focus group interviews;

Form 4: it was the Data Module and Process Map that guides the researcher and data collectors on the entry and exit of each received client, in order to collect data everywhere it is recorded;

Form 5: it was the Registers Review Sheet with 6 reported indicators. This sheet was used to collect data to be compared with data existing into district databases.

This current study used the same settings as the previous studies by Mate et al., (2009) and Heunis et al., (2011), which support the validity of the instrument. Table 1 reflects the content validity of the instrument that considers objectives of the study, components of the conceptual framework and data collection tools that were used in this study.

Table 1.2: Content validity of data collection instruments

Components of theoretical framework	Objectives of the study	Questions
<p>Data processing: <i>Quality</i>: Completeness, consistency, accuracy $\geq 75\%$, timeliness, <i>Reporting & Information sharing</i>, and <i>Target populations</i></p> <p>Data analysis: Self-assessment, Indicators, Targets</p> <p>Data Presentation : Tables, Graphs, Population, Maps</p> <p>Data interpretation: Comparison, Trends, Epidemiological thinking</p>	<p>1: To describe and analyze the current DQM system in the DHMIS in the selected district of Rwanda;</p>	Form 1 & 6
<p>Data collection:</p> <p>Essential data set</p> <p>Definitions</p> <p>Tools, equipment,</p> <p>Policies and guidelines</p> <p>Training for health personnel</p> <p>Good communication & networking actions</p>	<p>2: To explore the institutional support through formative supervision, monitoring and evaluation and review meetings at community, health centres and district hospital in the selected district of Rwanda</p>	Form 2: Q1-11 & 4

Components of theoretical framework	Objectives of the study	Questions
Information use Information culture, Feedback, Actions: Decision, plans & Evaluation of disease outcomes and program performance, Formative supervision, Monitoring & evaluations	3: To identify the current use of health information at community and district level in the selected district of Rwanda;	Form 2: Q12-20
	4: To explore views/perceptions of health data management and information use among health workers at community and district level in the selected District of Rwanda	Form 3
	5. To identify problems associated with DQM and health information use at community and district levels in the selected district of Rwanda.	All forms: 1 to 5
	6. To develop an intervention model that could facilitate DQM and health information use at community and district levels in Rwanda.	

Standard Operating Procedure (SOP) for Data Collection

A standard operating procedure (SOP) refers to detailed instructions that indicate the process in accomplishing a given function with uniformity among all parties involved in that process (Amarasingham et al., 2007).

In this study, there were steps to be followed by all data collectors to collect data reported to the district level using the Form 5 (See the questionnaire Appendix H). These were clarified during their training before starting data collection. More details of the SOP are given in the Form 4 of the questionnaire. They are as follow:

1. Start with the district summary and note when data are due at the district office;
2. Describe how data from the previous step is sent to the next step;

3. Choose where the Monthly Summary Sheet is submitted and cross out the other pathway. If the Sheet is sent to an information intermediary, write his/her title, note who sends it and when it is due;
4. Describe how data from the previous step is sent to the next step;
5. For the monthly summary sheet, please describe who fills it out and when in the month it is due;
6. Describe how data from the previous step is sent to the next step;
7. List all of the summary sheets collected including who is responsible to fill them and when in the month they are due. If the register tallies are entered directly in the monthly summary sheet, cross out this step and move to the next one;
8. Describe how data from the previous step is sent to the next step;
9. List all of the registers that collect any health data including who is responsible (name and position) to fill the register and when a monthly tally is due;
10. Gather all completed questionnaire and submit them to the researcher for further processes.

To survey health information users: an interview-guide was used to collect quantitative data from all stakeholders in health information management. This was done as follow:

1. Start with sampling the respondents (this to be done by the researcher);
2. Identify and agree with the selected respondents the convenient venue for interviews (the researcher and data collectors kept appointment with every respondent according to what is suitable to them);
3. Agree to the schedule of the interviews;

4. Conducting interview using and completing the interview-guide.
5. Gather all completed questionnaires and submit to the researcher for further processes.
6. To collect qualitative data, the researcher used the same SOP, but the interviewees were recorded using two recorders, at the same time the notes were written down.

1.7.3 Study three

In order to facilitate DQM and health information use at community and district levels in Rwanda, an intervention model was developed. This phase used a teamwork in “Group Model Building” (GMB) process, through a workshop of different stakeholders (Richardson and Andersen, 1995) in data management and health information use in Rwanda.

Model Development Process Using “the Teamwork in Group Model Building”

The teamwork in Group Model Building process that was used refers to the technique that includes clients and different stakeholders to construct system dynamic models on key strategic decisions on public affairs and policy making such as in health care settings, in effective and efficient manner (Richardson and Andersen, 1995). Those processes are the model conceptualization, formulation, analysis, and decision making. The teamwork in Group Model Building envisages three stages for model development: 1) problem conceptualization, 2) model formulation, and 3) group process.

There are five key roles players to facilitate and to explain the model building stages; those include the following: the facilitator, the modeler or reflector, the process coach, the recorder, and the gatekeeper.

1. *The facilitator*: this person facilitates the overall process for model development, and gives required information and of the specific area of interest for which the model is being developed, and oversees the group process, allocates roles in the group.
2. *The modeler or reflector*: this person focuses most on the model that is being formulated by the facilitator and the group, thinking and reflecting information back to the group, restructuring formulated concepts, identifies forgotten aspects of the model and clarifies assumptions that need more clarification.
3. *The process coach*: this person focuses on the dynamism of all working individuals within the group.
4. *The recorder*: this person takes notes of outcomes and together with the notes of the modeler; they make a more reconstructed draft of the model.
5. *The gatekeeper*: this person identifies the required participant in the group, helps in framing the problem together with the modeling team to schedule required working sessions from the beginning up to the end of the model building process.

Workshop Process and Data Analysis

This process was used to develop the model for DQM and health information use at community and district levels in Rwanda. A workshop was organized and potential participants and different stakeholders involved in DQM and health information use were identified and invited to participate. Those included the staff in charge of Community Health Desk in the Ministry of Health and the staff in charge of the Health Management Information System (HMIS) of the Ministry of Health. Research findings from the first and the second study were presented to the

group as part of the problem conceptualization phase of the process, and the proposed model as developed by the researcher was also presented. The participants were divided into smaller groups to work on specifically the model developed by the researcher, based on the evidences from the first, second and third evaluation studies, each group was identifying areas of the model that need improvement. The doctoral candidate was the facilitator of this process, while another senior staff was playing the role of the modeler and process coach. A recorder was designated and was at the same time the time keeper.

Each subgroup presented their proposed changes and suggestions to the larger group, and the modeling team facilitated the session to integrate suggested inputs. All inputs from each group were presented to the larger group and integrated in the initial developed model. The final model proposed was agreed upon by all the participants, as it is presented in chapter three of this thesis.

1.8 Significance of the Study

The study was worth in the sense that poor quality of health data and low use of health information have negative impact on decisions and plans made in health care sector and affects the quality health care in LMIC. To the author's knowledge, there has not been such study that attempted to develop an intervention model that could contribute to the resolution to this problem in the Rwandan context. Existing models mostly describe the information flow, but do not show how the quality of data is assured and health information is used for decisions and plans to improve the quality of health services delivery at each stage of the information cycle. This was the gap this study wanted to address.

The findings of this study may be useful for different stakeholders involved in health DQM and health information use, as well as planners and evaluators in health sector. Specifically, this model may assist stakeholders at all levels in health management information systems (HMISs) in making on-time and better decisions and plans for community-based health care and public health programs within resource constrained contexts. Better decisions and plans may improve not only health services delivery, but also funds allocations with efficiency.

Therefore the model may serve as a tool for CHWs to understand more health DQM, use of better information for better planning and decisions at grassroots level. Those health workers include community health nurses and in charge of community health activities, working in health centres and support directly CHWs (CHWs) working in their villages, health data managers at health centre and district levels, as well as all stakeholders in public health interventions in Rwanda and similar contexts.

The findings of this study may inspire the researcher's understanding and gaining new knowledge on health DQM and health information use. Other researchers may build on the results of this study and conduct more studies aiming at improving health information culture and the health system in Rwanda and similar settings. The development, implementation and evaluation of this model that facilitates health DQM and information system in resources constrained context is considered to be a new and useful knowledge specifically for planning health interventions and decision-making in the health sector.

1.9 Theoretical Framework

In order to choose the model to guide this study, the researcher reviewed the following health information management-related models: (1) DQM Implementation Framework, (2) DQM Maturity Model (Bostrom et al., 2011), (3) Health Care Domain Reference Data Model (HRDM), (4) The information cycle model (Heywood, n.d), (5), The Centres for Disease Control and Prevention (CDC) evaluation model (Wright et al., 2011), and 6) The AHIMA DQM Model (Ndabarora, 2010).

Because of its specificity to the health data management and health information use within district settings, the “health information cycle model” was chosen to guide this study. The study design also considered the six steps to effective evaluation as proposed by the Joint Information Systems Committee and the Centre for Diseases Control-CDC (2000). The health DQM characteristics to be evaluated were selected from the AHIMA DQM Model, and those included completeness, accuracy, timeliness (evaluated by comparison of collected data from registers and monthly summaries and those contained in the databases of the DHIS), definition, and accessibility (evaluated using the questionnaire and interviews).

1.9.1 Description of the Health Information Cycle Model

The health information cycle model is a framework for health data handling which describes the whole information cycle from the community and health facilities levels to the district levels, as well as health information use (See Figure 4). Also, this model considers paper-based and computerized health information systems, which makes it more applicable to district health

information systems evaluation in LMIC (Heywood & Rohde, *The Equity Project*, 2001). The information cycle refers to the different phases of the information from data collection, data processing or data management, data analysis, data presentation, interpretation and use of information (Heywood, n.d , Tan, 2001). DQM can be looked at throughout these phase of the information cycle, particularly the data processing phase. Health information use occurs mainly after data analysis, but this can occur at different levels of care, immediately after collecting data that needs immediate action. The following are the phases of health information cycle (Heywood & Rohde, *The Equity Project*, 2001):

Data collection: this phase includes the following stages: 1) gathering essential data set, such as data on routinely services delivered and non-priority activities data, special programs and clients served, administrative data, epidemiological surveillance data and population data; 2) data and indicator definitions, standardization and calculations; 3) selecting and standardizing data collection tools, policy and guidelines for health data management and use, 4) training of the personnel, and 5) good communication among all stakeholders at different levels. Health indicators reported in Rwanda are appended herewith.

Data processing: in this phase, data is aggregated and processed to ensure quality, consistency, and accuracy, among other characteristics of data quality. Data is reported both vertically (sent up to higher levels) and horizontally (shared with all staff, other health facilities) and fed into a computer to be communicated, depending on the system being used. Data processing is of great importance in the information cycle, because most of DQM is mostly needed at this level (Farley and Corporation, 2003, Heywood, n.d).

Data analysis: at this phase, self-assessment based on indicators status needs to be done, the comparisons with previous data within the same health entity and between different health entities has to be done in order to evaluate targets achievement.

Data presentation: since data is analyzed, it can be presented in tables and/or graphs display, in a way that facilitates managers and others users to understand and see clearly trends of different indicators. Population maps can be drawn for the same purpose.

Data interpretation: In this phase, with data analysis phase, comparisons of current data with previous data are done, within the same health entity and between similar health entities, to show trends of health indicators and allow epidemiological thinking to emerge.

Health information use: this phase enforces health information culture and commitment to DQM mainly through feedback to different levels of health care where the data was reported from. Either written or oral, this model considers the feedback as the main way to ensure DQM and health information use at different levels of health systems. Decisions need to be made and actions be taken, particularly evaluation of diseases outcome and program performance, continuous formative supervision and monitoring and evaluation.

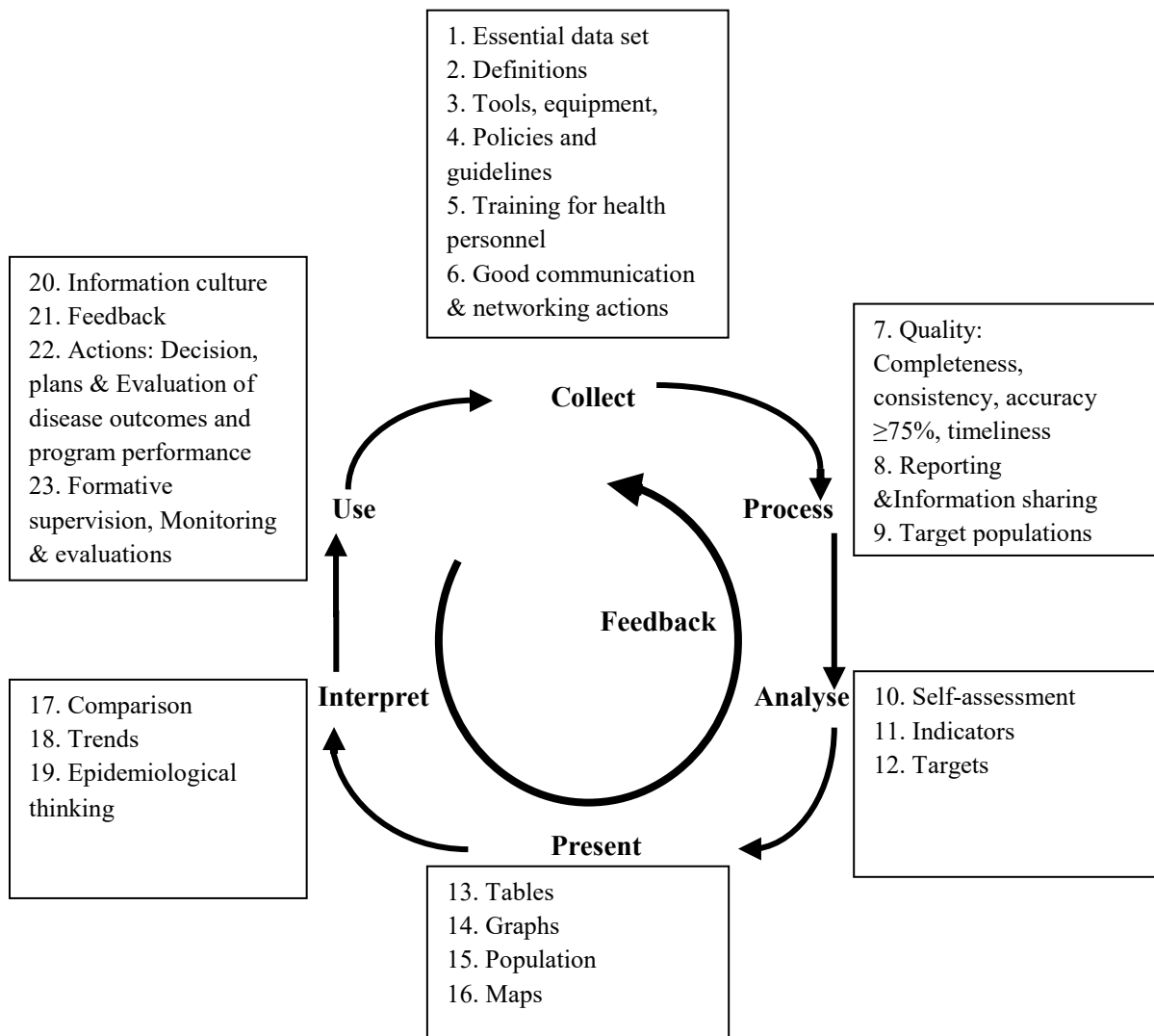


Figure 4: The adapted information cycle model: a framework of the data-handling process in health facilities (Heywood & Rohde, 2001).

1.9.2 Model Use in the Current Study

This study considered all phases of the health information cycle model, and the CDC six steps to effective evaluation of health care programs were followed (Glenaffric Ltd, 2007). Those steps are as follow: 1) Identification and analysis of stakeholders involved in health information system at community and district levels; they are CHWs, health workers based at primary health

facility and district level. 2) Program description, the district health information system as earlier described. 3) Evaluation design, the evaluation for two parallel district health information systems in Rwanda (District Health Information System and Community based Health Information System) were conducted. More details are given in the research methodology. 4) Gathering credible evidences, the data sources were identified; those were data from registers and monthly summaries at community and primary health facilities levels and those from DHIS databases, and key persons were surveyed and interviewed. 5) Data analysis was done according to the data analysis plan, and 6) Reporting the findings done according to the overall research plan.

1.10 Operational Terms

Health management information system (HMIS): This refers to the components and procedures organized with the ultimate goal of providing information and evidences to all stakeholders of the health system, to assist them in the planning process and making decisions to improve the quality of health services delivery (Lippeveld et al., 2000, Rodrigues and Stan, 2009). It is made of two entities: 1) health information processes (from the collection of raw data or inputs until this data is transformed into useable information or outputs, and 2) health information system management structure (a monitoring and evaluation structure that ensures that inputs produce the right output

DQM: This refers to the reliability of data collected due to care given to data during its collection, storage, quality-assurance and flow, processing, compilation, reporting and analysis (from inputs to outputs).

Health information use: Refers to the use of health information for decision making, and includes making health information accessible to intended users through feedbacks and data sharing, evidence-based decisions and policy-making and planning interventions to improve quality health services delivery, and information use for research.

District health information system: District Health Information System (DHIS) is an integrated and decentralized health information system program aiming at empowering communities in decisions making and planning health care interventions to improve the coverage, the quality and efficiency of health services. This includes data management and health information use by CHWs, health workers at primary health care units (Community level), and health workers at district level (Walsham, 2001).

1.11 Literature review

The literature review was completed as a systematic review as set out in the 1st study: Systematic review of health DQM and best practices at community and district levels in LMIC.

1.12 Conclusion

This introductory chapter looked at the background to the study, the problematic of health DQM and health information use in LMIC, the purpose of the study, objectives of the study, research questions, research setting description, overall research design, significance of the study, and theoretical framework. The chapter ends with operational definitions.

CHAPTER 2: STUDY FINDINGS

2.1 Introduction

This chapter presents the findings from the evaluation phase.

2.2 Phase one: evaluation phase

The evaluation phase consist of three evaluation studies: 1) a systematic review evaluating the existing published practices of data quality management and usage at community and district levels in low-and middle-income countries, 2) an evaluation of current practices in clinical data collection in the Bugesera District; and 3) an evaluation of current practices in community data collection in the Bugesera District.

The findings are presented in three (3) published or submitted papers. The following information is provided for each paper: the title, the authors, the journal where in the paper was published or submitted for publication, submission and acceptance history, and the published or submitted version of the paper.

2.2.1 Paper 1: Review of published evidence

Title:

Systematic review of health DQM and best practices at community and district levels in low-and middle-income countries.

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Systematic review of health data quality management and best practices at community and district levels in LMIC

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Abstract

Research findings have reported lack of reliable health data and poor management for district health information systems in low and middle-income countries (LMIC). This paper aims to review the literature on problems with health data quality management and health information evidences and evidences of best practices and use at community and district levels in LMIC, with a view to making recommendations for future research. Research citations, conference proceedings and diseases surveillance reports from 2000–2011 were accessed in PubMed, Medline, LISTA (EBSCO), CINAHL, Cochrane, and Google. Relevant studies were selected, the methodologies critiqued and synthesized. The researchers accessed 1383, and 38 were reviewed by three reviewers. Poor quality health data, low level of health information use, and poor management of health information systems were found. These findings hinder evidence-based decisions based and planning at community and district levels in LMIC. Though poor practices were found, improved health care services delivery with improved health data efficiency was found to be possible.

Keywords

data quality management, health information use, community, district health information systems, systematic review

It is feasible to design, implement and utilize health information systems that fit into local contexts.

Introduction

Reliable health data are the foundation of credible evidence of the health status of patients, and can assist policy makers in making decisions and plans to improve health care services delivery for better health (Haux, 2006). This review focuses on the available evidence of strategies that could facilitate data quality management and the utilization of health information in low and middle-income countries (LMIC) (Lippeveld et al., 2000; Kerr and Norris, 2010).

Data quality has to be ensured through all phases of data collection and utilization (World Health Organization, 2003). The utilization of health information includes making health information available to intended users through feedback and data sharing;

and using the data for evidence-based decisions, policy-making, and planning interventions. To facilitate data management and utilization, health information management systems (HIMS) are essential. These systems refer to the components and procedures to organize data and include two entities: (1) health information data collection and utilization processes, and (2) health information system management structures.

The process of data quality management includes ensuring the reliability of data collected from data

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input, which includes data acquisition and verification; data management or processing, which comprises data storage, aggregation, classification, data update and data computation; and data output, that includes data retrieval and data presentation (Tan, 2001 p.9). Health professionals and policy makers rely on available data as reported from healthcare facilities to make decisions and the decisions they make depend directly on the quality of the data they receive (AbouZahr and Boerma, 2005).

Globally, research findings have reported poor quality of health data (Calle et al., 2000; Goeree et al., 2009) and underutilization of health information for planning and decision-making (Corrao et al., 2009). These problems have hindered decision-making, planning processes and the performance evaluation of health care programs and diseases outcomes (Corrao et al., 2009). It is also of particularly major concern in LMIC, where health information systems are newly initiated within resources constrained contexts (World Health Organization, 2006; Bosch-Capblanch et al., 2009).

In most LMIC, the health information systems are also paper-based and often decentralized at district level (LaFond and Siddiqi, 2003). The district level information systems (DHIMS) are used to compile monthly reports on geographical, clinical and administrative from routine health services data, as well as disease notification from epidemiological surveillance data (Lippeveld et al., 2000). Most LMIC use paper-based data collection processes at primary health care level and paper and computer-based health information systems at district level (Haux et al., 2007; Heywood and Rhode, 2001). However, paper-based information systems are often found to generate data with poor quality and are underutilized within the health information management (Lium et al., 2008).

It is important to strengthen health systems in LMIC through good data management and data availability for better decision-making (Lippeveld et al., 2000; Haux, 2006). As there are concerns that quality health information is lacking and evidence-based planning and decision-making might be affected, the reported progress towards Millennium Development Goals by LMIC may be questionable (AbouZahr and Boerma, 2005; Kerr et al., 2007). It is in the light of these concerns that we reviewed and summarized the literature on data quality management and health information use at community and district levels in LMIC.

Purpose of the review

The objectives of the review were to:

1. Identify and review studies that evaluated health data quality management processes, health information use, and health information system management issues in LMIC.
2. Critique research methods used in those studies.
3. Describe problems with health data quality management and health information use in LMIC and identify reported best practices for implementation.

Methods

MeSH terms in the PubMed and their synonyms were identified to extensively search and retrieve relevant literature on quality management, health information use, and health information management structures in LMIC from 2000 to early 2011.

The following search terms were used: (Health OR Medical OR Patient) AND (Data OR information OR records OR Electronic Medical Records (EMRS) AND (Quality OR management OR reporting OR use OR systems OR data collection OR data processing OR reporting OR data analysis OR information use OR information literacy OR Feedback OR district OR primary care) AND (Evaluation studies OR randomized controlled trials OR experimental studies OR quasi-experimental studies OR descriptive studies OR qualitative studies OR Systematic Review) AND (information use OR decision-making OR policy-making OR planning). Databases searched included: PubMed, Medline, LISTA (EBSCO), CINAHL, Cochrane Collaboration, Joanna Briggs, Google and Google Scholar.

Relevant published papers, reports and conference proceedings were retrieved. No manual searching was performed. Only studies reporting on data quality management and health information in or relevant to LMIC in the English language were included. Two reviewers independently screened the titles and abstracts of all retrieved studies and disagreements were referred to the third reviewer to resolve. Once the studies were selected, the full articles were retrieved, reviewed for quality of study design type and relevant information extracted.

Results

The reviewers identified 1383 studies from the initial search. Of these, 253 (18.3 percent) were selected

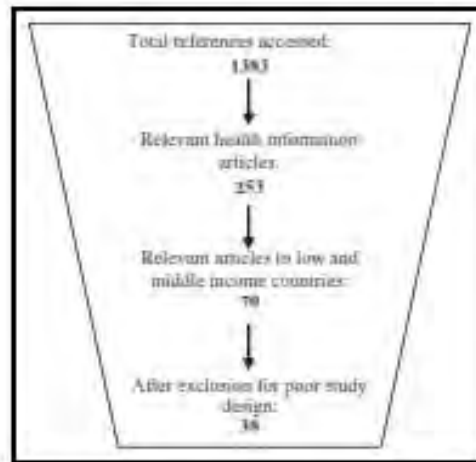


FIGURE 1. Flow diagram for study selection.

after the exclusion of irrelevant studies. A further 70 (5.1 percent) studies remained after studies not applicable to LMIC were also excluded. Based on the quality of the study designs, 38 studies (2.7 percent) were selected for full review (See Figure 1), though the 38 studies included three low quality design studies due to the nature of the information provided by these studies.

Characteristics of reviewed literature

Twenty-five of the 38 studies (65.8 percent) were conducted in Africa, 16 (42.1 percent) were evaluation studies, 13 (34.2 percent) were descriptive studies and seven (18.4 percent) were systematic reviews (Table 1).

Data quality management studies

In reviewing the studies that reported on the quality of data found in LMIC, the following criteria identified by the reviewers were used: accuracy or correctness, completeness, timeliness, comprehensiveness, consistency, accessibility, reliability and acceptability of data. Out of the 38 studies, seven (18.4 percent) studies (Odhiambo-Otieno, 2005; Ronveaux et al., 2005; Garrib et al., 2008; Bosch-Capblanch et al., 2009; Mate et al., 2009; Harper et al., 2011; Heunis et al., 2011) specifically evaluated the quality of health data (see Table 2). Of the seven studies, four (57.1 percent) were descriptive case studies evaluating the quality of the data collected in health facilities (see Table 2).

None of the studies reported on all the criteria of data quality. Overall, the seven studies reported poor

health data quality management in three domains. These include: (1) *Incompleteness of data*: Though 99 percent completeness was reported in a health registry for an aboriginal community in Canada (Harper et al., 2011), data completeness was poor in LMIC with missing data ranging from 19 percent (Odhiambo-Otieno, 2005) to 50.3 percent (Mate et al., 2009). (2) *Inconsistencies in data collection and processing*: Levels of inconsistency were reported for country immunization programs with only nine (22.0 percent) out of 41 countries reporting consistent data (Bosch-Capblanch et al., 2009). There were also inconsistencies in general for TB data (32.0 percent) (Heunis et al., 2011) and diagnosis data in health registries (18.3 percent) (Harper et al., 2011). (3) *Inaccuracy or incorrectness*: Though inconsistent definitions of accuracy were used, the study using a verification factor to assess accuracy showed that only 50 percent of the countries obtained 80 percent accuracy (Bosch-Capblanch et al., 2009). Likewise, in a study on HIV data accuracy, only 12.8 percent of PMTCT (Preventing Mother-to-Child Transmission) data, 19.8 percent of HIV Counselling and Testing (HCT) data and 5.5 percent of HIV PCR testing data of babies born to HIV mothers were reported as accurate (Mate et al., 2009). Other issues identified were poor usage of standard data collection tools, data duplications, multiple registers (Garrib et al., 2008; Bosch-Capblanch et al., 2009), poor and infrequent data quality checking procedures (e.g. tally sheets) and inconsistencies in the use of denominators to estimate coverage (Bosch-Capblanch et al., 2009). Though a lack of guidelines for data quality management was reported (Bosch-Capblanch et al., 2009), one study reported good understanding of the data collection and data collation processes (Garrib et al., 2008).

Studies on utilization of health information

Fifteen studies were found that reported on the utilization of health information, six on evidence of feedback initiatives and nine on the utilization of health information (see Table 3).

Health information sharing and feedback.

Of the six studies reporting on feedback initiatives (Garrib et al., 2008; Mate et al., 2009; Harper et al., 2011; Taylor and Shimp, 2010; van der Veer et al., 2010; Heunis et al., 2011) (see Table 3), two studies specifically reported infrequent evidence of

Table 1. Summary of the 38 studies for review.

Studies	No (%)
<i>Data from Country</i>	
South Africa	8 (21.1%)
Kenya	4 (10.5%)
Other African Countries	13 (34.2%)
Other relevant LMIC	13 (34.2%)
<i>Year</i>	
2000–2005	11 (29.0%)
2006–2011	27 (71.1%)
<i>Focus of Study</i>	
Data quality evaluation (4 of them reported also on feedback)	7 (18.4%)
Health information sharing and feedback	2 (5.3%)
Health information use for decision-making and planning	6 (15.8%)
Health information use for research	3 (7.9%)
Health Information System Management structure	14 (36.8%)
EMRS	7 (18.4%)
<i>Study Design</i>	
Systematic reviews	7 (18.4%)
RCTs	0 (0.0%)
Quasi-experimental studies with and without control groups	2 (5.3%)
Evaluation studies	16 (42.1%)
Descriptive studies and other designs	13 (34.2%)

feedback (Garrib et al., 2008; Heunis et al., 2011). Garrib (2008) reported incorrect usage of data collation tools, little analysis, interpretation or utilization of data and infrequent feedback to clinics (Garrib et al., 2008). Similarly, the study by Heunis et al. (2011) found lack of supervision to address data quality issues resulted in clinic personnel being unaware of their performance.

Overall, factors associated with effective feedback in the reviewed studies were: improved quality of data, motivation of the health care personnel and their expectations, and the availability of necessary equipment that enforce quality improvement.

The improvement of data quality as a result of feedback was reported from three studies. A systematic review on how medical registries provide feedback to health care providers found that feedback initiatives could positively influence the process and quality of care (van der Veer et al., 2010). This was also illustrated in a study in India and Nigeria which found that by sharing health information with the community, there was a significant increase in immunization (Taylor and Shimp, 2010). Similarly, in clinics where

health information was shared among health care providers and the clinic received feedback, TB data were used for planning, monitoring and evaluation of the performance and outcome of the TB programs (Heunis et al., 2011).

Utilization of health information for decision-making and planning

Two systematic reviews (Rahimi and Vimarlund, 2007; Guy et al., 2009) and two studies (Booman et al., 2000; Farias et al., 2010) reported on practices in using health information for public health interventions planning (see Table 3). These included: A systematic review of moderate quality on the application of IT-based systems in health which showed positive results in user satisfaction, financial benefits and improved organizational work (Rahimi and Vimarlund, 2007); A good systematic review on the usability of HCT data in assessing the impact of public health interventions which concluded that data from routinely collected data was useful for public health interventions in resource limited settings (Guy et al., 2009); Geographical data used for targeted risk identification and malaria control in South Africa (Booman et al., 2000); and Influenza (H1N1) pandemic control which used an integrated IT-based HIMS to evaluate program performances and disease outcomes in Argentina (Farias et al., 2010).

Three studies of high to moderate quality reported on evaluations of utilization of electronic medical records systems (EMRS) and diagnosis supporting tools to improve patients' management by using patient-specific clinical summaries in Uganda and Kenya (Merrell et al., 2004; Siika et al., 2005; Were et al., 2010). In Kenya health care providers in remote areas reported getting clinical decision support through health data sharing with medical experts (Merrell et al., 2004); and in Uganda and Kenya, the use of EMRS were shown to be efficient in managing HIV/AIDS patients, monitoring and evaluation of diseases outcome, tracking missing patients and infants enrolled in PMTCT from remote areas, saving time spent on care and facilitating research (Siika et al., 2005; Were et al., 2010).

Health information use for research

Four studies (Martin et al., 2002; Siika et al., 2005; Diero et al., 2006; Were et al., 2010) reported on the utilization of health information for research (see Table 3). Reports of prospective clinical studies using

Table 2. Summary of studies evaluating health data quality.

Article	Country	Study Design and Focus	Main Findings	Quality of Study
Ronveaux et al. (2005)	Global	Retrospective evaluation of the quality of immunization data from 27 LMIC using standardized data quality audits Accuracy=verification	Lower than 85% of verified DTP-3 doses recorded in 16 countries All countries reported weaknesses in their monitoring systems for data quality Overall poor management of immunization programs	No interventions Big sample size High validity with other HMIS evaluation findings
Odhiambo-Otieno (2005)	Kenya	Cross-sectional study to evaluate DHIMS in three districts	Accuracy 30% Completeness 19% Timeliness 26% Relevance 72%	Moderate quality (cross-sectional) Large sample size, High external validity in Kenya
Garrib et al. (2008)	South Africa	Retrospective evaluation of the quality of reported health data by nurses from 10 clinics of one District Accuracy= data missing and in expected ranges	Poor quality of health data 2.5% missing data values 25% outside expected ranges Rare data quality checking Good understanding of data collection	No intervention Big sample size High external validity of findings with other DHIMS evaluation reports
Mate et al. (2009)	South Africa	Retrospective evaluation of the quality of PMTCT routine data management from 316 clinics Accuracy= within 10% of constructed values.	Completeness: 50.3% Overall data accuracy: 12.8 Best: Record of HIV testing 19.8% Worst: Record of HIV PCR testing 5.3%	No intervention Big sample size High validity with other findings
Bosch-Capblanch et al. (2009)	Global	Retrospective data quality audit of the quality of immunization data from 41 LMIC Accuracy=verification factor (VF) of 80% & quality score (QS)	Accuracy: 50% countries obtained 80% VF 9 countries (22%) high VF & QS Poor availability of guidelines for data management Incorrect denominators to calculate coverage Data duplications	No intervention Big sample size Standard methodology High validity with other HMIS findings

(continued)

Table 2. (continued)

Article	Country	Study Design and Focus	Main Findings	Quality of Study
Harper et al. (2011)	Aboriginal	Population in Canada	Retrospective evaluation of patients' data captured in a health registry system in aboriginal communities: a case study	
		Accuracy=verification	Data completeness high: 99% Data inconsistency 18.3% Data accuracy of diagnosis 6.2% incorrect Data analysis was done at annually basis	No intervention Small sample size Low external validity with other HIMS findings
Heunis et al. (2011)	South Africa	Retrospective evaluation of the quality of TB-HIV routine data and nurses' views on data management in 5 districts	Overall inconsistencies: 32% Worst TB treatment start 44% & end: 41% Best TB patient file number 4% Rare data quality checking	No intervention Big sample size High external validity with other HIMS evaluation findings
		Accuracy=verification		

EMRS which could be undertaken at larger scale were useful to evaluate disease outcomes in Kenya (Siika et al., 2005; Diero et al., 2006) and Uganda (Were et al., 2010). Lastly, the study by Martin et al. (2002) described the efficiency in undertaking a research-based, Geographical Information System (GIS) for disease surveillance to influence health programs planning for Malaria Control Programs in South Africa (Martin et al., 2002).

Studies on practices for health information management system structure

Ten studies were found on Health Information Management System (HIMS) structure and processes. Seven studies evaluated structural factors and processes in DHIMS in South Africa, Kenya, Tanzania, Zambia, Mozambique and Nigeria (see Table 4), while three studies reported on interventions to improve data quality and feedback (see Table 5).

District Health Information System management structures and processes

Issues and problems with DHIMS described in the studies included: (1) *Structural problems*, namely: lack of clear policy for health information systems (Lima et al., 2009), lack of resources and facilities, lack of management commitment, pressure for good results, overloading forms to complete for different programs and parallel reports (Mutemwa, 2006), lack of feedback and poor collaboration between information technology experts, managers and users, especially in the conception phases (Odhiambo-Otieno, 2005), and parallel health information systems and lack of integration (Smith et al., 2008); (2) *Behavioural issues*, namely: lack of information culture and few evaluation studies which hindered comprehensive data quality assessments (Akande and Monehin, 2004; Hotchkiss et al., 2010); and (3) *Technical issues*, namely: use of inappropriate and complex technology, lack of training, lack of skills, lack of

Table 3. Summary of studies evaluating health information use.

Article	Country	Study Design and Focus	Main Findings	Quality of the Study
Feedback initiatives				
Garrib et al. (2008)	South Africa	Retrospective evaluation of the quality of reported health data by nurses from 10 clinics of one District	Good understanding of data collection Rare feedback to health facilities High perceived burden of health data management	No intervention Big sample size
Mate et al. (2009)	South Africa	Retrospective evaluation of the quality of PMTCT routine data management from 316 clinics	Rare evidence of feedback	No intervention Big sample size
Harper et al. (2011)	Aboriginal Population in Canada	Retrospective evaluation of patients' data captured in a health registry system in aboriginal communities: a case study	Data analysis was done annually Low accessibility of data to the users	No intervention Small sample size
Taylor and Shimp (2010)	Nigeria and India	Description of health information use for polio eradication in India and Nigeria	Communities became active agents in polio eradication in Nigeria and India through feedback and sharing health information Increased immunization rate	No intervention
van der Veer et al. (2010)	Global	Systematic review of the effect of a feedback on quality care (53 studies)	Feedback improved quality care processes and quality of data. Motivation of health personnel	No intervention High external validity Large sample size
Heunis et al. (2011)	South Africa	Retrospective evaluation of the quality of TB-HIV routine data and nurses' views on data management in 5 districts	Rare evidence of feedback	No intervention Big sample size
Health information use for decisions and planning				
Booman et al. (2000)	South Africa	Quasi-experimental study with description of the use of geographical health data for malaria control in Mpumalanga Province	Calculation of Risk Targeted interventions Malaria control at all levels, particularly malaria data management at community level of in	Intervention Historical control study design Large sample size

(continued)

Table 3. (continued)

Article	Country	Study Design and Focus	Main Findings	Quality of the Study
Merrell et al. (2004)	Kenya	Description of the use of ambulant community EMRS in 2700 patients in four villages	Data accessibility and interoperability improved Clinical decisions support reasonable cost Few live telemedicine consults were needed	Intervention No control group No Pre and Post data Large sample size of patients, but few villages Low external validity
Siika et al. (2005)	Kenya	Description of the use of EMRS for more than 4000 ambulatory HIV clients	Improved monitoring and outcome evaluation of ambulatory HIV clients from remote areas at reasonable cost was found; Facilitated research.	Intervention Large sample size No control group No Pre and Post data High internal validity.
Rahimi and Vimarlund (2007)	Global	Systematic review of 61 studies on IT-based systems in health care settings	User satisfaction, Financial benefits Improved organizational work Found no standard framework for evaluation effects and outputs of implementation and use of IT	Systematic review Large sample size
Guy et al. (2009)	Global	Systematic review of 20 studies on the usability of HIV routine data (VCT) to assess the impact of public health interventions	Routinely VCT data was found useful to evaluate the impact of public health interventions	Good systematic review Large sample size High external validity with other findings
Farias et al. (2010)	Argentina	Disease surveillance report and health data sharing with communities: a case study	Positive effect of integrated information tools Effective influenza A (H1N1) pandemic management was found, Funds reallocation and efficiency were found.	Intervention No control group No Pre and Post data Small sample size limiting generalizability
Were et al. (2010)	Uganda	Time and Motion evaluation of EMR-based paper clinical summaries to support HIV-care of 15,000 clients	Improved quality of data Save time Reduced mistakes Facilitated research with efficiency	Implementation Evaluation Historical control Pre and Post data Large sample size High external validity with other findings

(continued)

Table 3. (continued)

Article	Country	Study Design and Focus	Main Findings	Quality of the Study
Health Information use for Research Martin et al. (2002)	South Africa	Description of the use of a GIS for malaria control program	Appropriate malaria control, improved the quality of data with efficiency Saved time Facilitated research	Description of development and use Large sample size
Diero et al. (2006)	Kenya	Prospective study of computer-based EMRS to follow up 381 patients with tract infections.	Follow up of patients in remote areas was feasible Facilitated prospective clinical research and evaluation of disease outcomes with limited resources.	Prospective study Large sample size No control

pre-operational and post-implementation evaluation (Odhiambo-Otieno, 2005).

Interventions to improve data quality and feedback

Specific interventions to improve data quality were reported in studies in South Africa (Jacucci et al., 2006), Ethiopia (Wong and Bradley, 2009) and Nigeria (Osa-Eloka et al., 2009). One district in South Africa overcame problems associated with poor quality data management through formative supervision, monitoring and evaluation, guaranteed feedback to increase the quality of health data and the integration of data management and networking actions at all district levels (Jacucci et al., 2006). The following outcomes from their interventions were reported: improved quality of reported data from health facilities, increased accessibility of data, enhanced skills in the use of data collection tools and data analysis software, increased utilization health information use, and tangible management commitment to enforce good practice culture (Jacucci et al., 2006). In addition, daily quality data checks, utilization of health information to plan health interventions, and the use for financial negotiations with the district were observed (Jacucci et al., 2006). A study conducted in Ethiopia found that using hospital wide registration, one computer database, medical records re-engineering and standardized forms improved the retrieval of records, time spent on retrieval and improved records completeness (Wong and Bradley, 2009). And lastly, a study in Nigeria

showed that training greatly increases data management skills and reporting and local use of data among HIMS users (Osa-Eloka et al., 2009).

Studies on practices for Electronic Medical Information System Management

Internationally there has been a dramatic increase in the use and popularity of technology to develop electronic medical record systems (EMRS) for health data management. Though the context of LMIC makes the application of these systems difficult, 10 studies were found on the use of EMRS in LMIC. Three studies focused on factors affecting EMRS implementation in LMIC (see Table 6) and seven studies evaluated the effectiveness of the EMRS interventions in LMIC (see Table 7).

Electronic Health Information System implementation processes

The studies reviewed identified a number of factors which may encumber an EMRS implementation (Table 6). A case study in Tanzania found that poor information literacy, unclear policies and inflexible systems hindered the implementation of an EMRS (Kimaro and Nhampossa, 2005). A systematic review conducted on the adoption of EMRS implementation in primary care showed that the quality of the implementation process is as important as the quality of the EMRS (Ludwick and Doucette, 2009). Other important factors identified were personnel satisfaction,

Table 4. Summary of studies on health information system management structures and processes.

Article	Country	Study Design and Focus	Main Findings	Quality of Study
Akande and Monehin (2004)	Nigeria	Descriptive survey of HIMS in 37 private clinics	Structures Lack of necessary equipment and data management tools and form 29.7% supplied forms 16.2% had forms 36.4% made returns Processes Lack of training Lack of knowledge (10.8% knowledge of forms) Lack of awareness of HIMS (67.6%).	No intervention Moderate sample size Poor study design (descriptive)
Odhiambo-Otieno (2005)	Kenya	Cross-sectional study to evaluate DHIMS in three districts	Structures 0% DHIMS computerized Adequacy of structures poor: Staff 47%, Working space 40%, Storage space 34% and Stationary 20% Processes DHIMS not supportive of managers IT and health collaboration Confidentiality 32% Use of information 22% Training 73%	Moderate quality (cross-sectional) Large sample size, High external validity with other HIMS findings in Kenya
Musamwa (2006)	Zambia	Qualitative comparative case-study of two DHIMS implementation in two districts	Processes Using information for strategic decision making: organizational processes human resources organizational structure	No intervention Small sample size Low external validity
Smith et al. (2008)	Tanzania	Description of integration issues associated with DHIMS: understanding issues of integration	Structure Parallel systems creates problems Processes Health data need to be integrated Workflow	No intervention Low external validity
Lima et al. (2009)	Brazil	Systematic review of 78 evaluation studies of Brazilian HIMS	Processes Need for policy for HIMS, Paucity of continuous evaluations	Systematic review No interventions Large sample External validity
Hanmer et al. (2010)	South Africa	Survey of factors associated with computerized health information system success in two provinces	Processes Perceptions of usefulness of the CHIS Capacity building of the personnel Management commitment.	No intervention Case studies Low external validity
Hoehkiss et al. (2010)	Uganda	Evaluation of the Performance of Routine Information System Management (PRISM) framework in 12 districts	Structures PRISM effective conceptual framework to evaluate HIMS strengthening interventions Processes Promote culture of information Decision making Use of information Motivation for use	No intervention Large sample size Good external validity with other DHIMS findings

Table 5. Summary of studies on health information system management interventions.

Article	Country	Study Design and Focus	Intervention	Main Findings	Study quality
Jacucci et al. (2006)	South Africa	Case study description of standardization of health information systems and challenges for local sustainability	Integration of health information systems	Networking with DHIMS Layering of systems eg. Health and budget information Importance of workflow design Relevance of information for use Enforcing information culture Formative supervision, Monitoring and evaluation, Guaranteed feedback	Single case study Intervention No control No Pre and Post Limited generalizability
Wong and Bradley (2009)	Ethiopia	A pre and post-test time motion study to measure accessibility and completeness of medical records	Hospital wide registration Medical records re-engineering One simple computer database Standardized forms	Improved data quality Retrieval of data for returning patient from 14% to 87% ($p < .01$) Completeness 6.5% to 45.7% ($p < .01$) Saves time spent on record location 31.2 sec to 15.7 sec ($p < .01$) Physician satisfaction ($p = .02$)	Single case study Pre and Post No control Low sample Limited generalizability
Osa-Eloka et al. (2009)	Nigeria	Evaluation of the outcome of a training on data management among 107 clinics: before and after intervention design	Training scheme on data collection, recording, reporting and utilization practices among primary health care workers	Training increases greatly data management skills among HIMS users in intervention group ($p < .001$) Reporting and local uses of data improved in intervention group ($p < .001$)	Intervention Design Control group Large sample Pre and Post High external validity with other DHIMS findings

Table 6. Summary of studies on electronic medical records systems implementation.

Article	Country	Study Design and Focus	Main Findings	Quality of Study
Kimaro and Twaakyondo (2005)	Tanzania	Analyzing the hindrance to the use of information and technology for improving efficiency of health care delivery system: Action research in 5 districts	Lack of skills for data interpretation and utilization, Lack of clear policy guidelines on information and human capacity building, Lack of flexible system hinder proper HIMS management	Case study Large sample size
Kimaro and Nhampossa (2005)	Mozambique and Tanzania	Analyzing the problem of unsustainable DHIMS less-developed economies: Case studies Mozambique and Tanzania	Integration of a HIMS Local shaping of new cultures Cultivation approach to systems development	Action Research Study
Ludwick and Doucette (2009)	Global	Systematic review of 86 studies on the adoption of EMRS in primary care	Quality of implementation process Health system usability Computer skills Organizational culture.	Systematic review High external validity with other findings

usability and interoperability of EMRS for patient care and data sharing for clinical support and referrals (Ludwick and Doucette, 2009), and integration of HIMS systems (Kimaro and Nhampossa, 2005). Ludwick and Doucette (2009) also found that strong leadership, sound management, well established standards, staff training and due consideration of the technical and social context are fundamental to the success of any HIMS implementation.

Evaluation of effectiveness of EMRS in data management

Studies evaluating the effectiveness of technological interventions to improve data collection focused on EMRS (6 studies and a systematic review) and hand held devices for data collection (1 systematic review) (see Table 7).

A study conducted in India found that using a computerized HIMS assisted program managers in Primary Health Centres in the monitoring and supervision of

their daily activities, funds allocation and resulted in time efficiencies, increased data quality, and improved health services delivery (Krishnan et al., 2010). A systematic review on the impact of health information technology on quality, efficiency, and cost of medical care (Chaudhry et al., 2006) concluded that the health information technology improves the quality care and efficiency through adherence to guidelines and protocols for decision support.

Three studies conducted on HIV/AIDS Management systems in South Africa (Kotze and McDonald, 2010), Rwanda (Amoroso et al., 2010) and Haiti (Fraser et al., 2004) showed improved monitoring and evaluation of antiretroviral data and HIV/AIDS treatment across the three countries (Fraser et al., 2004; Merrell et al., 2004; Amoroso et al., 2010). In Rwanda, the use of detailed HIV/AIDS and TB computerized data facilitated patient follow up, improved data accessibility and quality (92 percent reduction in systematic errors) and improved patient care (Amoroso et al., 2010). In terms of capturing data using hand

Table 7. Summary of studies on effectiveness of EMRS in data management.

Article	Country	Study Design and Focus	Intervention	Main Findings	Quality of Study
Fraser et al. (2004)	Haiti	Description of the implementation of an EMRS system for HIV data (7000 HIV clients)	Web-based EMRS system for HIV data	Outcomes Improved patients follow up Improved data quality Data accessibility Interoperability Issues Lack of connectivity Literacy and patient IDs	Case study description Larger sample No control No Pre and Post
Chaudhry et al. (2006)	Global	Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care (257 studies)	Health information Technology	Outcomes Increased adherence to guideline care Increases data quality Decreases medical errors, Improve diseases surveillance Improve cost effectiveness	Good Systematic Review Not LMIC focused
Lane et al. (2006)	Global	Systematic Review of 9 RCTs of effectiveness of hand held computers with papers methods for data management	Handheld computers	Outcomes Improved speed and data processing Timely reports Adherence to data handling instructions. Preferred by the users.	Good Systematic Review Not LMIC focused
Amoroso et al. (2010)	Rwanda	Description of the implementation of EMRS system for HIV data: a case report for one district	EMR for HIV	Outcomes Improved patients follow up, Improved data quality Improved data accessibility: critical CD4 data that were not reaching clinicians by 34.2% (p=.002), Decreased systematic errors 92% On-time reports delivery Issues Structural issues Lack of skilled personnel	Evaluation study Small sample No control No Pre and Post

(continued)

Table 7. (continued)

Article	Country	Study Design and Focus	Intervention	Main Findings	Quality of Study
Kim et al. (2004)	Global	Conference proceeding on Personal Health Information Management System (PHIMS)	Web-based PHIMS in a surgical referral practice.	Outcomes Improved completeness of data Efficiency of patients care Users' satisfaction : Usability 85% Online referral 94%	Evaluation study Small sample No control No Pre and Post
Kotze and McDonald (2010)	South Africa	Description of the implementation of an information system for antiretroviral treatment program	Palm computer project followed by HIMS	Outcomes Data quality improvement Timely reports delivery Patients follow up Issues Lack of integration of all HIV information systems	Action Research Large sample size
Krishnan et al. (2010)	India	Retrospective evaluation of HIMS for primary health care in rural area: a case study	Computerized HIMS	Outcomes Improved data accuracy (>95%) Health workers useful Health Managers improved services, monitor and supervision Annual cost saving	Action Research Low sample No control No Pre and Post

held computers, the systematic review showed that hand held computers were better than paper use for data collection in terms of speed of data collection, ease of data processing, timely delivery of reports, adherence to data handling instructions, and were the most preferred by the users (Lane et al., 2006).

Structural problems in EMRS identified in Haiti and Rwanda included the lack of necessary infrastructure and equipment, inadequate program officers at different sites, and communication issues (Fraser et al., 2004; Amoroso et al., 2010).

Discussion

International evidence has shown that health information systems are fundamental to the delivery of quality health care (Chaudhry et al., 2006). In LMIC the burden of diseases such HIV/AIDS and the need for health information systems to coordinate care and treatment, is accompanied by concerns that paper-

based records are no longer adequate and should be replaced by more efficient EMRS (Kalogriopoulos et al., 2009). Countries in Europe and the USA are increasingly using EMRS to improve healthcare service delivery quality (Williams and Boren, 2008; Ali et al., 2011). Unfortunately LMIC face many challenges in implementing and utilizing health information systems, including concerns about quality of data and inadequate communications technology, human expertise and financial resources (Williams and Boren, 2008).

For health decision makers in LMIC, these challenges are compounded by a lack of high quality evaluations of health information systems and effective data quality management strategies (Chaudhry et al., 2006). Similarly, in this review of health information system evaluation studies, study quality ranged from high quality systematic reviews to low quality descriptions of single case studies. Despite these limitations, the reviewed studies showed that the use of

technology could improve both the quality and the use of health data in LMIC and could lead to good outcomes such as: improved patients' follow up from remote areas, increased users' satisfaction, adherences to data quality management standards, efficient management of health clinics, hospitals and public health programs and improved guideline adherence (Oluoch et al., 2012). In addition, the review showed that health information systems structures were found very helpful in overcoming problems associated with paper-based health information systems and facilitating clinical and health systems researches within limited resources contexts.

While the benefits of health information systems are clear, adapting new health information systems has proven difficult in the past and rates of use have been limited (Chaudhry et al., 2006). In LMIC, the overall aim of a health information system, which is to facilitate care, may not be reached, with the severe resource constraints hindering implementation, data quality management and utilization of health information. This review also supported this finding with studies identifying two major problems hindering data quality management: Firstly, technical infrastructure issues such as unreliable electric power and erratic Internet connectivity and clinicians' limited computer skills (Oluoch et al., 2012); and secondly, data quality management issues such as the lack of policies and guidelines, training for health personnel, required equipment, good communication and networking actions among all stakeholders of HIMS, supervision, monitoring and continuous evaluations, and information culture at different levels of district health information systems.

There are also evidence that in LMIC data are incomplete, inaccurate, unreliable and not timely (Simba, 2004) and that poor data quality management have a major impact on the utilization of health data and the potential use of an EMRS. Against a 75th percentile standard for data quality, the reviewed studies reported poor quality of data from LMIC health facilities and district health information systems. One of the main problems was data incompleteness with no LMIC country reporting data completeness over 50 percent. Though accuracy was also measured using different verification methods, data inconsistencies and inaccuracies were common and often the reviewed studies did not report the standards against which they appraised the level of data quality. Inaccurate and incomplete data may result in data not being seen as reliable enough to inform on programs

performance and disease outcomes or to be used for decision making and planning and that EMRS might expedite the dissemination of wrong or poor data (Simba, 2004)

However, with accurate data, feedback to users, information sharing, decision-making and program planning based on available health information could be good standards of quality usage of health information. Our review showed that good practices in data quality management and utilization of health information exist with a few studies reported using data for public health interventions and research. However, the review also showed that problems outweighed the good practices with health data being neither accurate (correct) nor reliable, poor evidence of feedback practices, district health information systems being poorly managed, a lack of information culture in LMIC, problems implementing HIMS and a failure to deliver reliable health information for better decisions and planning. To improve utilization of health information, it is believed that the establishment of strong leadership, using project management techniques, establishing standards and training their staff is essential for implementation success (Ludwick and Doucette, 2009) and more work needs to be done to overcome the barriers to implementation such as technical infrastructure and care providers' computer illiteracy (Oluoch et al., 2012). Similarly, this review identified a number of key strategies to improve the implementation and utilization of health information systems. Specifically relevant for LMIC were the development of integrated health information systems, reengineering of work flow and medical records, management commitment to create an information culture and training of data collectors and users. In addition, the development of EMRS with open standards and sharable components using open source software should also be developed tailored to the population, location, and availability of resources (Kalogiropoulos et al., 2009).

Conclusion

This review reinforces the need for well-designed studies evaluating the role and feasibility of health information systems which are customized to LMIC localities (Ali et al., 2011). In these studies, factors specific to implementation of health information systems and EMRS in LMIC settings should be addressed before such countries can demonstrate their full benefits. Similarly, it is important that existing

health information systems take significant steps to improve their data management processes so that quality health data is available timely to all users to improve health services delivery. However, despite the challenges faced by LMIC, it is believed that it is feasible to design, implement and utilize health information systems that fit into local contexts and can contribute to the delivery and monitoring of quality health care (Williams and Boren, 2008).

Conflict of interest

No conflict of interest associated with this work.

Contribution of authors

We declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. The authors conceived and designed the study together, and the first author collected and analysed the data.

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2.2.2 Paper 2: In situ clinical data collection evaluation

Title:

Evaluation of clinical data quality management and health information use in Bugesera District, Rwanda.

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Abstract

Background: Several studies have reported lack of reliable health data and poor management of Health Information Systems (HIS) in Low and Middle-Income Countries (LMIC). The purpose of this study was to evaluate the quality of health data contained in the District health Information System (DHIS) database, and to evaluate the use of health information in the Bugesera District of Rwanda.

Methods: A retrospective descriptive design of mother and child clinical data was used to evaluate the quality of health data contained in the DHIS database. A survey of health information managers and users was conducted to evaluate the DHIS using self-report questionnaire to collect data. Statistical tests used include the Pearson's correlation coefficient and Pearson Chi-Square test.

Results: Overall completeness data for children under the age of 5 years from health facilities and pregnant women were 68.2% and 69.5% of the time respectively. There was a good concordance of data collected from registers and monthly summaries sent by health centres ($r=0.60$, $p<.001$ at 95% CI), with a strong concordance between monthly summaries and data contained in the DHIS database ($r=1$, $p<.0001$ at 95% CI). There was a strong concordance between maternity data collected during data audit and monthly summaries at district hospital was observed ($r=1$, $p<.0001$ at 95% CI), and less than 5 years data collected from registers and those contained in DHIS database ($r=1$, $p<.0001$ at 95% CI). Problems identified included lack of training, lack of feedback, lack of formative supervision, lack of data management tools, lack of information culture, and lack of time. Predicting variables of data quality and use were the feedback, supervision, and the training.

Conclusion: Improved data quality and best practices in health information management with notable defects at the source of data were observed, and structural issues hindering the quality of health data and use were identified.

Keywords: DQM, health information use, District health information systems, Evaluation.

Introduction

Data quality management (DQM) and health information use are essential components of routine health management information systems (HMIS) that aim to generate accurate health data and reliable health information [1], to serve as evidence-based for planning and delivering health care services, policy and decision making, and evaluation of diseases outcomes and the success of community and health facility-based health programmes [2, 3]. Better plans and decisions that health care professionals can make, best practices in health care services delivery, as well as sound evaluation of disease outcomes and the success of health programmes depend much on the accuracy and reliability of available health information [4].

As countries strive to reach the Millennium Development Goals, high quality data and reliable health information is not yet achieved and constitutes a matter of concern in low and middle-income countries, and progress reports from these countries may not reflect what truly the situation is [5, 6]. Several studies have reported poor quality of health information in low and middle-income countries. One study that evaluated the quality of immunisation programmes data conducted across 41 LMIC revealed that only 9 (22%) countries showed consistency of the reported health data, and poor DQM systems, particularly the lack of data quality audit (DQA) as a tool to ensure accuracy of health data and reliable health information [7]. Some of these countries have reported inconsistently health data throughout all levels of their health information systems; those are Haiti, Madagascar, Mauritania, and Nigeria.

In Rwanda, a District Health Information System (DHIS) has been in place since the year 2000 in order to strengthen the lower level of health system through continuous formative supervision and data quality audit [8, 9]. In 2009 the study conducted by Otten et al. has evidenced that data

played major role in following up and controlling malaria in Rwanda and Ethiopia [10], despite the gaps in conducting formal health data evaluation studies. Health data inconsistencies in monthly reports of clinical health data in annual reports of the Ministry of Health of Rwanda were noted [11]. The main motivation to the researcher was the contribution to fill in this gap; and therefore, the aim of this paper is to report the findings of this study and propose way forward to reach accurate and reliable health data and health information at district level.

Methods

A retrospective descriptive design was used to audit the quality of health data contained in the DHIS database at district level, and to survey the use of health information in Bugesera District of Rwanda.

Specific objectives were to:

1. Evaluate the quality of reported data contained in the Bugesera District health information system (DHIS) database, in terms of concordance and completeness. Concordance was evaluated by calculating the agreement between data in health facilities and reported at district level and completeness of data by means of a retrospective audit of records at health facilities and at district office to evaluate whether the value of selected indicators is present or not in the registers of a specific health facility and the data base over time;
2. Explore the institutional support for data management, the use of health information and the problems associated with DQM by means of a survey of participants in the data capturing, reporting and utilization process within a district.

The setting

In Rwanda, Health Information Systems Management (HISM or *SIS- Système d'Information Sanitaire*) for health facility-based programmes is decentralized at district level. Routine data collection and reporting processes for the DHIS start with data being collected from patients' registers in each unit of the health centre, and then they are sent to the data manager who collate them in one monthly report and convert them in electronic format. The district supervisor will automatically have access to this software, and will be given the hard copy for verification. In addition, district supervisors work regularly with the in-charge of health centers and data managers and other health care providers through supervision, mainly for performance-based financing, and ensure that they receive necessary training to update them on new reporting requirements, and new data collection and reporting tools.

Sampling

The Bugesera District was purposively selected as a case study, as the District is similar to and represented any other District in Rwandan context. Due to the poor quality of records in 3 of 9 health centres in the District, the data quality audit was carried out in only 6 out of 9 health centres and the district hospital for the quarter considered, April, May, and June 2011. This quarter was purposively sampled considering that all reports might have been submitted as according to deadlines at the time of data collection. The 3 health centres excluded did not have all required registers and/or missing monthly summaries.

A sample of data collected was drawn to evaluate data quality and concurrence. Based on MDGs, mother and child health indicators were chosen because of their importance to reflect the picture of health status of a country, knowing that mothers and children are the most vulnerable groups to diverse causes of morbidity and mortality [12]. Data for the following reported indicators for children under the age of 5 years were collected: (1) number of children received, (2) number of cured, (3) number of deaths, (4) number of referred, and (5) number of feedback received. Maternal reported indicators were: (1) total deliveries, (2) pregnant women seen by CHWs, (3) pregnant women referred, (4) feedback received, and (5) maternal deaths. At the district hospital, data for the following reported less than 5 years indicators were collected: (1) number of malaria cases, (2) diarrhoea cases, and (3) number of deaths. Maternal indicators collected were: (1) Normal deliveries, (2) complicated deliveries, and (3) admitted for other causes.

To evaluate the knowledge and attitudes of health data managers and users at health centres and district hospital, all people involved in DQM and district health information system users who were available at the time of data collection (n=151) were surveyed using self-report questionnaires. These include all nurses, in charge of health centres, units' managers, data managers, supervisors, and medical doctors.

Ethical issues

Ethical approval for this study was obtained from the University of KwaZulu-Natal Biomedical Research Ethics Committee, the Rwanda National Ethics Committee, and the Rwanda Ministry

of Health. The study was partly funded by the University of KwaZulu-Natal, and the Supervisor and the researcher himself.

Data collection procedures

The study team visited all health centres and collected data according to the schedule that was agreed upon between July and September 2012. Data collection followed the standard operating procedures that were pre-established beforehand. Data was collected from patients' registers, data collection sheets, and monthly summaries for data audit, and their comparison was done with data contained in DHIM database. Data was collected and summarised in the same manner in which it is done at the end of each month.

Statistical analysis

Data completeness was assessed by comparing downloaded reported data contained in the database into a separate database with those collected from clinical registers and monthly summary sheets which were entered into independent database. All the data were entered in SPSS version 16, cleaned, and presented in tables and graphs. Data concordance between registers, clinic monthly summaries, and data contained in the DHIS database was evaluated using Pearson's correlation coefficient (r). Data of health information managers and users were

analysed using simple descriptive statistics, and Pearson Chi-Square test (χ^2) and multivariate analysis, with an α of .05 at 95% CI was used to evaluate the relationship between variables.

Results

Table 1 illustrates the characteristics of the nine health centers. The average of nurses per health center was 14, every health center has 1 data manager, the average of patient received during the evaluated quarter was 1,456, the number of supervision done in the quarter was 1, and all health centers were given basic equipment for data management namely registers, forms, and computers.

Table 1: Characteristics of health centers to be evaluated in data quality audit in the Bugesera District, Rwanda, April-June 2011.

Health Centers	Number of nurses	Number of data managers	Total number of patients received in the quarter	Availability of basic equipment for data management	Number of Supervisions in the quarter by district level
<i><u>INCLUDED:</u></i>					
Health center 1	10	1	1117	Yes	1
Health center 2	15	1	1568	Yes	1
Health center 3	13	1	2068	Yes	1
Health center 4	13	1	494	Yes	1
Health center 5	21	1	2101	Yes	1
Health center 6	12	1	2135	Yes	1
<i><u>EXCLUDED:</u></i>					
Health center 1	10	1	482	Yes	1
Health center 2	15	1	1042	Yes	1
Health center 3	14	1	2098	Yes	1
	<i>Average:14</i>	<i>Average: 1</i>	<i>Average: 1456</i>		<i>Average: 1</i>

It was noted that few of the health centres, 3 out of 9 (33.3%) had very poor record- keeping as they did not have either all previously used registers and/or data collection sheets, or monthly summaries; therefore they were excluded from data quality audit. These three health centres had no obvious reasons for the poor data (the first had 10 nurses and 482 patients, the second had 15 nurses and 1042 patients, the third had 14 nurses and 2098 patients, and all of them had basic equipment for data management and 1 quarterly supervision was done). The overall completeness of data from maternity and paediatrics units of the District Hospital was 95.9% and 93.9% of the time respectively.

Data completeness

As it shows in Table 2, the overall completeness in the health centres of children under the age of 5 years data and pregnant women reported data were 68.2% and 69.5% of the time respectively. The best reported indicator was “total deaths reported” reported 83.3% of the time, followed by “total children received” reported 75.8% of the time, “total children cured” reported 72% of the time, “total referred” 59.8%, and “feedback received” reported 50% of the time and the most poorly reported indicator. The best reported data for maternal indicators was “total deaths” reported 100% of the time, followed by “pregnant women referred reported 68.9%, “total deliveries” reported 66.5% of the time. “Pregnant women seen by CHWs” was reported 56.5% and “feedback received” reported 55.5% of the time and the most poorly reported indicator.

Table 2: Percentage of clinical data completeness of children under the age of 5 years data and pregnant women data in Rwanda, Apr-Jun 2011

	Children under 5 year clinical data from health center 68.2% (n=8496)					Pregnant women data from health center 69.5% (n=537)				
	Total children received	Total children cured	Total referred	Feedback received	Deaths reported	Total deliveries	Women seen by the CHWs	Pregnant women referred	Feedback received	Maternal deaths
April 2011	72% (n=3150)	76.3% (n=525)	61.7% (n=34)	50% (n=2)	100% (n=1)	69.2% (n=91)	52.9%	69.2% (n=91)	50% (n=18)	100% (n=0)
May 2011	77.9% (n=2722)	76.5% (n=547)	58.3% (n=24)	50% (n=2)	50% (2)	69.5% (n=98)	52.3% (n=)	73.5% (n=98)	66.6% (n=13)	100% (n=0)
June 2011	77.6% (n=2624)	63% (n=452)	59.3% (n=32)	50% (n=2)	100% (n=1)	60.9% (n=105)	64.2%	64% (n=105)	50% (n=13)	100% (n=2)
Quarterly average	75.8%	72 %	59.8%	50%	83.3%	66.5%	56.5%	68.9%	55.5%	100%

Data concordance

Figure 1 shows that there was a poor relationship between data collected for data quality audit and monthly summaries sent to the district ($r=0.60$ ($p<.001$ at 99% CI), and there was a very strong correlation ($r=1$, $p<.0001$ at 99% CI) between monthly data summaries and data contained in the DHIM database (Figure 2). A strong concordance between maternity data collected during data audit and monthly summaries at district hospital was observed ($r=1$, $p<.0001$ at 99% CI), similarly to less than 5 years data collected from registers and those contained in DHIS database ($r=1$, $p<.0001$ at 99% CI).

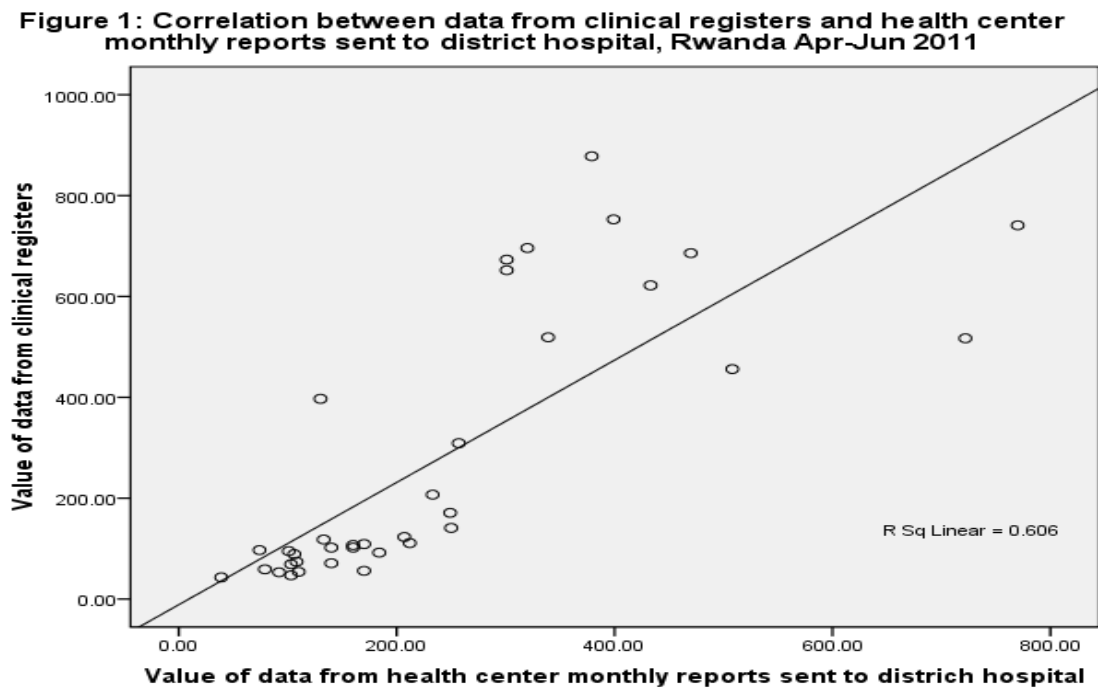
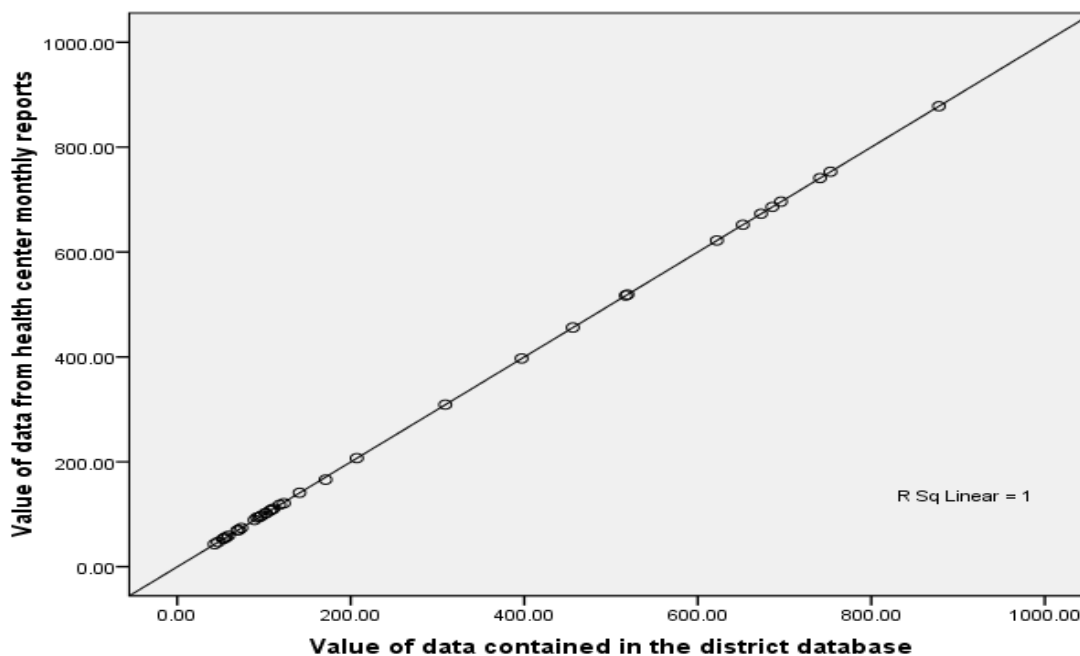


Figure 2: Correlation between data from health center monthly reports and data contained in the district database, Rwanda Apr-Jun 2011



District health information system evaluation

The sample consisted of 151 respondents. The education of the respondents was nurses and data managers with an A2 (secondary certificate) (68.9%), nurses with an A1 (advanced diploma) were 19.2%, nurses with an A0 (honors degree), public health, and medical doctors with a B-degree 7.9%, and Sociology and Environmental health officers with a B-degree were 4%.

A slight majority of them (56%) reported that all health care providers are involved in data collection and reporting processes, while 26.5% reported units' managers, and 17.2% reported data managers only enter data. The mean of days needed to complete these processes was 5.9 (≈ 6) with a SD of 7.865.

Institutional support through training, formative supervision, monitoring and evaluation, and review meetings at health centres and district hospitals was explored. The minority of respondents (38.4 %) have been trained for data management. The majority, 82.8% expressed the need of training in DQM as whole, and 17.2% suggested the training be specifically about data management tool utilization.

All health centers in-charge and unit managers, 100% (n=92) reported that they have sent all required reports to the next levels, and a slight majority, 52.2% have received feedback. Again a slight majority, 52.5% confirmed that the feedback was useful, and 47.5% said that it was not helpful. The majority, 69.5% (n=151) have never been supervised for data quality audit against 30.5% who have been supervised. The minority, 34.4% reported that the supervision for data quality audit was adequate. The majority (70%) suggested that the supervision be done monthly, 30% suggested it to be done quarterly.

The relationship between a range of variables was calculated (Table 2). Feedback is the most powerful variable, significantly influencing understanding of the DQM process, use of the data and perceptions about usefulness. Supervision is the second most influential variable, influencing understanding and perceptions of difficulty. Training influences only variable (understanding of the process) and level of education none.

A multivariate analysis was performed which indicated a significant relationship between the training on health data quality management and the dependent variable, namely the understanding of the steps needed to complete data quality management processes ($p < .001$). However, there was no significant relationship between the training and the perception of whether data quality management processes are easier or difficult ($p = .648$), and the use of data

and health information ($p = .114$). There was also a significant relationship between the supervision for data quality audit and dependent variables ($p < .001$), namely the understanding of the steps needed to complete data quality management processes ($p = .045$) and the perception of whether data quality management processes are easier or difficult ($p < .001$). However, there was no significant relationship between the training and health information use ($p = .250$). There was also a significant relationship between the feedback initiatives and dependent variables ($p = .010$), namely the understanding of the steps needed to complete data quality management processes ($p = .039$), the perception of whether data quality management processes are easier or difficult ($p = .012$) and health data and information use ($p = .015$).

Table 2: Relationship between self-reported variables among data and health information users in the Bugesera District, Rwanda, Apr-Jun 2011

	Participation in DQM processes		Understanding of DQM processes		Use of data and health information		Perception DQM processes as easy or difficulty		Perception of data as useful for planning and decision-making	
	Pearson's Chi-square (χ^2) value	p -value at 95% CI	Pearson's Chi-square (χ^2) value	p -value at 95% CI	Pearson's Chi-square (χ^2) value	p -value at 95% CI	Pearson's Chi-square (χ^2) value	p -value at 95% CI	Pearson's Chi-square (χ^2) value	p -value at 95% CI
Level of Education	5.1	.531	.9	.821	4.7	.188	.4	.932	2.3	.494
Training in DQM	.3	.842	5.3	.021*	.4	.513	.9	.333	.1	.739
Supervision	3.8	.145	6.7	.009*	2.2	.137	7.5	.006*	.06	.806
Feedback initiatives	11.4	.003*	.04	.834	6.5	.010*	.3	.532	5.8	.012*

* Relationship significant with a $p < .05$ at 95% CI

The completeness and concordance scores were correlated with scores of other variables, and there was no relationship among them (Table 3). Also, the views/perceptions of health data management and information use among health workers at health centres and district levels were identified. The majority, 55% perceived data management as difficult, and 45% as easy. Reported reasons of their difficulty were overloading work (35.8%), lack of computers and internet connection (26.5%), short time to prepare the report (24.5%), and lack of skills (6%). The majority of respondents, 53.6% (n=151) had the wrong description of data collection and reporting processes, and 46.4% had correct description. However, a Chi-square test that was performed showed no relationship between the level of education and the perception of data collection and reporting processes whether easy or difficult ($p=0.932$) [95% CI]. Also there was no relationship between the level of education and understanding the steps required to complete data collection and reporting processes ($p=0.82$) [95% CI].

Table 3: Correlations between concordance and completeness scores and other variables' scores among data and health information users in the Bugesera District, Rwanda April-June 2011

	People involved in data management score		Having equipment score		Supervision score		Feedback score		Data use for planning score	
	Pearson correlation	<i>P</i> value at 95% CI	Pearson correlation	<i>P</i> value at 95% CI	Pearson correlation	<i>P</i> value at 95% CI	Pearson correlation	<i>P</i> value at 95% CI	Pearson correlation	<i>P</i> value at 95% CI
Completeness score	-.06	.8	.2	.2	.0	.7	-.2	.3	-.1	.6
Concordance score	.2	.3	.2	.3	.1	.5	.1	.6	-.1	.4

Relationship significant with a $p < .05$ at 95% CI

Health information use at health centres and district levels was explored. The majority (87.4%) reported that they used data for planning and decision-making purposes, and 12.6% do not use data for same purposes, and 41.7% reported that they have used data and health information to improve the performance, 36.4% have used it to improve the practice, and 11.9% have used it for decision-making and leadership purposes. There was no relationship between the level of education and the use of data and health information for planning and decision making ($p=0.100$) [95% CI].

Identified problems associated with DQM and health information use at health centres and district levels were namely lack of formative feedback (32.2%), lack of formative supervision (27.1%), a passing by and superficial supervision (15.3%), 15.5% reported that the supervision is only the quarterly Performance-Based Financing (PBF), and 10.2% reported irregularity. Other issues included the lack of training reported by 23.8%, then 23.2% reported multiple and incomplete registers, 17.9% lack of data management tools, 17.2% reported overloading work, 6% reported short time allocated to this activity, and 4.6% reported the lack of information culture. Only 7.3% reported that they do not encounter any problem. The majority 88.1% ($n=151$) reported that they do not have enough equipment for DQM against 11.9% who reported that they are enough. The most reported lacking equipment was daily data gathering forms (58.3%), then enough computers (39.1%), and lack of internet connection (2.6%). There was no relationship between problems experienced and the perception of whether DQM is easy or difficult ($p=0.295$) [95% CI], there was no relationship between lack of equipment for data quality and perceiving data management as whether easy or difficult ($p=0.429$) [95% CI]; also, there was no relationship between lack of equipment for DQM and the use of health information for planning and decision making ($p=0.192$) [95% CI].

Table 4: Reported problems experienced during data collection and reporting processes

What are the problems do you encounter during data collection and reporting processes?	Frequency	Percentage
Overloading work	26	17.2%
Short time allocated	9	6%
Lack of training	36	23.8%
Lack of data management tools	27	17.9%
Lack of information culture	7	4.6%
Incomplete registers	35	23.2%
No problem experienced	11	7.3%
Total	151	100%

Discussion

This data quality evaluation and health information use survey shows that there are still, 12 years after implementing the health information system at district level, remarkable gaps in the completeness of data in registers. Yet it is this data that is used as evidence-based for planning and evaluating success of health programmes, policy and decisions making, and evaluation of diseases outcomes and system performance. Previous evaluation studies of DQM and health information use had similar findings, particularly data sources in LMIC showed compromising the desired data quality such as data incompleteness, inaccuracy, unreliable and not timely delivery [13-15]. However, a good number of evaluated health facilities showed good data quality whereby all health centres have submitted monthly reports timely, and best practices in data collation and reporting at health centres and units at district hospital with the use of technology. A very strongly concordance between monthly summaries with those contained in the district database was found. Similar findings were found in a recent study in South Africa, that showed evidence of promising trends in DQM and the possibility to reach high quality

health data in LMIC [16]. Other evidence have shown that the use of technology could improve both the quality and the use of health data in LMIC and could lead to good outcomes such as: improved patients' follow up from remote areas, increased users' satisfaction, proper use of tools, adherences to DQM standards, improved and efficient management of health clinics, hospitals, and public health programs; and improved guideline adherence [17]. It was evidenced that the sources of data are the main challenging areas where the quality of data was found to be poor, whereas the quality of data increased at the levels where the data is entered in a computer. Previous studies have shown similar findings [13, 18], and this suggests a particular intervention to be done at sources of data where the quality is critical.

This survey included also health information structure evaluation. Even though the majority of health information managers and users have only a secondary education the level of education was not associated with any of the variables for DQM and health information use. However, a gap in involvement in data collection and reporting processes and understanding of these processes was noted. Also it emerged that lack of health information culture is still a matter of concern. Several respondents, particularly in maternity wards and emergencies expressed that data is recorded at the end of a busy day, or some health professional such as medical doctors do not complete registers because it takes such a long time. However, a culture of using health information exists with notable gaps. Lack of training of health information managers and users was emphasised and this should be addressed. Furthermore, training was associated with understanding of data collection and reporting processes. Similarly, previous studies have found the importance of training in improving the quality of health data and their use for managerial and health services delivery purposes, and the positive role played by involvement of all stakeholders [14, 16]. In addition, it was evidenced that the leadership needs to be strong enough

and uses project management techniques, establishing standards and training all data and health information users which constitute essential pillars for the success of health information management systems [19].

A big gap in formative supervision and data quality audit was identified, and the participants emphasised the need to undertake such formative supervision and feedback at reasonable rhythm, monthly or quarterly rather than performance-based financing evaluation. Also, the supervision for data quality audit was associated with the perception of data management and health information use. Several studies have previously reported the same findings, suggesting that formative supervision increases information culture [6]. In Rwanda, integrated formative supervision has started, and it is hoped to take health DQM and the use of available health information to a higher level. Another important finding is the feedback initiatives that were found, but with a notable gap that needs to be addressed. Also, feedback was associated with perception of health data and health information as useful for planning and decision-making for better health care service delivery. The importance of the feedback in improving DQM and health information use is well known [4]; however, most of LMIC have not yet made the feedback initiatives a culture in their health management information systems structure[20].

Additional reported factors as hindrances to DQM and health information use were multiple registers and difficulties to complete all of them, and lack of data management tools which were explained by the majority. These findings are in agreement with those of previous studies that found that one of the hindrances of health data quality is the duplication and complexity of registers, the reason why the World Health Organisation has recommended the use of simple and user friendly data collection tools, including reduced numbers of registers, selected minimum indicators, and available trained personnel particularly at a local level, the source of data [21,

22]. At the time of data collection in this survey, new and comprehensive registers were being distributed to health facilities, and it was found that health information management processes were dynamic and efforts were being made to improve health DQM in Rwanda.

The limitations of this survey were mainly the self-reported data, and that there was no similar study to allow comparison of different districts, and Rwanda's Health Information Management System has been migrated to a new web-based platform since January 2012, with several changes in the system's operations. Bugesera is one of the districts having Millennium Villages where particular efforts are made to reach the Millennium Development Goals, and this may have impacted the high quality of health data observed. In addition, the performance-based financing (PBF) model has brought a new culture of completing documents before the evaluation takes place as evidenced in this survey, which may obscure the true picture of the quality of health data on daily basis. Despite the limitations of this survey, its findings are very informative on the quality of data between monthly reports and observed data contained in the district database. Structural issues identified included a lack of completeness in reporting data, a lack of formative and regular supervision and data quality audit, a lack of feedback, a lack of training, a lack of an information culture, and too much changing of systems.

Conclusion

This survey reports observed quality of health data from health facilities and the situation of health information management structure in Rwanda. The personnel involved in health information management will need to have new information culture of DQM on daily basis, in order to generate evidence-based for daily decisions and better plans for health services delivery

and evaluation of success of health programmes. There is a need of a model for DQM and health information use that may be used in Rwandan context.

List of abbreviations

DHIS: district health information system

DQM: DQM

LMIC: LMIC

HMIS: health management information systems

HIS: health information systems

PBF: performance-based financing

Competing interests

No competing interests were identified associated with this work.

Authors' contribution

EN conceived and designed the study; coordinated data collection processes, performed the data analysis and drafted the manuscript. JC participated to the study design and contributed to the statistical analysis. LU participated to the study design, data analysis, writing draft, and approved each stage of the study. All authors read and approved the final manuscript.

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2.2.1 Paper 3: In situ community data collection evaluation

Title: Evaluation of community data quality management and health information use in the Bugesera District, Rwanda.

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Abstract

Background: There is evidence of poor data quality management and low use of health information in low and middle income countries (LMIC). The purpose of this study was to evaluate the quality of community-based health data contained in the District Health Information Database in Rwanda and to survey Community Health Workers (CHWs) as the primary data collectors and users in the Bugesera District in Rwanda.

Methods: The evaluation consisted of two studies: A retrospective descriptive audit to evaluate the quality of community-based mother and child health data contained in the SISCom (*Système*

d'Information Sanitaire) database in 4 community data collection cells; and an exploration of CHW data collection and use practices through a survey questionnaire and interviews.

Results: Data completeness for children under 5 years' data and pregnant women data were reported by CHWs across the 4 cells were 57.7% and 68.5% respectively across the 3 selected time periods. Poor concordance in data collected from registers and data sheets sent by data collection cells to health centres was observed ($r=.45, p=.002$). However, strong concordance were found between summary cell data collation sheets and monthly summaries sent by the Health Centres to the District ($r=.99, p<.0001$) and monthly summaries and data contained in the District Database ($r=.99, p<.0001$). The evaluation of CHWs identified poor knowledge in the description of data collection and reporting processes, lack of training, lack of received feedback, lack of formative supervision, and lack of data management tools.

Conclusion: The quality of community-based health data was poor particularly at the source of data with improved quality in other levels. While opportunities and best practices in data quality management exist and need to be strengthened, training, supervision, and feedback initiatives influenced data quality management and potential health information use.

Keywords: Data quality management, health information use, CHWs, evaluation.

Introduction

Reliable health information and high quality data are essential to measure the progress made by low and middle income countries striving to reach the Millennium Development Goals (MDGs), but the quality of the data informing this are still a matter of concern putting the progress reported in doubt [4]. In addition, reliable and accurate community health information is important in planning, monitoring and evaluation of the effectiveness of community health programmes[1], and serves as the evidence for policy making to improve service delivery for better health [2]. Planning and decision making depend on routine health management information systems which can to generate accurate and reliable health information [3].

Several studies that evaluated the quality of community health data in low and middle income countries reported poor management of data quality and health information use across different levels of health information flow [5, 6]. A large evaluation study of immunization data quality conducted across 41 low middle income countries showed that only nine countries (22%) showed concordant data [7]. Similar findings were observed in Africa. In Mozambique, the immunization data reported to the district level were inconsistent with immunization data reports at facility level [8]. In South Africa, several studies found similar problems. Discordances in tuberculosis data at different levels were identified with figures of 44% for treatment start dates and 41% for treatment end dates [9]. Another study evaluating PMTC (Prevention of Mother to Child Transmission Programs) data from 316 sites, revealed that data completeness was only 50.3%, with low use of health information for decisions and planning at all surveyed health facilities[1]. Kenya found that District Health Information Systems were fragmented and that this was caused by structural and technical problems such as the lack of an information culture, poor quality of data and low health information use [10].

Background

Rwanda has adopted a decentralization strategy for all sectors part of an overall strategic economic development and poverty reduction strategy [12]. For health services, this involved a devolvement of health services to the community at village level to ensure the availability and accessibility of health services to the majority of the population [12]. There are three levels of health systems in Rwanda, namely a community level, the health centre level and the district level.

Health services at the community level is delivered by Community Health Workers (CHWs) at a village level [11]. CHWs are elected by the community members from their respective villages and are required to be able to read and write. Once elected, four (4) CHWs are assigned to each village and are provided with one week of training [13]. CHWs provide essential health care at community level and are responsible for managing community cases of children under 5 years, following up pregnant women and new-borns, providing Information Education Communication (IEC) and taking care of health-related social affairs [13]. The CHWs are required to provide a monthly village report that is sent to a CHW cell coordinator who supervises around eight villages. The data CHWs report is essential to measure the efficiency and effectiveness of the health system as whole, particularly in monitoring and evaluation of community cases management for children under 5 years' and pregnant women's programmes [14, 15]. The health conditions reported on by the CHWs include children under 5 years' illnesses (malaria, pneumonia/cough, diarrhoea and malnutrition), health visits, community sensitisation sessions (IEC-Information Education Communication), maternal health, other deaths and the follow up of chronic diseases [11]. The cell coordinator sends the village monthly reports to the supervising Health Centres within eight days of the end of the month. A District Health Information System

(DHIS) was put in place in order to strengthen the lower level of health system through continuous formative supervision and data quality audit [16].

At the sector/health centre, the second level, the CHWs are grouped in a cooperative, through which the Ministry of Health remunerates them based on their performance as determined by the District performance-based financing (PBF) committees based [13]. This performance evaluation is done quarterly and measures the timeliness, accuracy and completeness of the monthly reports sent by each health centre [13]. Feedback is sent to the PBF committees based at health centre/sector levels where payment are done [13]. Each health centre has a dedicated person responsible for receiving and collating monthly village reports from all cells and providing a monthly summary report which is sent on to the district level and entered in the district health database within 15 days of the end of the month. This report is also sent back to the CHW cell coordinator and CHWs in their villages to provide feedback.

The district is the third level of health service provision. A community health supervisor is here is responsible of receiving monthly summaries from all health centres, crosschecking the data entered in the database, ensuring that support is provided as needed, conducting formative and performance-based financing (PBF) supervision and providing feedback to health centres.

Currently, Rwanda has two main parallel health information systems within the District Health Information System (DHIS) which operates independently. The first is the Health Management Information System (*SIS- Système d'Information Sanitaire*) which collects and reports data from health centres to district hospitals to the national level. The second is the Community Health Information System (*SISCom- Système d'Information Sanitaire Communautaire*) which collects and reports community health data. The national level has automatic access to entered data at district level.

In previous studies conducted in Rwanda, poor data quality management at community level was found [11]. Poor concordance was found for data indicators *total sick children*, *fever* and *pneumonia*, ranging from 59%, 58%, and 71% concordance with registers and 53%, 57%, and 79% concordance with data collection forms respectively [11]. For the composite indicator, data concordance was only 26% between reports and registers and 27% between reports and data collection forms [11]. Despite noted data inconsistencies in monthly reports of community-based health programmes in annual reports of the Ministry of Health of Rwanda and poor quality of reported community health data [11], data plays major role in following up and controlling malaria in Rwanda and Ethiopia [17].

In this context, this study aimed to evaluate the quality of community-based health data contained in the District Health Information System in terms of completeness and concordance and to survey Community Health Workers (CHWs) as the primary community data managers and users of data in the Bugesera district of Rwanda on their knowledge and perceptions of data capturing processes, utilization of data at community level. In addition, it was hypothesised that there would be an association between institutional support initiatives such as supervision and training and CHWs perceptions and knowledge of data collection processes and data usage. The data and the findings were to be made available to the District to assist in planning strategies to achieve accurate and reliable health data and maximize health information use.

Methods

Focusing on the Bugesera District in Rwanda, the research used a case study approach with two studies: Study1: *A Data Quality Audit* to evaluate the quality of the community-based health data in the SISCom (*Système d'Information Sanitaire*) database through a retrospective descriptive

audit measuring concordance and completeness for the period of April, May and June 2011; and Study 2: A CHW survey to evaluate the institutional support for CHWs at the village level for data quality management, use of health information and the problems associated with data quality management through interviews using a questionnaire with qualitative components.

Ethical approval for this study was obtained from the University of KwaZulu-Natal Biomedical Research Ethics Committee (No HSS/1099/011D), the Rwanda National Ethics Committee (No 020/RNEC/2012), and the Rwanda Ministry of Health. Due to the selection of one District as a case study, issues of anonymity was recognized and accepted as reported data per sector is accessible by all users and stakeholders of the DHIS from national to district level. Because clinical registers contain the patient names, their anonymity was assured through the collection of de-identified level data.

Setting

For this study, the Bugesera District in Rwanda was purposively selected as a case study as it was both a rural and semi-urban area and was thought to represent a ‘typical’ case study of a District Health Service in Rwanda with all three levels of health information data collection systems present. The data quality audit and the CHW survey was carried out by randomly selecting four (4) out of a possible 11 sectors in the District. There were 19 cells in these 4 sectors from which four (4) cells were randomly selected. The four cells included 33 villages and 132 CHWs.

The village level is the smallest and first level of political administration. There are four CHWs are assigned to each village with the following responsibilities: managing community cases of children under 5 years’ data, follow up pregnant women and newborn, delivering health Information Education and Communication (IEC) and take care of health-related social affairs.

These CHWs are elected by their fellow citizens. At least they have knowledge of reading and writing their mother tongue. At the end of every month, they come together to collect data from their registers for a village monthly report that will be sent to the CHW cell coordinator. A cell is the next administrative level after the village, and comprises a number of villages. At this level, there is a CHW cell coordinator who supervises around eight villages and sends those village monthly reports sheets to their supervising health centre within eight days of the end of the month. The health centre is the second level where the in charge of the community health is based. This person is responsible for receiving and collating all village monthly reports from all cells and makes one monthly summary report that will be sent to the district level and entered in the district database within 15 days of the end of the month, and send the feedback to the CHW cell coordinator and CHWs in their villages.

The district is the third level where the community health supervisor is based. This person has the responsibility for receiving monthly summaries from all health centers, cross checks data entered in the database, ensures that they receive necessary support as needed, conducts formative and performance-based financing (PBF) supervision and gives feedback to health centers. The national level has automatic access to entered data at a district level.

Data Quality Audit

Design: A retrospective descriptive design was used to audit the quality of community health data contained in the SISCom database for concordance and completeness of data from registers, village monthly report sheets and monthly summaries sheets at health centre levels.

Sampling: Reported data for from the 4 cells were purposively sampled for one quarter of April, May, and June 2011 to ensure that all reports were submitted prior to data collection and all cases for the reported periods were reviewed, a total number of 917 cases. Though CHWs

collected data and reported every month on 30 health indicators (7 on the treatment of children under 5 years, 4 on nutrition, 4 on visits for IEC-Information Education Communication, 8 on maternal health, 2 on deaths in the community and 5 on the follow up of chronic diseases), 13 indicators were purposively sampled based on their importance for MDGs, namely eight (8) children under 5 years' indicators and five (5) maternal health indicators. These were: Indicators for children under 5 years: (1) total number of children received, (2) number of children treated and cured, (3) number of children under 5 years' deaths, (4) number of children referred, (5) number of feedbacks received by the CHW, (6) number children treated for malaria, (7) number of children treated for diarrhoea, and (8) number of children treated for pneumonia; and Maternal health indicators: (1) total deliveries, (2) deliveries at home, (3) women accompanied by CHWs, (4) feedback received by the CHW, and (5) maternal deaths.

Data collection: The research team received training on the purpose of the study, the data collection tools and standard data collecting procedures. The team visited all health centres to collect data from village monthly report sheets sent by the villages and stored at health centre and data from monthly summary sheets collated at health centres. The team also visited CHWs of each selected cell to collect data from CHWs clinical registers, village monthly report sheets and monthly summaries at sector level for the period between July and September 2012.

Data analysis: The accuracy of the process by which data is collected, summarised, sent to the next level, and entered in the district data base was evaluated by comparison of data of the same month and same village with data contained in the data base to establish their degree of agreement. A comparison of data collected was therefore done at three levels. Firstly, data from CHWs clinical registers was compared with data contained in village monthly report sheets at village level. Secondly, data from village monthly report sheets were compared with monthly

summaries at sector level. Thirdly, data from monthly summaries at health centre/sector level were compared with data contained in the district database. Data was collected and summarised in the same manner in which it is done at the end of each month. Two data quality indicators were used, namely data completeness and concordance and descriptive statistics were used to describe these. Data was entered into SPSS and the % of completeness was calculated based on whether the value of a reported indicator was present or not in the registers of a specific village and the SISCom database over the selected time periods. To measure concordance, Pearson's correlation coefficient (r) were calculated between data (i.e. cases reported against indicators) collected from registers completed by CHWs, sent to health centre by the cell's coordinator, summarized from data collation sheets sent by cell's coordinator and the monthly summaries collated and sent to district level by the health centre supervisor, and the monthly summaries data sent from health centre and those contained in the district database.

CHWs survey

Design: A quantitative survey of CHWs was conducted using a questionnaire with both quantitative and qualitative data which was used to interview CHWs.

Sample: All CHWs from the four (4) cells randomly selected were included in the sample (n=132 CHW from 33 villages).

Data Collection: Each interview was agreed upon between the researcher and the CHW coordinator of each cell, and the researcher met CHWs in their respective cells. Interviews were conducted by the researcher himself assisted by a note taker. Those notes and recorded data were later transcribed and analysed for themes. The questionnaire included questions on the number of CHWs involved in data collection and reporting processes, the time dedicated to data collection,

data collection processes, knowledge of data collection and reporting, perceptions of data collection processes, perceptions of usefulness, use of data in decision-making and planning, and data quality supervision and support provided to CHWs.

Data analysis: Data was captured, entered and analysed using the Statistical Package for the Social Sciences (SPSS) version 16. Descriptive statistics were used to describe CHWs knowledge, perceptions and challenges related to data collection and reporting processes. To analyse the relationship between CHWs training and supervision history with their knowledge and perceptions of data collection processes, a Pearson Chi-Square test (χ^2) and multivariate analysis, with significance set at $p < .05$ were used to evaluate the relationship between variables.

Results

Sample Description

Four cells with 33 villages and a total of 132 CHWs (average 33) were included in the sample (Table 1). There was a high level of consistency across the four cells with each cell including at least 8 villages, one cell coordinator, an 32-36 CHWs and all cells reported having basic data management tools namely registers and reporting forms. The cells differed on the level of supervision received from the health centre during the study period, with only one cell out of four being supervised during the quarter consider in the survey. The cells included a total of 917 children under 5 years' cases and 340 maternal cases for review.

Table 1: Characteristics of the cells evaluated for data quality audit in the Bugesera District, Rwanda, April-June 2011.

Cells surveyed	Number of villages	Number of CHWs	Number of cell coordinators	Total number of children under 5 year cases reviewed	Total number of pregnant women cases reviewed	Availability of equipment for data management	Number of supervision visits in the quarter
Cell 1	8	32	1	145	83	Yes	1
Cell 2	8	32	1	140	92	Yes	0
Cell 3	9	36	1	361	79	Yes	0
Cell 4	8	32	1	271	86	Yes	0
TOTAL	33	132	4	917	340		1

Data Quality Audit

Data quality was measured using two metrics, data completeness and data concordance.

Data completeness: Overall data completeness for children under 5 years and pregnant women reported by CHWs was 57.7% (n=917) and 66.5% (n=340) respectively. As can be seen from Table 2, the best reported indicator for children under 5 years was “the number of children treated for pneumonia” reported 66.9%, followed by “total children cured” reported 64.2% , “children treated for fever” reported 62.8%, “total deaths” reported 61%, “referred cases” reported 57.6%, and “children treated for diarrhoea” reported 56.6%. The most poorly reported indicator was “feedback received” reported 35.7% (Table 2). The best reported indicator for pregnant women was “maternal mortality” reported 83.5%, followed by “deliveries at home” reported 62.5%. The most poorly reported indicator was “women accompanied by CHWs” reported 60.2% (Table 2).

Table 2: Percentage of completeness of children under 5 years and pregnant women reported data by CHWs, Rwanda, April-June 2011

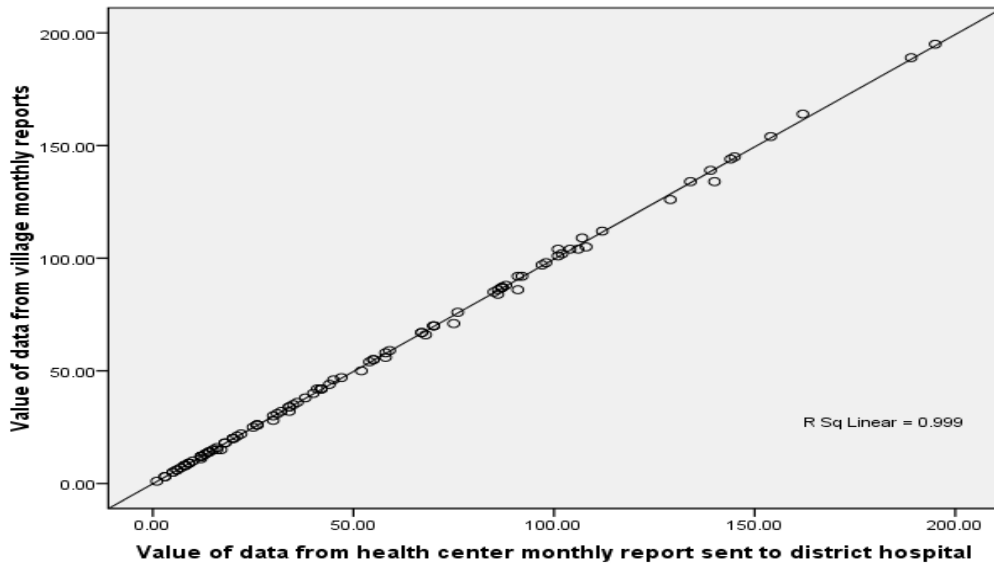
	Community children under 5 years data (n=917)							Community pregnant women data (n=340)		
	Total children treated and cured	Deaths	Referred Cases	Feedback	Treated for Fever	Treated for diarrhoea	Treated for pneumonia	Women accompanied by CHWs	Deliveries at home	Maternal deaths
April 2011	74% (n=150)	50% (8)	56.3% (n=64)	57.1% (n=14)	53.3% (n=60)	41.7% (n=24)	71.4% (n=35)	62.6% (n=91)	55.6% (n=18)	100% (n=0)
May 2011	55.1% (n=98)	33.3% (n=6)	50% (n=26)	50% (n=2)	68.4% (38)	53.5% (n=43)	62.5% (n=24)	70.4% (n=98)	69.2% (n=13)	100% (n=0)
June 2011	63.7% (n=143)	100% (n=1)	66.6% (n=12)	0% (n=1)	66.7% (n=75)	72% (n=39)	66.7% (n=54)	47.6% (n=105)	61.5% (n=13)	50% (n=2)
Quarterly average	64.2% (n=391)	61 % (n=15)	57.6% (n=102)	35.7% (n=17)	62.8% ((n=173)	56.6% (n=106)	66.9	60.2% (n=294)	62.5% (n=44)	83.5% (n=2)

Data concordance: For data concordance, 917 patient cases were reviewed. A poor correlation between children under 5 years' community health data from CHWs registers and those contained in the monthly village report ($r=.45, p=.002$) was observed (Figure 1). However, there was a strong correlation between data summarized from monthly village report sent by cell's coordinator and the monthly data summaries sent by the health centre supervisor to district level ($r=.99, p<.0001$) (Figure 2), similarly to monthly data summaries sent from health centre and those contained in the district database ($r=.99, p<.0001$) (Figure 2)

Figure 1: Correlation between data from CHWs registers and village monthly report sheets sent to health center, Rwanda Apr-Jun 2011



Figure 2: Correlation between data from village monthly report and health center monthly reports sent to district hospital, Rwanda Apr-June 2011



CHWs survey

A total of 130 (98.5%) of CHWs were available for the survey with only 2 CHWs not present at the time of the visit. Information was collected on data collection processes, data use and institutional support.

Data collection processes: Just over half of the CHWs (72, 55.4%) reported that only two CHWs in charge of children under 5 years were involved in data collection and reporting processes and 58 (44.6%) reported that all CHWs, including social affairs workers were involved in these processes. The mean number of days needed to complete data collection was 3.9 (± 4) days, and this was viewed as a short time to collect and collate all the data. Just over half of the CHWs (67, 51.5%) when asked, provided incorrect descriptions of the data collection and reporting processes. The majority of the CHWs (122, 93.8%) reported that these data collection processes were difficult to them. Reported reasons of their difficulty were the lack of data collection tools (39, 30%), lack of transport and other amenities (35, 26.9%), time consuming (30, 23.1%), and lack of knowledge (26, 20%).

Use of data: The majority of CHWs (112, 86%) confirmed that they use available health data for planning and decision-making purposes, and 18 (13.8%) did not use it. Reported areas where they used health information were planning family visits (79, 60.8%) and self-evaluation (51, 39.2%). In addition, 102 (78.5%) confirmed that they find reported data useful for decision-making and planning, and 28 (21.5%) did not find it useful. Just over two thirds (88, 67.7%) found it useful in getting informed on people's health status in their respective villages, and 42 (32.3%) reported that they use the data as a basis to teach the people in their villages.

Institutional Support: All CHWs (130, 100%) reported that they had sent their monthly report to the next level, but only 19 (14.6%) reported that they had received individual feedback from the supervisors, with the majority (111, 85.4%) reporting that they have received it through their cooperative meeting. Seventy two CHWs (55.4%) found the feedback helpful, and 58 (44.6%) found it not helpful. The majority of CHWs (93, 71.5%) have not been supervised for data quality management, and 37 (28.5%) have been supervised. Many of them (115, 88.5%) suggested that the supervision should be done monthly, and 15 (11.5%) suggested that this be done quarterly. The majority of CHWs, 123 (94.6%) have not been trained with regard to QDM. They suggested that they may be trained in data collection and reporting (117, 90%), and data management as whole (13, 10%). Just under two thirds of CHWs, (79, 60.8%) reported that they have enough tools for data quality management. Reported lacking tools were forms (99, 76.2%), and phones which were not working properly (31, 23.8%).

In examining the relationship between being trained in data quality management and the perceptions whether the data collection processes are easy or difficult, there were significant associations between the two variables ($\chi^2 = 6.4, p = .011$). There were significant associations between supervision and perceiving health data as useful for planning and decision-making ($\chi^2 = 5.5, p = .019$), and there was a relationship between feedback initiatives and using health information for planning and decision making ($\chi^2 = 5.8, p = .015$) (Table 3).

A multivariate analysis was performed and there was no significant relationship between the training and dependent variables ($p = .160$). The understanding of the steps needed to complete data quality management processes ($p = .763$), health data and information use for planning ($p = .973$) and health data use for daily decision-making ($p = .634$). However, there was a significant relationship between the training and the perception of whether data quality management

processes are easier or difficult ($p = .011$). There was no relationship between the supervision for data quality audit and dependent variables ($p = .183$); the understanding of the steps needed to complete data quality management processes ($p = .680$), the perception of whether data quality management processes are easier or difficult ($p = .824$) and health data and information use ($p = .945$). However, there was significant relationship between the supervision and health data use for daily decision-making ($p = .019$).

Table 3: Relationship between self-reported variables among CHWs involved in data quality management and health information use in the Bugesera District, Rwanda, April-June 2011

	People involved in DQM processes		Understanding of DQM processes		Use of data and health information		Perception of DQM processes as easy or difficulty		Perception of data as useful for planning and decision-making	
	(χ^2) value	p -value	(χ^2) value	p -value	(χ^2) value	p -value	(χ^2) value	p -value	(χ^2) value	p -value
Training in DQM	0.9	.760	0.09	.760	0.001	.972	6.4	.011*	0.2	.631
Supervision	0.3	.556	0.1	.678	0.005	.945	0.05	.823	5.5	.019*
Feedback initiatives	0.5	.447	1.2	.273	5.8	.015*	0.7	.395	3.4	.073

*Pearson's Chi-square Tests was used with Fisher Exact Tests where appropriate. Significance was set at $p < .05$. * 95 CI

Discussion

This study evaluated the quality of community health data and surveyed CHWs as the primary data managers and users. The findings revealed defects in data completeness of children under 5 years and pregnant women. In addition, poor data quality concordance was observed particularly data collected from registers and data summaries sent to health centre cells. These findings are in agreement with those found in a similar study conducted in Rwanda on the quality of data from

communities [11]. Other studies have identified similar issues, particularly poor quality and lack of inclusion of community health data in the national health information system, which leads to parallel health information systems [18].

A positive finding was that the data quality concordance observed between data summarized from data collation sheets sent by cell's coordinator during data audit and the monthly summaries sent by the health centre supervisor to district level was of high quality. Similarly monthly summaries sent from health centres to district level and those contained in the district database were found with high quality levels of concordance. Similarly to the recent study conducted in Rwanda, this finding shows that opportunities to strengthen community health data quality management exist, health centres playing major in this function [11].

An important finding from this study was that some CHWs were not involved in data collection and reporting processes, whereas they participated in community case management. In addition, the majority of them had poor knowledge of data collection with incorrect descriptions of these processes, and the majority highly perceived these processes to be very difficult. Similarly, it was found that lack of data collection tools, lack of transport and other amenities, time consuming, and lack of training and knowledge constitute hindering factors of community health data. The CHWs emphasized the need to be trained on data collection and reporting. Previous studies have similarly reported the need of institutional support as prerequisite of success of community health-based programmes including data management [11, 19].

This study found a similar finding as the National Community Health Desk [20] that all CHWs sent required monthly reports to the next level despite their incompleteness. However, very few of them have received individual feedback from the supervisors, and formative supervision and

data quality audit were rarely done. This has notable implications on the performance-based financing approach (PBF), especially by the fact that the evaluation done by PBF committee at district level considers only the reports as they were sent from health centre/sector level[13]. The only ways to verify the quality of data in the CHWs registers at community level are namely individual feedback initiatives from the health centre supervisors, formative supervision and data quality audit, which were found to be rare. Studies have found that training in data quality management processes, supervision, and feedback initiatives influenced the quality of community health data and health information use. Previous studies have confirmed that formative supervision and feedback initiatives constitute best practices that improve data quality management and health information use particularly at community and district levels, which are the main sources of health data [3, 6]. Unfortunately, several studies reported poor training of health information users whereby the high level leaders need “quick positive results” not based on durable foundation [21]. Formative supervision and feedback initiatives were also reported to be rare in several low and middle income countries whereas they constitute the foundation of better health data and their use [22].

A valuable opportunity to improve data literacy was identified by the majority of CHWs, who perceived health data they collect as very useful in getting informed on health status in their respective villages and their performance, and planning and decision-making purposes. These findings are in agreement with those found in a previous study conducted in Rwanda [11] where community health data have been used in planning and monitoring and evaluation of community case management program, despite their poor quality that was observed. In Ethiopia, it was evidenced that the use of community health data played a major role in improving child health services, especially in the planning, monitoring and evaluation exercises of community

integrated management of childhood illness (CIMCI) program, despite challenges identified for using available health information as evidence based decisions [23].

Limitations of the study

Limitations of this study were that only one district was chosen and the selection of more districts could have allowed better comparison of diverse contexts for better understanding of the processes.

Conclusion

In conclusion, this paper reports the quality of community health data contained in district database and findings of CHWs as primary information users. Poor data quality was identified at the community, but maintained consistency of data throughout further levels of information cycle. Structural problems were identified and found to be major hindrance of the quality of community health data, particularly training, acquisition of necessary data management tools, formative supervision, data quality audit, and feedback initiatives. A model for health data quality management and health information use for Rwanda addressing the above-mentioned problems is needed in order to reach the high quality of health data at different levels of health information cycle, particularly at community and district levels.

Competing interests

No competing interests were identified associated with this work.

Authors' contribution

EN conceived and designed the study; coordinated data collection processes, performed the data analysis and drafted the manuscript. LU participated to the study design, data analysis, writing draft, and approved each stage of the study. JC participated to the study design and contributed to the statistical analysis. All authors read and approved the final manuscript.

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2.3 Additional findings

In this study, the researcher collected quantitative and qualitative data. Only the quantitative findings were presented in this thesis in published papers. Findings from qualitative data were not included in those papers, but they were considered during the model development. Key themes that emerged are provided in Table 3 and the detailed transcripts and analysis are provided in appendix M.

2.3.1 Introduction

In order to complete and validate the quantitative survey data, focus group interviews were conducted at the same three levels, namely community, health center, and district hospital levels. Following the multistage simple random sampling technique of sectors, cells, and villages to select the participants for the quantitative survey, the same participants were included in a focus group and in-depth interviews. Seven questions were asked to all participants, and their responses are transcribed in tables below. Each question was asked until data saturation was reached.

2.3.2 Methodology

2.3.2.1 In depth interviews for CHWs

In depth interviews were conducted for 20 CHWs from 4 cells randomly which were selected, each with 5 CHWs. CHWs were selected and interviewed on the days when they were compiling

data to prepare monthly report. The researcher participated in the data compilation by CHWs, and by doing so, observation was done and at the same time conducting in-depth interviews.

2.3.2.2 Interviews at Health Centers

Two health centres were randomly selected in order to select the participants in the focus group interviews. Each group had 10 respondents making up a total of 20 participants made of Units/services managers, nurses, laboratory, social workers, and community health workers supervisors, all selected using convenience sampling technique. Each of the 14 senior nurse managers of all health centers were interviewed individually. The findings of units/services managers and the 14 senior nurse managers are presented and analyzed all together.

2.3.2.3 Focus group interviews at District Hospital

At district level, 12 respondents including the senior and the Deputy Chief of Nursing, Units/services managers, Health Centers' supervisors, and medical doctors were selected using convenience sampling technique. All respondents of the categories above-mentioned were included in the focus group interview as they happened to be available on the day of the interview.

2.3.3 Findings

The findings of in-depth interviews are presented in the transcription summary tables below according to the levels of health care where the participants are based, namely community level, health centers, and district level.

Table 2.1: Themes emerged from interviews and focus groups

	CHWs	Health Center Staff	District Hospital
Quality of data	<ul style="list-style-type: none"> ○ Quality of health data important ○ Some characteristics of data quality are important ○ Difficult to them to fulfill their duty and care for the quality of data because they felt very limited in knowledge. ○ A positive understanding of the quality of health data and the use for further planning 	<ul style="list-style-type: none"> ○ It emerged that all health care providers interviewed find the quality of health data important ○ The participants showed much doubt in reaching desired quality of data, and this was the center of their explanation. ○ Data quality management is considered as basis for planning better health services delivery ○ Keeping the records was considered as extra work not integrated in what the health professional is expected to do equally as other tasks ○ Lack of information culture ○ Some reported good practices: daily compilation of managed cases and therefore easy to have cumulative data summary 	<ul style="list-style-type: none"> ○ The participant found the quality of data important ○ They had positive and correct understanding of the worth of the quality of data and health information ○ Data is used for planning interventions ○ The participants perceived data quality as hindered by different issues ○ Lack of information culture and feedback were several times underlined among other hindrances of the quality of data
Use of data	<ul style="list-style-type: none"> ○ Collect and report to evaluate their performance in their cooperative, and diseases outcomes; ○ Pan community-based interventions, such as households visiting, and IEC sessions during community work. ○ Some CHWs explained that they do not use data 	<ul style="list-style-type: none"> ○ Data and health information collected is sometimes used for planning and evaluation of the performance ○ The feedback from district hospital does not always reach specific Units ○ There is lack of information culture ○ All health care professionals are not 	<ul style="list-style-type: none"> ○ The participants agreed that they use data for planning interventions ○ It emerged that the team was very comfort with the use available data ○ Emphasis was on the time constraint with data quality management

	except for PBF purposes	involved in the planning processes and they feel not very concerned	
Assistance in work	<ul style="list-style-type: none"> ○ Helps them in planning interventions such as alert to health center, field visits, and IEC in the community, and evaluation of their cooperative performance. ○ It emerged that some CHWs do not use data in their daily work, but data is just used for reporting and cooperative PBF purposes 	<ul style="list-style-type: none"> ○ The Senior Nurse Managers (Titulaires) reported that they use data and health information for planning purposes, and decision-making ○ Some health providers and Units/services managers are involved in planning process and use available data and health information ○ Health professional/providers explained that data and health information is not really used in their daily practices ○ There is lack of information culture 	<ul style="list-style-type: none"> ○ Data was used mainly in evaluation of the performance of health centers and district hospital
Problems	<ul style="list-style-type: none"> ○ Lack of training in data management ○ Lack of feedback to CHWs ○ Lack of standardized data collection tools ○ Short time to do unplanned report ○ Long time required to complete monthly data collection and reporting process without financial support ○ Lack of means such as transport facilities, shoes and umbrella when doing village tours ○ Lack of motivation ○ Overloading work because of overlapping responsibilities ○ Unfair cooperative management 	<ul style="list-style-type: none"> ○ Overloading work ○ Lack of standardization and stability of data management tools ○ Lack of training ○ Short time for collection and reporting processes ○ Pressure from above ○ Incomplete registers and patients' files ○ Lack of information culture 	<ul style="list-style-type: none"> ○ Overloading work ○ Lack of standardization and stability of data management tools ○ Lack of training ○ Short time for collection and reporting processes ○ Incomplete registers and patients' files ○ Missing data ○ Lack of information culture

<p>Suggestions to improve data management</p>	<ul style="list-style-type: none"> ○ Harmonize and standardize data collection tool and expected report ○ Need individual feedback ○ Motivation/cost of the day spent at Health Center ○ Need equipment such as working cell phones 	<ul style="list-style-type: none"> ○ Training for health care professionals is needed ○ Suggestion to use daily data compilation model ○ Then a computerized data management system to be decentralized up to Units with the Health Center ○ Standardize data collection and reporting tools ○ Data quality audit (DQA) to be the routine and formative in nature ○ Feedback need to be given to all health professionals 	<ul style="list-style-type: none"> ○ Training for health care professionals is needed ○ Suggestion to use daily data compilation model ○ Standardize data collection and reporting tools ○ Data quality audit (DQA) to be the routine and formative in nature ○ Feedback to be given systematically
<p>Strategies to improve user-friendliness and use of data</p>	<ul style="list-style-type: none"> ○ Training all CHWs in data management ○ Data management tools harmonization ○ Individual feedback ○ Motivation Regular supervision reaching every individual CNW 	<ul style="list-style-type: none"> ○ Enough time for data collection and reporting processes is needed ○ Daily data compilation and cumulative data gathering ○ Training of CHWs and Health workers ○ Standardize data management tools, including computerization up to Units in HC ○ Stable system and continuous data quality audit (DQA) 	<ul style="list-style-type: none"> ○ Daily data compilation and cumulative data gathering ○ Training all Health professional ○ Standardize data management tools, including computerization of medical records ○ Routine data quality audit (DQA)

2.4 Conclusion

This chapter looked at the study findings. Papers already published and those under review were mentioned, and the status of their review was explained. In addition, the themes from the qualitative data analysis were presented.

CHAPTER 3: RECOMMENDATIONS AND CONCLUSION

3.1 Introduction

This chapter describes and explains the developed intervention model for DQM and health information use at community and District levels in Rwanda, as the conclusion of the three preliminary studies conducted. Recommendations to the researchers, health care providers and other different stakeholders involved in data quality and health information use in Rwanda are given. Similar settings to Rwanda, those are LMIC are also recommended to use in this developed model to improve the data quality management and health information use. This chapter also explains the contribution of the study to the existing knowledge and ends with the final conclusion and additional data analysis section as it was requested by the examiners of this thesis.

3.2 Model development process

The overall objective of this study was to develop an intervention model that could facilitate health DQM and health information use at community and district levels in Rwanda. This model was developed based on the findings of the findings of this study. It is also based in the Health Metrics Network (HMN), which is the framework and standards for country health information systems as recommended by the WHO (2008). This model aims to improve global health by strengthening the health systems in generating data with high quality and information products for better evidence-based decision-making and public health programs evaluation.

The HMN framework is made up of six components of a health information system. These six components are classified into three categories, namely inputs, processes and outputs. The inputs

include: the required health information system resources namely the policing, personnel, financing, logistics support, information and communications technology (ICT) and coordination. The processes include the definitions of core indicators, data sources, and data management (data collection, storage, quality assurance and flow, processing, compilation and analysis). Outputs comprise of information products, and their dissemination and use. This framework provides the information needs and tools at different levels to ease data quality management and use. The current model development took into consideration all those levels in Rwandan context namely household and community level, patient and health facilities, district, and national levels.

As it was earlier described, the health system in Rwanda is made of the following levels: community, district, and national (Mitsunaga et al., 2013). At each level different stakeholders play major roles in data quality management and health information use. The main target of this study was to develop an intervention model for data quality management and use at community and district levels where more efforts are greatly needed. The model was developed by classifying all the findings from the systematic review and the evaluation studies according to the health system levels. Three classes were identified: interventions, process indicators and outcomes. It was then refined and discussed at a workshop with different stakeholders. These stakeholders included the Ministry of Health staff involved in data management and health information use, the Community Health Department staff, and one expert in Health management Information Systems and health system strengthening working as consultant in HMIS in the Ministry of Health of Rwanda. The model was presented, and then discussed in groups to identify areas that need to be improved. The results of the workshop were that the team agreed upon the developed model after the inclusion of minor changes suggested by each group.

3.3 Description of Model for health DQM and health information use at community and district levels in Rwanda

The proposed model is made of a number of interventions to be carried out, process indicators, and outcome indicators at different levels of the health system in Rwanda, in order to reach the highest health DQM and health information use. The following is the description of those levels of health care in Rwanda, and of the different role players throughout the information cycle from the community to the central level. The proposed model is presented in the diagram below (Figure 3).

The levels of health care in Rwanda are made of the community level which includes CHWs (CHWs) followed and supervised by the Health Centre level, followed and supervised by the District level which includes District hospital and District health directorate, and the last is the central level which includes the Ministry of Health (Seymour et al., 2010). CHWs play a major role in offering health services to the people in each village, under the coordination of CHW cell coordinators (Mitsunaga et al., 2013). Among the tasks assigned to CHWs, data collection, data gathering and reporting is included. They play a pivotal role in informing the rest of the health system on how health services are delivered at community level and what the disease outcomes are. Those CHWs therefore need to be trained on DQM beforehand, involved in data collection and reporting processes, and supervised monthly so that they understand the data collection and reporting processes well in order to deliver data with quality and reliability for use.

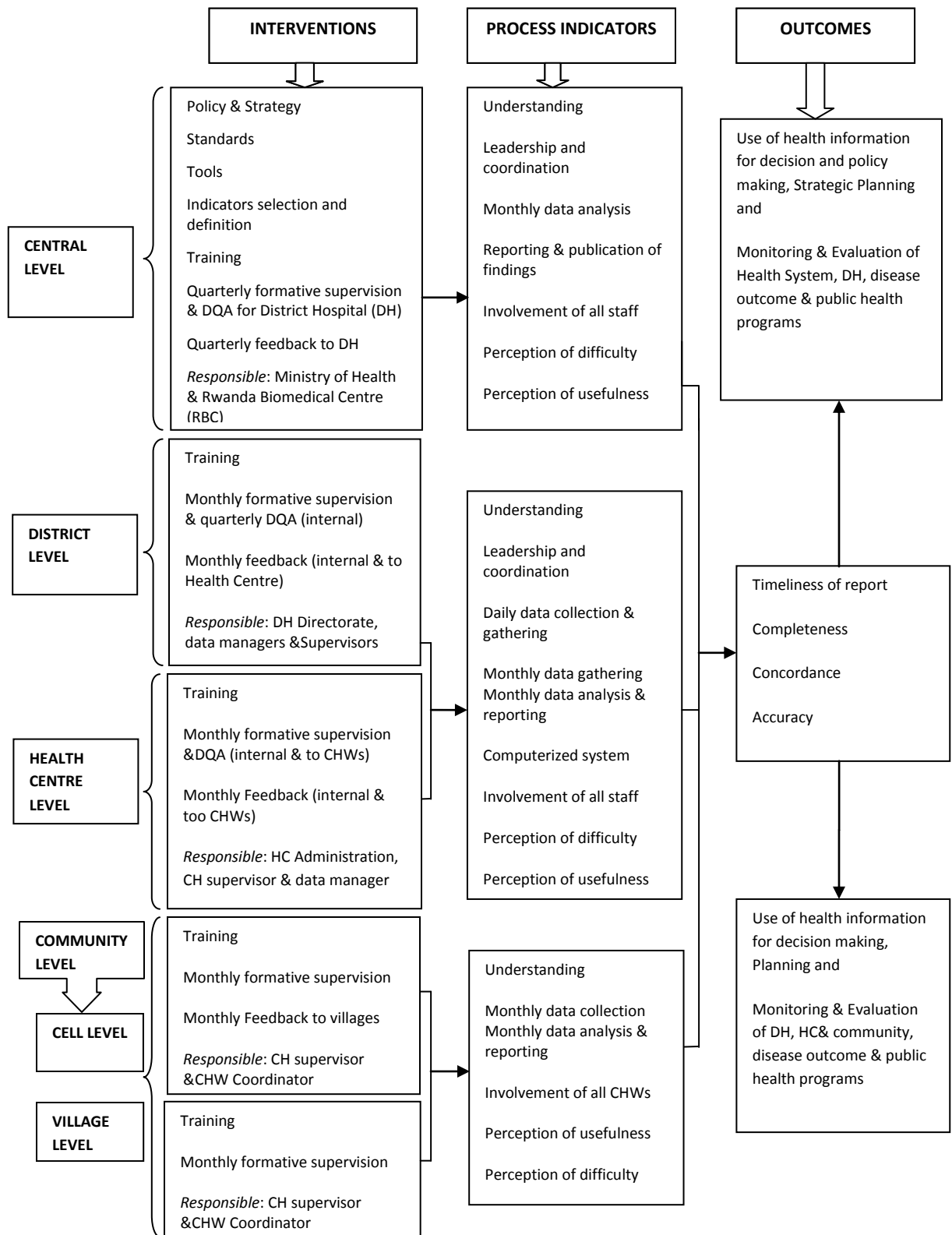


Figure 3: Proposed model for health DQM and health information use at community and district levels in Rwanda.

The feedback is an important initiative in order to help CHWs to make corrections continuously, and also to perceive data and health data management processes as easy, feasible and positive, and produce data with high quality and use them. The responsible persons at this level are the community health supervisor based at health centre and the community health worker coordinator of other CHWs based at cell level. Those persons need to involve all CHWs and provide them with assistance as required throughout the whole data management and health information use processes.

The next level of health care is the health centre where a multidisciplinary team of health care providers play an important role offering health services and DQM and use. All the staff need to be trained, given monthly formative supervision, and given feedback for potential corrections and self-evaluation. They all need to be involved in the task, having developed a correct understanding of DQM processes and health information use, which may lead them to perceive data, data management and the usefulness of data positively, and therefore they may strive for the quality of health data and the use. Data Quality Audits (DQA) should be regular and internally done by the data management team in addition to the DQA done by the District level. They also have the responsibility to train, supervise CHWs, and provide any other assistance they may need.

The health centre staffs are very important as they are the intermediate level between the community and the district, and at the same time the primary source of clinical health data based at health facilities. Responsible persons at this level include the Nurse in charge of the Health Center, the CHWs' supervisor and the data manager based at Health Center. These persons need to involve other health care providers who need to play major role in data management and use

processes. The community and health centre levels were found to have poor data quality; because they are the major sources of health data, they therefore need particular attention in order to improve the quality of health data and its use.

The district level is the person in charge of District Health Information System Management (DHISM) among other decentralized health programs. The staff in charge of health data management and all people involved in health services delivery need to be trained adequately in order for them to deliver high quality data and to maximize the use of available health information, to assist health centres to fulfill the same goal, and to liaise with the central level through computerized health information systems and narrative reports. At this level, the formative supervision is planned and implemented and feedback has to be given to all health centres. District staff needs therefore to have an information culture, a correct understanding of data management processes and health information use, and play a major role to coordinate and lead the District Health Information System (DHIS) efficiently and effectively. This may assist the system to generate timely, accurate, complete and reliable health data useable for effective planning, decision-making, and evaluation of diseases outcome and the progress of health programs being implemented within the district.

Responsible persons at this level include the leadership of District Health Directorate, namely the Director of Health, Director of District Hospital, Chief of Nursing, Monitoring and Evaluation in charge, data manager, and all supervisors. District Health Management Information System leadership needs to play a particular role in DQM and health information use, particularly in daily decision-making, planning, monitoring and evaluation of the progress of implemented health programmes and disease outcomes.

The central level in turn needs to guide and ensure overall coordination and leadership for other levels in order to have a clear policy for health information management and use, the strategies put in place in order to reach the highest level of health data quality and use, key indicators and their definitions, required tools to manage health information systems, and conducted DQA, supervision and evaluation of the health system as whole and district levels. The staff at central level therefore need to be highly trained in order to have a correct understanding of health data management and use, the leadership it requires, and the information culture so that a high level of health data and maximum use of available health information is achievable. They need to be the cornerstone of health sector policy making and strategic planning, monitoring and evaluation of health care programs and health system as whole.

3.4 Recommendations

In the light of the findings of this study, the following research and service recommendations are given:

Research recommendations

1. This study was conducted in only one District in Rwanda due to limited resources. It is recommended that other researchers may carry out similar studies in other Districts to allow for comparison.
2. It is also recommended that similar research may be carried out in similar settings in Rwanda so that we learn more about the quality of health data and what interventions are

truly helpful to move forward in achieving high quality health data and to maximize the use of health information for better health services delivery and better health.

Service recommendations:

3. District Health Information System Management in Rwanda and similar settings in LMIC need to double efforts in their management and leadership so that high quality health data and maximum use of available health information is an achievable goal.
4. The proposed intervention model for health DQM and health information use could be of helpful to improve health DQM and use at community and district levels, if it is implemented.

3.5 Contribution of the study to the existing knowledge

This study highlighted the reality of health DQM and the use of available health information in LMIC in general and in Rwanda in particular, where onsite evaluation studies were conducted. The main contribution of this study to the existing knowledge is the proposed model that may assist health care professionals, CHWs, policy makers and other stakeholders involved in health data management and the use of health information in Rwanda and similar contexts in performing effectively their tasks. Since health data with high quality is very much needed for better planning and making better decisions for better health and evaluating health programs implementation, the model would be very helpful in monitoring and evaluating the outcomes of public health programs that are implemented in Rwanda and similar settings such as LMIC in general.

3.6 Conclusion

At the completion of this study, it was evidenced that district health information systems management in LMIC, including Rwanda where these evaluation studies were carried out, are poorly managed and that they are not yet ready to generate accurate and reliable enough health data which is needed for daily decision-making among health care providers for policy-making, planning, monitoring and evaluation of health care programmes and disease outcomes. As LMICs strive to reach the Millennium Development Goals (MDGs), data are playing a major role in the evaluation of the successes made by those countries. In this light, it has been worthwhile to propose an intervention model for health DQM and health information use at community and district levels in Rwanda and other similar settings in contexts of limited resources.

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APPENDICES

APPENDIX A: INFORMATION DOCUMENT

Study title: “Developing an Intervention Model for DQM and Health Information Use at Community and District Levels in Rwanda”

Researcher: Eléazar Ndabarora, Student at the University of KwaZulu-Natal (UKZN), Howard College Campus, School of Nursing and Public Health.

Dear Participants,

I, Eléazar Ndabarora, a PhD student at UKZN, School of Nursing and Public Health, Howard College. We are conducting this study as part of the larger study on the “Development of an Intervention Model for DQM and Health Information use at Community and District Levels in Rwanda”.

To complete this study, we would like to invite you to participate in the study and provide information that is required. We therefore need to provide you the following information regarding this study.

A team of data collectors will collect information from different registers that are used in the health care process at community level, health centers, and district hospital, as well as interviews at those three levels of care. Although, the study will not benefit you directly; however, it will provide necessary information on the quality of health data and its use for improving the quality of care for the clients.

Your participation in this study is voluntary; and there is no obligation to do so. If you consent to participate, you have the right to withdraw any time if you feel uncomfortable to continue, and without any inconvenience. Only your participation will inconvenience your time, as your contribution that we are requesting. The completion of the interview could take about 20 minutes.

The individual responses you will provide will be kept confidential, and they will not be linked to your identity through the data management process, and the interview-guide will not require you to put your name, only the initials and signature will be required. The data collected from health facilities will be captured in the computer using codes and this data will be analyzed without any link to these facilities in such a way that it is not possible to link any information to its source.

You are free to ask any question for more clarification, and the data collector will be there to respond accordingly. Below are addresses for the researchers that you may contact if you need to do so.

Thank you,

Eléazar Ndabarora Signature & Date
Tel: 078 5371 340
Email: endabarora@yahoo.fr

Rwandan National Ethics Committee:
Dr Wane Justin: 0788500499
Biomedical Research Administration
Dr Emmanuel Nkeramihigo: 0788557273

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APPENDIX B: INFORMATION DOCUMENT IN FRENCH

DOCUMENT D'INFORMATION

Titre de l'étude: "Développer un Model d'Intervention pour la Qualité de Gestion des Données et l'Utilisation de l'Information Sanitaire au niveau Communautaire et de District au Rwanda".

Chercheur: Eléazar Ndabarora, Etudiant à l'Université de KwaZulu-Natal (UKZN), Campus de Howard Collège, Ecole de Nursing et Sante Publique.

Chers Participants,

Je soussigné, Eléazar Ndabarora, étudiant au programme de doctorat à l'Université de KwaZulu-Natal (UKZN), Campus de Howard Collège, Ecole de Nursing, Afrique du Sud. Nous menons cette étude qui est une partie d'une grande étude ci-haut citée.

Afin de mener cette étude, nous voudrions bien vous inviter d'y participer et fournir l'information demandée. Une équipe des collecteur des données obtiendra l'information des différent registres qui sont utilisés dans tout le processus d'offrir des services de santé au niveau communautaire, centre de santé, et l'hôpital de district. Cependant, cette étude ne vous bénéficie pas directement; mais il nous donnera l'information nécessaire à propos de la qualité des données de santé et son utilisation pour améliorer la qualité des soins offerts aux clients. Votre participation dans cette étude est volontaire, et il n'y a pas d'obligation de le faire. Si vous décidez d'y participer, vous avez le plein droit d'abandonner si vous voulez le faire et sans inconvénients. Seulement votre participation prendra de votre temps, et cela constitue le seule inconvénient de participer dans cette étude. Compléter l'interview pourra prendre approximativement 20 minutes.

Les réponses individuelles qui seront fournies seront traitées avec grande confidentialité, et elles ne seront jamais liées a l'identification de la personne qui les a données durant tout le processus de gestion des données. Aussi l'interview que nous mènerons ne demande pas que vous donniez votre nom, seulement les initiaux seront demandés. Les données qui seront collectées des formations sanitaires seront entrées dans l'ordinateur en utilisant les symboles et ces données seront analysées sans qu'elles soient en aucun cas liées à la formation sanitaire où elles ont été collectées. Vous avez le plein droit de poser n'importe quelle question de clarification en rapport avec cette étude, et les collecteurs des données sont prêts a vous répondre. Ici-bas vous trouvez les adresses que vous pouvez utiliser au cas de besoin.

Nous vous remercions,

Eléazar Ndabarora

Signature & Date

Tel: 078 5371 340

Email: endabarora@yahoo.fr

Commutée d'éthique du Ministre de la santé au Rwanda:

Dr Wane Justin: 0788500499

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APPENDIX C: INFORMATION DOCUMENT TRANSLATED IN KINYARWANDA
UMUGEREKA E: UBUSOBANURO K' UBUSHAKASHATSI

Izina ry'Ubushakashatsi: "Gukora iyoboramikorere ku byerekeranye no gutanga raporo zikubiyemo ubutumwa bwizewe kandi bukreshwa mu bajyanama b'ubuzima kugera ku rwego rw'Akarere mu Rwanda".

Umushakashatsi: Eléazar Ndabarora, Umunyeshuri muri Kaminuza ya KwaZulu-Natal, muri Afrika y'Epfo.

Bakozi mushinzwe ubuzima,

Ndi umunyeshuri ukorera impamyabumenyi y'ikirenga muri Kaminuza yo muri Afrika y'Epfo. Tukaba turi gukora ubushakashatsi ku iyoboramikorere yafasha gutanga raporo nziza n'ikoreshwa ry'ubutumwa buyikubiyemo mu kunoza imikorere mu buvuzi kuva mu Mudugudu kugera mu rwego rw'Akarere mu Rwanda. Kugira ngo ubu bushakashatsi bushoboke, twifuza kubasaba kubigiramo uruhari, bityo twifuza kubaha ibisobanuro bijyanye n'ubu bushakashatsi.

Hari itsinda ry'abashinzwe gukusanya amakuru bahereye ku bitabo byandikwamo abaturwa mu mudugudu no ku mavuriro, ndetse tukazanabaza abantu batandukanye uko babona habaho inozamikorere mu itangwa ry'ubutumwa (raporo) ku buvuzi n'ikoreshwariy ubwo butumwa mu rwego rwo kunoza serivisi z'ubuvuzi duha abatugana. Kuba muri ubu bushakashatsi ni ku bushake, ndetse ushobora guhagarika gukomeza kubigiramo uruhare mu gihe waba ariko ubyifuje cyangwa hari icyo ubona kitagushimishije muri bwo, kandi nta nkurikizi iyo ariyo yose wagira. Gusa kugira uruhare muri ubu bushakashatsi byagutwara umwanya ugereraniye nk'iminota 30 mu gihe twaba tukubaza ibibazo twifuza kukubaza.

Ibisubizo uraduha ni ibanga kuva mu ntangiriro z'ubushakashatsi kugera bushoje. Ndetse ntabwo tuzahuzwa umwirindoro wawe n'ibisubizo uraduha, dore ko tutaranagusaba kwandika amazina ku rupapuro rw'ibibazo, gusa uradusinyira kugira ngo byerekane koko ko ari ibisubizo byatanze n'uwabajijwe. Ku makuru tuzakura mu mavuriro, no ku bajyanama b'ubuzima, ntabwo tuzigera tuyahuzwa n'ivuriro twayakuyemo, ndetse no kuyinjiza muri mudasobwa tuzakoresha amagambo y'impine kandi y'ibanga (codes), bityo nta muntu ushobora guhuza amakuru n'uwayatanze. Ikindi nuko twiteguye kwakira ikibazo cyose n'ibisaobanuro mwadusaba. Ndetse hasi aha murabona umwirindoro w'ukora ubushakashatsi, ababuyobora, n'urwego rwa Etike mu Rwanda; bityo mushobora kubabaza icyo mwifuza cyose cyerekeranye n'ubu bushakashatsi.

Murakoze,

Ukora Ubushakashatsi:

Eléazar Ndabarora Umukono & Itariki

Tel: 078 5371 340

Email: endabarora@yahoo.fr

Komite ya Minisiteri y'Ubuzima

Ishinzwe ubushakashatsi :

Dr Wane Justin: 0788500499

Dr Emmanuel Nkeramihigo: 0788557273

Uyobora ubushakashatsi:

Prof Leana Uys

Tel: +27 12 349 5218/19/20

Email: UYS@ukzn.ac.za

Jennifer Anne Chipps

Email: jchipp@telkomsa.net

Mobile phone: +27(0) 834160800

Komite ya Kaminuza ishinzwe

Ubushakashatsi (UKZN)

Tel: 27 31 2604769

APPENDIX D: INFORMED CONSENT

DECLARATION

I..... (Initials of the participant),

By signing this document, I give my consent to participate in the study entitled “Developing an Intervention Model for DQM and Health Information Use at Community and District Levels in Rwanda”. Written and oral information was provided to me, and I understood the nature of the study, and I found convenient to participate in the study.

I was informed that the participation in the study is voluntary, and I guarantee my participation freely. It was agreed that I can withdraw from the study if I opt to do so without any inconvenience, and that the information I will provide will be kept confidential, and will not be linked in any manner to my identification throughout the whole research project.

Signature

Date.....

APPENDIX E: INFORMED CONSENT TRANSLATED INTO FRENCH

FORMULAIRE DE CONSENTEMENT

DECLARATION

Je soussigné,..... (Initiales du participant),

Par la signature de ce document, je donne mon consentement de participer dans l'étude intitulée "Développer un Model d'Intervention pour la Qualité de Gestion des Données et l'Utilisation de l'Information Sanitaire au niveau Communautaire et de District au Rwanda".

Information écrite et orale m'a été donnée, et j'ai bien compris la nature de l'étude, et je vois bien qu'il est convenable d'y participer.

J'ai été informé que participer dans cette étude est volontaire, et je garantis ma participation volontairement. Il a été convenu que je peux me retirer de l'étude si je me décide de faire ainsi sans qu'il y ait n'importe quel inconvénient, et que l'information que je donnerai sera traitée avec grande confidentialité, et ne sera en aucun cas liée à mon identification tout le long du processus de recherche.

Signature

Date.....

APPENDIX F: INFORMED CONSENT TRANSLATED IN KINYARWANDA

UMUGEREKA F: KWEMERA KUBA MU BUSHAKASHATSI

IBYO TWEMERANYIJWE

Jyewe..... (Inyuguti zitangira amazina yawe gusa),

Nsinye uru rupapuro kuko nemeye kugira uruhare mu bushakashatsi bujyanye no “Gukora iyoboramikorere ku byerekeranye no gutanga raporo zikubiyemo ubutumwa bwizewe kandi bukreshwa mu bajyanama b’ubuzima kugera ku rwego rw’Akarer mu Rwanda”.

Ibisonauro byanditse ndetse no mu magambo ku bushakashatsi nabihawe, kandi nabisobanukiwe, nkaba nemeye kugira uruhare muri ubu bushakashatsi.

Twumvikanye ko kugira uruhare muri ubu bushakashatsi ari ubushake, nkaba mbyemeye ku bushake bwanjye. Twumvikanye kandi ko nshobora guhagarika kugira uru reuhare igihe naba ariko mbyifuje, kandi ko ibisubizo ndatanga bitari buhuzwe n’umwirondoro wajye, ahubwo ko bizagirwa ibanga kuva mu ntangiriro kugeza mu iyusirizo ry’ubushakashatsi.

Umukono.....

Itariki.....

APPENDIX G: LETTER TO RWANDA ETHICS COMMITTEE BOARD

To: The Chairperson of Rwanda Ethics

Committee Board

Tel (+250) 55 10 78 84

Email: rnec@moh.gov.rw

P.O Box 84

Ministry of Health

KIGALI-RWANDA

Eléazar Ndabarora

Student No 205516350

School of Nursing and Public Health

University of KwaZulu-Natal

Cell phone: +250 785371340 (Rwanda)

Or +27 734622613 (South Africa)

The 05th November 2011.

Dear Sir,

RE: Request for the permission to undertake the research project at Bugesera District in Rwanda

I would like to submit to you my request for authorization to conduct my PhD study in Bugesera District in Rwanda.

The title of the study is “Developing an Intervention Model for DQM and Health Information Use at Community and District Levels in Rwanda”.

Please find enclosed herewith a copy of the proposal for the project.

Thank you,

E Ndabarora (Mr.)

Signature.....

Student

Appendix H: DATA COLLECTION TOOLS

Community Health , Health Centre & Hospital Information Systems

DATA QUALITY AND CONSISTENCY EVALUATION

University of Kwa-Zulu Natal

Howard College

School of Nursing

Step 1. Prior to Visit

Site Name: _____

Date of Site Visit: _____

Please contact Community health Supervisor, Health Centre-In-Charge and Hospital Mgt to request and ascertain the following:

For every selected cell (CHWs):

Monthly Summary Sheets Apr, May, June 2011 (submitted to Health Centre)

All registers for April, May, June 2011 (CHWs)

For every Health Centre:

Monthly Summary Sheets Apr, May, June 2011 (submitted to DHIS)

All registers for Apr, May, June 2011 (nursing)

For the Hospital:

Monthly Summary Sheets Apr, May, June 2011 (submitted to DHIS)

All registers for Apr, May, June 2011 (nursing & Medical Ward Registers)

Step 2. Day of Visit

1. Introduce yourself to the Hospital Management/Health Centre-In-Charge/Community Health Supervisor/CHWs
2. Explain the About the study and submit Information Document.
3. Allow the Sister to walk the team through the flow of information reporting
4. Complete the forms listed below in order for each facility:

For every selected cell and Health facility, complete together with CHWs the following Forms:

- | | |
|--|--|
| | FORM #1 - Monthly Summary Sheet Review |
| | FORM #2 - Interview guide |
| | FORM #3 - Data Module-Process Map |
| | FORM #4- Register Review Tally Sheet (for as many registers as needed) |

FORM #2 - Data Quality Management & Health Information Use Interview Guide

Instructions: Please complete the following questionnaire with the CHW or th Health Center-In-Charge including the Data Module & Process Map on the back of this questionnaire.

Data Collection Process (To be answered by CHWs, Health center in-charge or Nurse Managers)

- 1. How many patients are seen by CHW or at this Health Center or Hospital per day? (counting them)
- 2. How many Registers are used to collect clinical data by CHW or at this Health Center or Hospital? Counting them
- 3. How many people are involved in the data collection process?
- 4. How many times/days are needed to complete the data collection process?
- 5. How many steps are there in the data collection process?
- 6. Do you find easier or difficult to collect and report health data?

Easier	Difficult
--------	-----------
- 7. Please explain your answer to the above question

- 8. Do you use the data or health information for planning purposes? Y/N
- 9. Please explain your answer to the above question

- 10. Do you find the health data/information useful for decisions and planning purposes? Y/N
- 11. Please explain your answer to the above question

Site Name _____
Date _____

Reporting and Feedback, Supervision, Monitoring and Evaluation

12. Did you send all required reports to the next level? Y/N
13. How many Feedback did you receive from higher level since January up to June 2011?
14. Was the feedback useful for your improvement? Y/N
15. Have you ever been supervised or evaluated for data quality audit between April-June 2011? Y/N
16. What was your performance as CHWs cooperative or health facility? _____
17. At which rythme do you think you need to be supervised for data quality check? monthly quarterly other?

Training, Logistics and Infrastructure Module

18. Have you been trained in data management (collection, processing, analysis)? Y/N
19. What, if any, are the areas you need more thaining? _____

20. Do you have the necessary equipment for Data collection? (data collection forms, Computor,...) Y/N

Site Name _____
Date _____

QUESTIONS FOR FOCUS GROUP INTERVIEWS

1. Do you find the quality of health data important?

Y/N

2. Please explain your answer to the above-mentioned question

3. How do you use health data you collect?

4. How data helps you in relation to your work as a CHW/Health Workers?

5. What, if any, are the problem areas of the health information system in daily operation?

6. How can the health information system be improved to make it more useful in different management areas?

7. How can the health information system be improved to make it more user-friendly for CHWs, Health Centre and Hospital?

FORM #45- Registers Review - Re[Porting/Tally Sheets

Instructions: Step 1 - Locate all registers used at community level or Health Center. Step 2 - For every type of register identify which of the 6 data elements (column headings) are not present in that type of register and cross out those columns. Step 3 - Start at April, 2011 and go patient-by-patient and fill in EVERY blank space with either: **Y = Yes, N = No, Not documented, or Not applicable.** Step 4 - **Start a new tally sheet when you change months or when you switch to a new type of register.** Step 5 - When all of the registers have been completed for April, May, & June 2011, sum all the Y's or "yes"s in the last row of each column.

Register Name / Type: _____ Month: _____

How many of this type of register were used at this site during this month? _____

How many of these registers are available for review on the day of the site visit? _____

Patients	Reported Number of cases received	Type /Diagnosis: Fever, Pneumonia, Diarrhae, Malaria or PREGNANCY	Number of Cured cases	Number of Referred cases	Number of Feedback received	Number of Deaths reported
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
Sum the Y's						

Patients	Reported Number of cases received	Type /Diagnosis: Fever, Pneumonia, Diarrhae, Malaria or PREGNANCY	Number of Cured cases	Number of Referred cases	Number of Feedback received	Number of Deaths reported
31						
32						
33						
34						
35						
36						
37						
38						
39						
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59						
60						
Sum the Y's						Site Name _____ Date _____

Appendix K: Ethical approval letter from Rwanda National Ethics Committee

REPUBLIC OF RWANDA/REPUBLIQUE DU RWANDA



NATIONAL ETHICS COMMITTEE / COMITE NATIONAL D'ETHIQUE

Telephone: (250)2 55 10 78 84

E-mail: r nec@moh.gov.rw

Web site: www.r nec.moh.gov.rw

Ministry of Health
P.O. Box. 84
Kigali, Rwanda.

FWA Assurance No. 00001973
IRB 00001497 of IORG0001100

February 03, 2012
No. 020/RNEC/2012

Eleazar NDABARORA

Principal Investigator

PHD CANDIDATE

Your Project title: **"DEVELOPING AN INTERVENTION MODEL FOR DATA QUALITY MANAGEMENT AND HEALTH INFORMATION USE AT COMMUNITY AND DISTRICT LEVELS IN RWANDA"** has been evaluated by the Rwanda national ethics committee.

Name	Institute	Involved in the decision		
		Yes	No (Reason)	
			Absent	Withdrawn from the proceeding
Dr. Justin Wane	King Faisal Hospital, Kigali HOD Laboratory	X		
Dr.Emmanuel Nkeramihigo	Senior Lecturer, National University of Rwanda. Faculty of Medicine	X		
Dr. Dariya Mukamusoni	Ministry of Health	X		
Dr Juliet Mbabazi	Member	X		

Prof.Alexandre Lyambabaje	National University of Rwanda	X		
Mrs.Françoise Uwingabiye	Lawyer Musanze	X		
Dr. Eugène Rutembesa	National University of Rwanda	X		
Sr.Domitilla Mukantabana	Kabgayi Nursing and Midwife school	X		

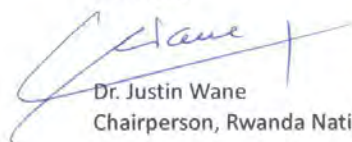
After reviewing your protocol during the RNEC meeting of 14 January 2012, where the quorum was met, and revisions made on the advice of the RNEC submitted on 03 February 2012, **we hereby provide approval for the above mentioned protocol.**

Please note that approval of the protocol and consent form is valid for **12 months**.

You are responsible for fulfilling the following requirements:

1. Changes, amendments, and addenda to the protocol or consent form must be submitted to the committee for review and approval, prior to activation of the changes.
2. Only approved consent forms are to be used in the enrollment of participants
3. All consent forms signed by subjects should be retained on file. The RNEC may conduct audits of all study records, and consent documentation may be part of such audits.
4. A continuing review application must be submitted to the RNEC in a timely fashion and before expiry of this approval.
5. Failure to submit a continuing review application will result in termination of the study.

Sincerely,



Dr. Justin Wane
Chairperson, Rwanda National Ethics Committee.



Date of Approval: February 03, 2012

Expiration date: February 02, 2013

C.C.

- Hon. Minister of Health.
- The Permanent Secretary, Ministry of Health

Appendix L: Approval letter from the UKZN Ethics Committee



UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

Research Office (Govan Mbeki Centre)
Westville Campus
Tel. No. 031 260 3587
Email: Ximbap@ukzn.ac.za

27 October 2011

Mr E Ndabarora (205516350)
School of Nursing

Dear Mr Ndabarora

PROTOCOL REFERENCE NUMBER: HSS/1099/011D
PROJECT TITLE: Developing an intervention model for data quality management and health information use at community and district levels in Rwanda.

PROVISIONAL APPROVAL – EXPEDITED

This letter serves to notify you that your application in connection with the above has been reviewed and granted provisional approval through an expedited review process. Your research protocol has been approved subject to Gatekeeper permission being obtained from the Rwandan National Ethics Committee.

This approval is granted provisionally and the final approval for this project will be given once the above condition has been met. Please quote the above reference number for all queries/correspondence relating to this study.

Kindly submit your response to the Chair: Prof. S Collings c/o Ms. P Ximba, Research Office as soon as possible

Yours faithfully

.....
Professor Steven Collings (Chair)
Humanities & Social Sciences Research Ethics Committee

cc Supervisor – Professor L Uys
cc Ms J Chipps
cc Mr S Reddy

Appendix M: Additional findings from focus group and in-depth interviews

Detailed transcripts and theme analysis are presented below.

1. Findings from the in-depth interviews at community level

<i>Question 1: How do you find the quality of health data important?</i>		
Responses	Main themes	Redundancy and saturation
<p>“Yes, health data quality is important, uuhh,... because we are evaluated, so we need our report to be complete so that we have high performance”</p> <p>“Yes, indeed the quality of data is very important so that we know the reality of what is happening”</p> <p>“Yes, we need the quality of data so that we know what is going on in our citizens, or the outcome of the service we offer to our people”</p> <p>“Yes, I understand that we need data with quality and correct report so that it helps me to know the disease most occurring in my village!”</p> <p>“Yes, data is important but it is difficult to achieve, but we need it”</p> <p>“Yes of course, when we send the correct report on time we have high</p>	<ul style="list-style-type: none"> ○ It emerged that all community health workers (CHWs) find the quality of health data important ○ Some CHWs showed that they know some characteristics of data quality and the importance of having data with quality ○ CHWs explained that it is very difficult to them to fulfill their duty and care for the quality of data because they felt very limited in knowledge. 	<p>All 20 CHWs showed they value the quality of health data</p> <p>Seven CHWs showed some knowledge of the characteristics of data quality</p> <p>All 20 CHWs explained their limitation in doing the report</p>

<p>performance, and the cooperative gain more money!”</p> <p>“When we were trained, we were told that we need to report correctly without delay and avoid mistake, so the quality of data is important!”</p> <p><i>Question:</i> Is it the same view to all of you?</p> <p>“Yes!!”</p> <p>“Yes, I am not saying No!,... I agree that we need to have a correct report, yes we need it, but really we are very limited in knowledge, it is difficult for us when are compiling the report, it is difficult!”</p> <p>“Of course even though we have difficulties, but I understand that when do not have a correct report, it is very bad because we do not show exactly what is happening, and our work is not well know!”</p> <p>“I personally wish I know how to do report properly, but I get lost when I add numbers from the books I use to treat children!”</p> <p>“The quality of the report is important as my colleagues said, but honestly we do know to do it properly, but I know that when I do it properly, it helps me to</p>		
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<p>know exactly the people who are sick in my village, you know....”</p> <p>“Yes we are very limited in the knowledge of doing the report, but the quality is very important. If I can give an example, when we reported wrongly, it takes us so long time to finalize the report, we resubmit the report to the Social Affairs, it takes more time... when we do it correctly, it is very important”</p>		
<p><i>Question 2: Please explain your answer to the above-mentioned question?</i></p>		
<p>“ Me I said that the quality is important because basically we need the performance in our cooperative so that we get remunerated”</p> <p>“Yes, I am saying the same as before, because you know when we correctly record the number of people who are sick, we know the situation of our people, we know those who do not have latrine, and then we can visit them...”</p> <p>“Yaah, as my colleague said, we for example visit families when we see that all children are reported vaccinated, we invite them to go for vaccination,...</p> <p>“what I can add on what my colleague is that it is really important to have correct numbers in our report so that we know the truth of what is happening</p>	<ul style="list-style-type: none"> ○ It emerged that all interviewed CHWs have positive understand of the quality of health data and they use it for further planning ○ All CHWs interviewed continuously explained their limitations in particularly knowledge of compiling the report. 	<p>All 20 CHWs</p> <p>All 20 CHWs</p>

<p>in villages,... you know the Health Center can even intervene to address reported problem”</p> <p>“Yes, I said it, the quality of health data is important but it is difficult to be done because it takes many days!...</p> <p><i>Question: How long?</i></p> <p>...at least 5 days, you know we collect data in books, we come at Health centre and compile, we come back for corrections, we may even come back again, ... it is a very difficult work!”</p> <p>“We have been committed to do this work, but we really need to work long days, and it is not easy! So the quality of the report is very import but very difficult for us to achieve, because we really do not have equal knowledge, we do report individually, then we come together, we bring the report to the social affairs and it takes more times and more days, what I can say is that it not easy!”</p> <p>“Even though it is a difficult work, a correct report shows the image of our villages, and higher levels can plan for the needs we have, based on correct information”</p> <p>“You know yourself that a good report is rewarding, the PBF, do remind to the citizens when you see that somewhere your indicators decreased or</p>		
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<p>diseases increased, you go and teach them,..."</p> <p>"Yes, the quality of the reported data is very important so we the work we have done, but we need more knowledge because we see that we do not know how to do the report properly. I wish we do it at home without all the time coming at health center, but we are not able to do it alone!"</p>		
<p><i>Question 3: How do you use health data you collect?</i></p>		
<p>"As I said, when you get information of a family without latrine, kitchen garden, unvaccinated child, you go directly in that family and talk to them and request them for correction"</p> <p>"... when you get information of a family without latrine, kitchen garden, unvaccinated child, you go directly in that family and talk to them and request them for correction"</p> <p>"Yes, I said, when you see that somewhere your indicators decreased or diseases increased, you go and teach the households under your responsibility,..."</p> <p>"We do remind the citizens in our respective villages when you see that somewhere your indicators decreased or diseases increased, you go and teach</p>	<ul style="list-style-type: none"> ○ CHWs explained they use data they collect and report to evaluate their performance in their cooperative, and diseases outcomes; they plan community-based interventions, such as households visiting, and IEC sessions during community work. ○ Some CHWs explained that they do not use data except for PBF purposes 	<p>At least 15 CHWs</p>

<p>them, and ask more question to know the reason they do not have the mosquito nets for example, why the pregnant woman did not go to health center for Antenatal Consultation (ANC), etc.</p> <p>“ Data we collect are used to know diseases existing in the community”</p> <p>“Also we use the data to do evaluation of our performance in the cooperative and we get money from the Ministry of health accordingly, so reported health data helps us so much”</p> <p>“We do family visits and the report reminds us the problems identified and we plan Information Education Communication (IEC) sessions at community public work ‘Umuganda’ and we talk to them when the local leaders give”</p> <p>“Data we collect are used to evaluate our performance and we get remunerated”</p> <p>“I see that we do not really use data we compile for the report except for the performance of the cooperative”</p> <p>“We use the data to know the situation of the people in our villages and we</p>		<p>About 5 CHWs</p>
---	--	---------------------

<p>particularly when there is a disease increase and we immediately visit families to teach them how to prevent that disease”</p> <p>“If we do not have data how can we evaluate our performance in the cooperative? Reported data helps us so much!”</p> <p>“We do family visits and we plan Information Education Communication (IEC) sessions at community public work. The topic we chose depends on main issues identified based on the reports”</p>		
<p><i>Question 5: What, if any, are the problem areas of the health information system in daily operation?</i></p>		
<p>“We do not receive the feedback! If they found our reports have errors and they keep quiet, how can we correct ourselves?”</p> <p>“Most of the time they ask us more information which is not in the format we were given for continuous data collection, and we do not have time enough to go around all households, ...”</p> <p>“Yes, also they need those reports in a very short time! Reports for kitchen garden, mosquito utilization, water and sanitation and we do not collect those data as other disease-specific data, and then people start putting what comes</p>	<p>The following issues were identified:</p> <ul style="list-style-type: none"> ○ Lack of training in data management ○ Lack of feedback to CHWs ○ Lack of standardized data collection tools ○ Short time to do unplanned report ○ Long time required to complete monthly data collection and reporting process without financial 	<p>All the participants</p>

<p>in mind”</p> <p>“What I see as the big problem is that we are not trained for data management!”</p> <p>“We do not have means to travel around our villages, if I do not have umbrella, no shoes/boots, nothing, I am not motivated,...and you know we also need something to take home!”</p> <p>“We do not have enough skills to do report, because we haven’t been trained for reporting”</p> <p>“...the Ministry does changes of CHWs several times and no training follows, you will just work and reporting tools are confusing! (Social affairs CHWs)”</p> <p>“Other CHWs say that we chose wrong partners who don’t give any support, we need a support as other do otherwise yourself you can give up!”</p> <p>“We do not have petrol, and then a mother brings her child and you need to examine the child, it is a lot! I go to ask for debt for the oil, so that I have light for to take the sample, you do it, again and again, then you say to the</p>	<p>support</p> <ul style="list-style-type: none"> ○ Lack of means such as transport facilities, shoes and umbrella when doing village tours ○ Lack of motivation ○ Overloading work because of overlapping responsibilities ○ Unfair cooperative management 	
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<p>person who gives you the petrol that they have to have hygiene, and they do mockery on you saying “pay us first!” a pregnant woman comes and you need to accompany her, it is raining, maybe during the night, you do not have light, no proper shoes, no torch, no umbrella, really we need basic equipment!”</p> <p>“Yes, we really need to have travel means such as bicycle, and all my mentioned”</p> <p>“We really need to come and work together, because what I did wrong the coordinator does corrections and other colleagues helps you, we really need to be trained so that we understand how to report without spending so many days come to health center”</p> <p>“I can add that also we have the issue of cell phones which are user friendly, they not easily chargeable, not functional,…”</p> <p>“To be a CHWs is very expensive and too much demanding: uuh,... we spend days when compiling data without any payment, without food or drink, really unresolved problems are so many!”</p> <p>“We transfer children but we do receive feedback, except TB cases, if it is because of the money involved in I don’t know!”</p>		
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<p>“Compiling report is very difficult for us: we honestly do not know to do it except the coordinator helps us, but it requires that we spend many and long days at HC, hungry... Better they train us and since we are able, we can do it at home”</p> <p>“Really we are given too much work; we are no longer able to cope! You are called by mothers to examine their children day and night, visiting households, accompaniment of women, attending meetings at HC, really we are overwhelmed!”</p> <p>“Yes, we are overwhelmed and we do not have enough space to store securely the equipment we were given, the box is too small, books are now so many,”</p> <p>“Cooperatives are not well managed because we gain a very small personal income, and when you are replaced, they just give you the contribution you have put in and ignore the work you have been doing during 4 or 5 years, it is not correct and demotivating!”</p>		
<p><i>Question 6: How can the health information system be improved to make it more useful in different management areas?</i></p>		
<p>“We need more supervision and feedback so that we get corrected on time and be able to give a report with high quality. Yes sometimes we are supervised,</p>	<p>The following were suggested:</p>	<p>All 20 participants</p>

<p>but we are not given feedback of the reports we have sent!”</p> <p>“Harmonize data collection tools and training all CHWs including Social affairs in charge...”</p> <p>“We need motivation and basic equipment, this is also important because at home they expect us to come back home with something (insimburamubyizi)”</p> <p>“The feedback is given to the cooperative and they bring us together to explain to us what was our performance, what we need to correct is not clear to me as a CHWs”</p> <p>“The cell phone are very helpful, they assist us in communication, so we need them to be replaced when they are not working properly”</p> <p>“We need the correction be done for everyone, and not collectively”</p>	<ul style="list-style-type: none"> ○ Harmonize and standardize data collection tool and expected report ○ Need individual feedback ○ Motivation/cost of the day spent at Health Center ○ Need equipment such as working cell phones 	
<p><i>Question 7: How can the health information system be improved to make it more user-friendly for CHWs?</i></p>		
<p>“We need more supervision and feedback so that we get corrected on time and be able to give a report with high quality. Yes sometimes we are supervised,</p>	<p>The following were suggested:</p> <ul style="list-style-type: none"> ○ Training all CHWs in data 	<p>All the participants</p>

<p>but we are not given feedback of the reports we have sent!”</p> <p>“I suggest that they harmonize data collection tools and training all CHWs including Social affairs in charge...”</p> <p>“Motivation is also important because at home they expect us to come back home with something”</p> <p>“We need more supervision, the availability of supervisors is limited and they do not reach every CHW,...”</p> <p>“Me, I am visited every quarter because in our villages, there is a lot of TB, I wish the supervision be done every month”</p> <p>“I think even the supervision done every quarter would be better but arriving at everyone and bring the feedback of previous report”</p> <p>“Training is very low, they just go through as we are in the meeting, that how our mistakes belong, they just explain what was changed in the report format for example, but they do not take time to teach us,...”</p>	<p>management</p> <ul style="list-style-type: none"> ○ Data management tools harmonization ○ Individual feedback ○ Motivation ○ Regular supervision reaching every individual CNW 	
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<p>“The training is not really done! They say something at the end of a very busy day, imagine as a woman, thinking about my kids, the family, I do understand, and we just go without understanding what we were touch, better they plan a training for data management separately”</p> <p>“I am a CHW, my relatives are CHWs in others health centers, who receive 1000 per day when they have been doing report, and this can even cause misunderstandings between us and husband, they think that we receive something and we do not reveal to them, there are problems –ni ibibazo!”</p> <p>“Data collection and reporting process in addition to too much work we do, the quality control, etc all these increased our workload, it takes all our time is really a busy and heavy work, you pass by somewhere and the citizens think that you have some money, really we need motivation”</p> <p>“It takes so longer to do the report, we are hungry when from health center, other times, you need to go around the villages, when you also have do to, you do supervision, in the rain, it would be better to bring together limited villages when compiling the report, but the ASOC cannot have such time”</p>		
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2. Findings from interviews conducted at Health Centers

<i>Question 1: Do you find the quality of health data important?</i>		
Responses	Main themes	Redundancy and saturation
<p>“Yes, of course health data quality is important, as we all know”</p> <p>“Yes, I understand that the quality of data is very important, otherwise we cannot know the situation of diseases outcome, even the burden of the work we do everyday ”</p> <p>“I basically say the same that we need the quality of data so that we know what is going on , the outcomes the sick people we treat, etc”</p> <p>“Yes, we know that the quality of health data is important in health sector, otherwise we cannot plan if we do not have the data, or we can plan but based on incorrect data, so we really need the data to be with quality”</p> <p>“We really know and understand that the quality of data is so important, but the issue you know yourself if our daily too much work which hinders that quality we are talking about!”</p>	<ul style="list-style-type: none"> ○ It emerged that all health care providers interviewed find the quality of health data important ○ The participants showed much doubt in reaching desired quality of data, and this was the center of their explanation. 	<p>All 14 Health Centers managers and 20 health providers agreed that the quality of health data is important</p>

<p>“In our days, particularly last year training was done and the main objective was for us to report correct information, so data quality is so important!”</p> <p>“Yeah, the problem is the workload you know it yourself, we have talking about the quality of heath data, it is important, but we find it difficult to have it done practically”</p>		
<p><i>Question 2: Please explain your answer to the above-mentioned question?</i></p>		
<p>“As you know, the quality of health data is important because that is the only one way to understand what is going in the community and in the health facility. Then we can plan the future accordingly”</p> <p>“As a data manager, I really need the quality of data and the report we submit, but we retrieve ourselves doing the monthly report and you encounter difficulties in abbreviations nurses write in patient registers, they do not complete some of the information, and you are confused when you are collecting data for the monthly report”</p> <p>“Data quality is very important for our planning of health interventions at community level and here in the health center, but I say that it is difficult to</p>	<p>Of what the participants explained the following can be understood:</p> <ul style="list-style-type: none"> ○ Data quality management is considered as basis for planning better health services delivery ○ Keeping the records was considered as extra work not integrated in what the health professional is expected to do equally as other tasks ○ Lack of information culture ○ Some reported good 	<p>All 14 Health Centers managers and 20 health providers agreed that the quality of health data is important</p>

<p>have that quality because we are overwhelmed and you find yourself incapable to keep all the records of every patient you received, there is a very long queue waiting for you”</p> <p>“Yes, it is true, if you have ten women in labor and you are observing them alone, your colleague is busy with other patients, how will you complete all the documents?”</p> <p>“The quality of health data is important but it is difficult to be done because it takes many days for the people to understand its importance! This is because for example the nurses are the primary sources of data we report. Sometimes they do not complete registers,... even if they participate in the monthly data collection and reporting, and they see how it is very tough”</p> <p>“It is very difficult because only two days we need to have completed the whole report. Even during the two days, consultations continue, you will not have access to the register in such short time”.</p> <p>“Data quality is important but still a big issue: for example we were promised that all data will be computerized and you can have access easily, but you see our nurses working and they consult more patient than they register, patient files are incomplete, it is not easy, we will take longer to have improvement”</p>	<p>practices: daily compilation of managed cases and therefore easy to have cumulative data summary</p>	
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<p>“I see that something important is being done, as you enter data and the district hospital has direct access, I believe that this will minimize errors, but the issue remains the community health workers and people who receive people who do not complete documents properly”</p> <p>“Things are getting easier by the training of nurses done, we encourage daily compilation of receive cases (<i>pointage journalier</i>) so that at the end of the month you use the same form daily completed, but this is our initiative, there is no form to do that”</p> <p>“In order to not delay to report, you daily compile on rough paper and at the end the month you compile on original paper and submit it to the data manager”</p> <p>“The in-charge of the service takes the responsibility to make sure the register is completed, lab results included, but you will see that when you are collecting data to prepare the monthly report, you will be surprised, lab results are not completed, diagnosis are not complete, really you do not know what to do!”</p>		
<p><i>Question 3: How do you use health data you collect?</i></p>		
<p>“We analyze data first, then we compile the report, and we take them to be discussed in the staff meeting, each service is given responsibility to make corrections of identified errors”</p>	<p>The following were identified:</p> <ul style="list-style-type: none"> ○ Data and health information collected is sometimes used 	<p>All 14 Nurses and 20 health providers</p>

<p>“ We use data for evaluation of the performance and plan interventions accordingly, for example in the staff meeting, we discuss the situation of each service and find out the solution, such as community sensitization conducted in the monthly community work (Umuganda), the Managing Committee Board of the Health Center, etc”</p> <p>“We use data for planning interventions sometimes, but quarterly and annual actions plan is mainly done by the Senior Nurse Manager (Titulaires), we do not really participate in the planning process”</p> <p>“After you have report, you need to compare with previous data and analyze the root causes of the observed decrease or increase of diseases and make decisions accordingly”</p> <p>“Theoretically, we say that we use data, but I do never see us using data, just we report and we do not know what happened. Sometimes the Senior Nurse Manager mention in the meeting what was the feedback for the health center, but we need to know what was the feedback for our respective services”</p> <p>“After data analysis, we might come together and discuss areas that need interventions; however it is not always done”. I even see people who were</p>	<p>for planning and evaluation of the performance</p> <ul style="list-style-type: none"> ○ The feedback from district hospital does not always reach specific Units ○ There is lack of information culture ○ All health care professionals are not involved in the planning processes and they feel not very concerned 	
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<p>trained before, are the same to be trained for other sessions, and they want us to all manage data like them, How can? We need to be trained all!”</p> <p>“At hospital the feedback is done, but this is not done in the health center. But sometimes we do it in the COSA, or quality assurance, but we do not really take that time to discuss data except when there has been a scandal”</p> <p>“as my colleagues said, we discuss when there somewhere they find something that may cause noise, but we do not have formative feedback; even it is done, it is just to have good performance for PBF, but not for corrections”</p> <p>“Yes, it is true that people spend some days completing books and patients’ files before the PBF evaluation team is about to come. If you can compare the patients complains and the diagnosis mentioned, you can sometimes be amazed, they are not related at all! There is no continuous data quality check”</p>		
<p><i>Question 4: How data helps you in relation to your work as a health professional or leader?</i></p>		
<p>“It helps us in self evaluation and we can know the performance of our health center”</p>	<p>The following emerged of the participants explanation:</p> <ul style="list-style-type: none"> ○ The Senior Nurse Managers (Titulaires) reported that they 	<p>All 14 Senior Nurse</p>

<p>“Data we report helps us in planning new interventions according to the performance, if something went down, such as it goes services utilization, you need to do corrections accordingly and plan visit at community level”</p> <p>“When the feedback back is done in the coordination meeting and each health center can know their performance and make correction of identified mistakes accordingly”</p> <p>“Except data quality audit is done seldom, they show us where thing are going wrong and propose corrections to be done. Unfortunately PBF takes all the people, ourselves and district supervisors, and they do not have time to conduct data quality audit”</p> <p>“Data helps us to prepare for the PBF evaluation, and we do corrections as necessary”</p> <p>“To be honest, I do not see us using data in our daily practices, but only to prepare for PBF, and when this is finished, we remember data when we are about to have next PBF evaluation, that is why you see people spending nights completing document,... uhhh, you know it yourself!”</p> <p>“It is true that PBF occupied and replaced everything, the quality of data is not really considered and I do not think we use it in our daily work, we just keep</p>	<p>use data and health information for planning purposes, and decision-making</p> <ul style="list-style-type: none"> ○ Some health providers and Units/services managers are involved in planning process and use available data and health information ○ Health professional/providers explained that data and health information is not really used in their daily practices ○ There is lack of information culture 	<p>Managers</p> <p>Around 5 participants</p> <p>Around 15 participants</p>
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<p>records and document to get ready for PBF!”</p> <p>“If you can finish too much work you have, you can complete registers and files as required, but if you haven’t finish your work, I do not know, except there is someone to complete them”</p>		
<p><i>Question 5: What, if any, are the problems or areas of the health information system in daily operation?</i></p>		
<p>“We have really overloading work, people do not complete registers, not because they are willing, but because of too much work”</p> <p>“Some previous forms were confusing, but the new ones are clear enough, we hope that they be helpful”</p> <p>“We only have one data manager; when she goes no one is ready and able to replace her! But I think because other nurses working in different services were trained, things will be well done”</p> <p>“There is no capacity building being done in data quality management except data managers and in charge of services, we all need to be trained”</p> <p>“Data management is our concern, all of us, but they do not train us, then</p>	<p>The following issues were identified:</p> <ul style="list-style-type: none"> ○ Overloading work ○ Lack of standardization and stability of data management tools ○ Lack of training ○ Short time for collection and reporting processes ○ Pressure from above ○ Incomplete registers and patients’ files ○ Lack of information culture 	<p>All 14 Senior Nurse managers and the 20 health care providers explained the same issues</p>

<p>people feel less concerned and they indeed less skilled”</p> <p>“The problem I see is that community health workers are being trained, but the health technicians are not focused on, and they want us to offer data with high quality, that is not possible”</p> <p>“To collect data in only two days is difficult and quality may suffer very much”</p> <p>“The big issue is the overloading work and very short time to collect and prepare the report”</p> <p>“Data collection tools are not standardized enough and they keep on changing so that even those who have been trained previously are not used to new forms”</p> <p>“The source of data is a big problem for the quality of data: some are not complete, others not readable, very short time for compilation, I think there is a lot to be done in order to have data with quality”</p> <p>“Community health workers are not trained and not able to do the report</p>		
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<p>correctly, we know that they are not capable to do it properly”</p> <p>“The report is requested in a very short period of time and this may lead to report wrongly to fulfill the requirement but without having verified the data to be reported”</p> <p>“We do report in hurry and we do not have time to verify, so it is a big issues for which we need alternative solution”</p>		
<p><i>Question 6: How can the health information system be improved to make it more useful in different management areas?</i></p>		
<p>“Training is really needed for the capacity building of the health care providers”</p> <p>“I think they need to make everyone responsible of data quality management, not focusing only on data management and in charge of services”</p> <p>“Daily compilation (<i>pointagejournalier</i>) may be helpful but for some services such as consultations services, this is very difficult. In that case, standardized forms for daily data compilation would be needed”</p> <p>“If there would be possibility to daily enter data in the computer and the data</p>	<p>The following were identified:</p> <ul style="list-style-type: none"> ○ Training for health care professionals is needed ○ Suggestion to use daily data compilation model ○ Then a computerized data management system to be decentralized up to Units with the Health Center ○ Standardize data collection and reporting tools ○ Data quality audit (DQA) to be the routine and formative in nature 	<p>All 14 Senior Nurse managers and the 20 health care providers explained the same issues</p>

<p>manager can directly have access to them, that would be great”</p> <p>“A systematic feedback from the District Hospital should be given and reach all health care providers and not only the in charge of Health Center”</p> <p>“We really do not have enough feedback on data, we may have feedback for each report we submitted”</p> <p>“There is a need of making data quality audit a routine, and not necessarily the PBF evaluation, just DQA aiming at improving the quality, and not remuneration”</p>	<ul style="list-style-type: none"> ○ Feedback need to be given to all health professionals 	
<p><i>Question 7: How can the health information system be improved to make it more user-friendly for CHWs, Health Centre and Hospital?</i></p>		
<p>“ We need enough time to do data collection and the report”</p> <p>“But I think a daily data compilation can be the solution, if we have to resolve the issue of time spent on data collection and reporting processes”</p> <p>“Community Health Workers also need to be trained on data management, at</p>	<p>The following was suggested:</p> <ul style="list-style-type: none"> ○ Enough time for data collection and reporting processes is needed ○ Daily data compilation and cumulative data gathering ○ Training of CHWs and Health workers ○ Standardize data management tools, including 	<p>All 14 Senior Nurse managers and the 20 health care providers explained the same issues</p>

<p>least using their reporting forms, we really have big problem of the data coming from CHWs”</p> <p>“We need training of all health care providers so that data is managed with quality by all the concerned personnel”</p> <p>“We need standardized data collection tool, not every time changing tools”</p> <p>“We may share the report before the data manager sends it to the next level so that we do corrections that may have been introduced by the data manager”</p> <p>“We need to have a stable system, change is good but in a reasonable time”</p> <p>“Performance-Based Financing (PBF) model is helpful, but it seems to make people fabricating data just in order to have good note. I think we rather need to have a continuous data quality audit in all services so that people do work because the evaluation and remuneration will follow!”</p>	<p>computerization up to Units in HC</p> <ul style="list-style-type: none"> ○ Stable system and continuous data quality audit (DQA) 	
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3. Findings from the focus group at District Hospital

<i>Question 1: Do you find the quality of health data important?</i>		
Responses	Main themes	Redundancy and saturation
<p>“Of course Yes, health data quality is important”</p> <p>“Yes, the quality of health data is important so that we know the progress and diseases outcomes as we treat patients”</p> <p>“Yes, we need the quality of data so that we know what is going in health centers and evaluate their performance, we plan particular supervision based on reported data from health center, so we therefore the reported data to be with high quality”</p> <p>“Yes, I can add something, the quality of health data is important in a sense that the district, I mean district hospital and health centers are evaluated based on available data; that is our responsibility as supervisor, data managers”</p> <p>“It not always done in that way, but we plan every single health care for the patient based on one’s data: a child, adult, pregnant woman, ... we need that quality to be correct so that we do a correct plan as well”</p>	<p>The following was identified:</p> <ul style="list-style-type: none"> ○ The participant found the quality of data important ○ They had positive and correct understanding of the worth of the quality of data and health information 	<p>All 12 participants have convergent ideas</p>

<p>“Yes, we really the quality of health data you are talking about, but we see that when it come to the time of evaluation, I can see that people are not ready, they keep on search when files are kept, completing registers, so this became our big concern, we need it and we know that it is very important”</p> <p><i>Question:</i> Is it the same view to all of you?</p> <p>Yes!</p> <p>.....</p>		
<p><i>Question 2: Please explain your answer to the above-mentioned question?</i></p>		
<p>“Yes, the quality of health data is important it helps un to be informed on the progress of implemented community and health facility-based health programmes. Then we can plan interventions such as supervision, meetings accordingly”</p> <p>“Of course the quality of data and the report we receive from health center, from different services in the hospitals constitute a big matter of concern. Basically we do everything based on data; I cannot say everybody but that</p>	<p>The following was identified:</p> <ul style="list-style-type: none"> ○ Data is used for planning interventions ○ The participants perceived data quality as hindered by different issues ○ Lack of information culture and feedback were several times underlined among other hindrances of the quality of data 	<p>All the respondents have a bit divergent views:</p> <p>Around 7 convergent</p> <p>And around 2 divergent</p>

<p>what is supposed to be. this data and report have to be with quality, otherwise we may be planning intervention wrongly”</p> <p>“Except it is a big issue for some data is missing, but we normally evaluate health centers using available data. Reports are always available, but the quality is not. So we need the quality that is what is lacking!”</p> <p>“The quality of data is important but, really I find it difficult to be achieved, because of diverse issues such as too much work. We value the quality of data but it is not yet a sound and practical concept to many nurses”</p> <p>“Oohh, you say it TRUE! But add that also some medical doctors, particularly in Out Patient Department (OPD), they do not write in the register, the nurse has to do it after the medical doctor has consulted the patient, you will be very busy with your work, then you need to come back to register all the cases the medical doctor saw the whole day, the quality is critical”</p> <p>“Yeah you know, it is difficult for some of us to see the patient, and complete all required registrations, that is why we have different scope of work but completing each other”</p>		
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<p>“Yes, I try personally to design a form that different services in the hospital can use, and I see that the Unit managers are doing their best. Indeed we are very concerned with the quality of data and reports we receive from different services and health centers ”</p> <p>“I can say something, I do not see us involved in the planning and we do not necessary used data, and we seldom receive the feedback so that we can improve where we have to improve”</p> <p>“The issue of the feedback is crucial, for example, we very seldom receive feedback from the central level, but sometimes they do it! It would be better if they go it regularly and do field visits beside the PBF evaluation”</p>		
<p><i>Question 3: How do you use health data you collect?</i></p>		
<p>“The data we collect is summarized and reported to the data manager. We use it for example to plan our duty roaster, if patient increase suddenly in a service, we can allocate a staff from another service, just as an example”</p> <p>“ Yeah, we use reports to evaluate ourselves, and to evaluate health centers, you know, the PBF, continuous supervision, we always look at the data to</p>	<p>The following was identified:</p> <ul style="list-style-type: none"> ○ The participants agreed that they use data for planning interventions ○ It emerged that the team was very comfort with the use available data ○ Emphasis was on the time 	<p>All the respondents have convergent views</p>

<p>decide on the performance of any health center”</p> <p>“We have a monthly meeting with the Senior nurse managers (Titulaires) and one of the points we discuss is reported data. what we discuss is basically what we identified as errors in their reports and suggest and agree on potential corrections, decisions are made, and the way forward is decided together”</p> <p>“indeed we use data as they are reported to monitor the progress of health centers and the hospital”</p> <p>“We do not have connection with data, but we use data in the practice, just to plan our work, you can see that even at the OPD, consultations rooms may change in number because of a know period of time whereby diseases increase ”</p> <p>“Okay, we really find ourselves very busy, yes we use data, but we do not have time for example to go back and what happened and what is currently happening so that we can compare and establish trends of diseases, we just work and work, too busy, so really available data is remembered sometimes”</p> <p><i>Almost all roughing!</i></p>	<p>constraint with data quality management</p>	
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<p><i>Question 4: How data helps you in relation to your work as a Health Worker?</i></p>		
<p>“As we said earlier, we do evaluation of health center and we keep the records, the central level evaluate the district hospital by the peers, and we know our performance, basically that is what we do with data reported from all over”</p> <p>“you know everything we do, data helps us in deciding what to plan for, what should be the priority, all is based on the available data”</p> <p>“Yes, for example when we get feedback from central level, we do corrections they suggest us to do, we evaluate report from health center and send them the feedback, and they can do corrections of identified errors, etc”</p> <p>“Mainly you know the PBF, we always use data and reports to allocate marks to the health center, we do a lot with data”</p> <p>“Yeah, talking about the evaluation, the central level conduct data quality audit for maternal mortality, and this helps us to know where we have to correct, where we have to put more effort , etc”</p>	<p>The following was identified:</p> <ul style="list-style-type: none"> ○ Data was used mainly in evaluation of the performance of health centers and district hospital 	<p>All the respondents have convergent views</p>

Question 5: What, if any, are the problem areas of the health information system in daily operation?

“We have too much work; we can treat a big number of people and register few, which happens sometimes to be true, to work a very few number of nurses is a crucial problem!”

“The supervision has been suggestion an daily data compilation, but there is no tool to do it, if we had it we could try and see what it gives”

“We need to be trained as data managers and supervisors are trained, if we have to really produce data with quality”

“I think all health professional need to have a habit of recording everything they do, even though they are having a lot of work, which true, but really doing their best to record everything they do, nurse, medical doctors, lab technicians, that the starting point for the quality of data to be real!”

“Yeah, but we need to discuss the feasibility and strategies for the quality of health data quality management, I think; if we have to increase days of data collection and prepare the report, because we are overloaded and we find ourselves not really doing right things!”

The following issues were identified, almost similar to health center level:

- Overloading work
- Lack of standardization and stability of data management tools
- Lack of training
- Short time for collection and reporting processes
- Incomplete registers and patients’ files
- Missing data
- Lack of information culture

All the respondents have convergent views

<p>“We need data collection tools to be standardized and available, such as the daily data compilation, among others”</p>		
<p><i>Question 6: How can the health information system be improved to make it more useful in different management areas?</i></p>		
<p>“I said it earlier, let all us try to be responsible of data quality management, particularly when registering the cases, and when reporting, not only the Unit manager or the data manager”</p> <p>“I think we can also try the system daily compilation of data, I think that can help to improve the quality of data”</p> <p>“A feedback is also important, supervisors and data manager could give us the feedback in different services, if the central level does not do it, our team can help to improve thinks”</p> <p>“Yes, also the central level should give us feedback, not only on the report but also on the patients we always refer to referral hospitals and we do not receive any feedback from them”</p>	<p>The following were identified:</p> <ul style="list-style-type: none"> ○ Training for health care professionals is needed ○ Suggestion to use daily data compilation model ○ Standardize data collection and reporting tools ○ Data quality audit (DQA) to be the routine and formative in nature ○ Feedback to be given systematically 	<p>All the respondents have convergent views</p>

<p>“the training as well, do not forget it, because I think that what will make everyone responsible”</p>		
<p><i>Question 7: How can the health information system be improved to make it more user-friendly for CHWs, Health Centre and Hospital?</i></p>		
<p>“I think it is the same as we said, we need all people being trained, have data collection tools be standardized and available, all people responsible,...”</p> <p>“Yeah, the data quality audit should be done for other diseases as well, not only for maternal mortality, TB, and malaria, because of the money deployed in, I think we need to make the DQA a routine and all levels involved, we can improve, you know”</p> <p>“I think in a hospital like this one, we may propose that we start entering data in the computer daily, I think this would be very helpful”</p> <p>“We had so many registers; I think with the new registers, we not need to have PBF registers, cases registers, the new one may be considered as enough because I can see that they are comprehensive. I also support using computerized system in our hospital”</p>	<p>The following was suggested:</p> <ul style="list-style-type: none"> ○ Daily data compilation and cumulative data gathering ○ Training all Health professional ○ Standardize data management tools, including computerization of medical records ○ Routine data quality audit (DQA) 	<p>All 14 participants had convergent views</p>