



**A COMPARATIVE STUDY ON DATA COLLECTION METHODS;
DIGITAL VERSUS PAPER BASED FOR COMMUNITY HEALTH
SURVEYS**

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College of Medicine and Health Sciences

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MASTERS OF SCIENCE IN HEALTH INFORMATICS

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by

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A dissertation submitted in partial fulfillment of the requirements for the degree of

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in the

COLLEGE OF MEDICINE AND HEALTH SCIENCES

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Kigali June 2016

DECLARATION

“I do hereby declare that this research dissertation submitted in partial fulfillment of the requirements for the degree of Master of Science in Health Informatics, at College of Medicine and Health Sciences, University of Rwanda, is my original work and has not previously been submitted elsewhere. Also, I do declare that a complete list of references is provided indicating all the sources of information quoted or cited.

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Date:/...../.....

AUTHORIZATION

Dr David TUMUSHIME

In my capacity as a Supervisor, I do hereby authorize the student to submit his dissertation.

Signature:

Date:/...../.....

DEDICATION

I dedicate this work to:

My wife NYINAWUMUNTU Jeanne;

My two daughters INEZA KUNDWA Michelle and INEZA SHIMWA Christelle;

My classmates, especially Mr Boney MUTABAZI;

My work colleagues, especially Mr Francois Xavier SUNDAY and Mr Reverien RUTAYISIRE;

All people who have contributed to the success of this work.

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Finally, my gratitude and appreciation go to my classmates and friends whose contribution to this study was in one way or another.

ABSTRACT

Background: This study has compared two community data collection methods, digital data collection to paper-based by focusing on three aspects: the quality of the data collected using each method, the cost involved in using each method for short and long term and the time consumed when collecting Community Health Data using each method.

Aim: The aim of this study was to compare the two data collection methods with the target of finding the best to be used for conducting community surveys. This study answered the following question: Between digital data collection method and paper based data collection method which one is the best in terms of the quality of collected data, cost effectiveness and time consumed for community health data collection?

Methods: After getting the permission to conduct this study granted by IRB office and the authorization to conduct data collection granted by the Principal of the college of Medicine and Health sciences, a self administered questionnaire was distributed to the study participants and used to gather information for the current study. All data gathered on the returned surveys were entered in an Excel master file. The analyses were generated using Stata version 13 Data Analysis and Statistical Software.

Results: In this study, it is found that researchers from UR-CMHS used much more paper based data collection method (74.32% from Table 4.2) than digital data collection method (22.97%). But, when respondents were asked to make a choice among the two data collection method for the next data collection activities, 74.67% of participants (From Table 4.3) have chosen to use Digital data collection method against 25.77% who have chosen to use paper based data collection method.

Conclusion: The final results of this study show that Digital Data collection method is the best one when it is compared to paper based data collection, since it presents good data quality, it is cheaper when used in long term and it is faster than paper based, which accelerate the feedback to the community.

Keywords: *Paper based data collection method, Digital data collection method, Data collection methods, Questionnaire.*

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List of Symbols and Abbreviations

CMHS: College of Medicine and Health Sciences

DDC: Digital Data Collection

EDC: Electronic Data Capture

GPS: Global Positioning System

IRB: Institutional Review Board

PBDC: Paper Based Data Collection

UR: University of Rwanda

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CHAPTER 1: INTRODUCTION

1.1. Definitions of key terms pertinent to the study.

Data. In computing, data is information that has been translated into a form that is more convenient to move or process. Relative to today's computers and transmission media, data is information converted into binary digital form (1).

Data collection. Data collection is the systematic approach to gathering and measuring information from a variety of sources to get a complete and accurate picture of an area of interest. Data collection enables a person or organization to answer relevant questions, evaluate outcomes and make predictions about future probabilities and trends. Accurate data collection is essential to maintaining the integrity of research, making informed business decisions and ensuring quality assurance (2).

Paper based data collection method. It is a traditional approach to data which involves using questionnaires printed on paper and filled in manually by the enumerators during the interview (3).

A paper based data collection is a completely paper-based system designed to collect clinical/ community data in a paper format and used for educational/ research purposes (4).

Mobile electronic devices. They are also known as a handheld computer. A mobile electronic device is a small, handheld, computing device that typically has a display screen with touch input or a miniature keyboard. The device has an operating system that can run various application software and allows connections to the internet (4).

1.2. Background to the study

In the last three decades, private sector companies use ICTs as a tool for supply chain management, market research, and for monitoring and evaluation purposes. In more recent years the use of ICTs has been adopted by the development and humanitarian sector where in the past, paper based surveys were the most common method for monitoring and evaluation. Paper-based methods are relatively costly, time-consuming, and largely susceptible to human error. While still in use by the majority of practitioners and projects, paper-based methods can take months or years to complete, from research design, through data-collection, inputting cleaning and analysis, to dissemination of findings. The output from such research can be delayed to such an extent that when the findings are released, they are of limited use, due to being out-of-date, or at least losing their original currency (5).

Digital Data collection method is increasingly being chosen by investigators and sponsors of community Health researches instead of the traditional paper based data collection method (6).

The University of Rwanda is an academic institution with seven colleges dispatched all around Rwanda in different campuses. The mission of UR is to deliver quality education and develop innovative teaching and research meant to address the problems of the population, the students, the nation, the region and the world (7).

To achieve its mission, the University of Rwanda has a big number of staff and among it there are academic and administrative staff also called support staff. The academic staff has three main activities to accomplish, teaching students, conducting researches and community engagement. Among the conducted researches a big number is conducted in the community (7). To collect information from the population, researchers conduct the community surveys. Those surveys can be conducted in different ways such as hard copy survey questionnaire, which is a traditional method and it is called paper based data collection method or using digital devices, which is modern method and it is called digital data collection method.

This study has compared the two data collection methods, digital and paper based by focusing on three aspects: the quality of the data collected using each method, the cost involved when using each data collection method and in short and long terms and the time consumed by each method when collecting Community Health Data.

It emphasised on community Health Data because Health Data are more sensitive than any other type of data. This study on the comparison of the two data collection methods; Digital and paper based has focused largely on own perspectives of UR-CMHS staff. The research outcomes will make a valuable contribution in the field of community surveys to the University of Rwanda in General and to the college of Medicine and Health Sciences in particular.

1.3 Problem Statement

Most of researchers from UR-CMHS are using paper based data collection method to collect health information from the community, situations where there is a need of two teams to carry out the task, one team of enumerators for community data collection and another team of clerks for data entry exercise. Moreover, when clerks are entering data from hard paper questionnaires to computers there is a big number of errors induced due to may be a bad hand writing of enumerators, bad reading of the clerks or typing errors. Otherwise, by using digital data collection method, only one team of enumerators is involved, which reduces the number of research personnel as well as the number of errors which can occur during the data collection exercise.

There was no comparative study done between the paper based and digital data collection methods. This study aims to compare both methods to find out which one is better, in terms of quality of data, cost effectiveness and time consumption and inform researchers of UR-CMHS on which one is suitable for Community health data collection.

1.4. Objectives

1.4.1. Main Objective

The main objective of this study was to compare two community data collection methods digital and paper based, used at the college of Medicine and health Sciences, in terms of quality of collected data, cost involvement and time consumption.

1.4.2. Specific Objectives

- i. To evaluate the quality of data collected using each of the two data collection methods;

- ii. To assess the cost involved in collecting community health data using each of the two data collection methods in long and short terms;
- iii. To compare the time consumed while collecting community health data using each of the two data collection methods;
- iv. To determine which one to be recommended to the researchers of the College of Medicine and Health Sciences at the University of Rwanda for community health data collection.

1.5. Research Question

Between digital data collection method and paper based data collection method which one is the best in terms of the quality of collected data, cost effectiveness and time consumed for community health data collection?

1.6. Significance of the study

This study has compared two community data collection methods which are frequently used.

This study will make a significant contribution to knowledge in the field of community health data collection by generating substantive theory which will lead to understanding the situation faced by UR-CMHS researchers who are conducting community surveys in the field of health.

After the completion of this study, the outcomes will enhance the knowledge of researchers of UR-CMHS on how to make good choice on the method to be used for community health data collection before starting community health surveys.

1.7. Subdivision of the Project

This study is subdivided in 6 main chapters and each chapter has also its subchapters.

The following are those main parts:

Chapter one (Introduction): This part contains definitions of key terms, background of the study, problem statement, objectives, research question, significance of the study, and subdivision of the project.

Chapter two (Literature review): This part relates different researches previously done on the current study.

Chapter three (Methodology): This part shows in details the way the study was conducted. It is comprised of study area, study design, study population, study sample, sampling strategy, data collection methods and procedures, data Analysis, problems and limitations of the study and ethical considerations.

Chapter four (Results): This part shows the results obtained during the study in relation with the study objectives.

Chapter five (Discussion): This part provides the discussion of the study results in relation to relevant literature.

Chapter six (Conclusion and Recommendations): This part summarizes the key findings of the study and describes recommendations from the study for the future researches.

CHAPTER 2: LITERATURE REVIEW

There have been extensive researches relating the two methods of data collection and comparison of the quality of data collected, cost involvement, time requirement, advantages, disadvantages and limitations when using each the two methods of data collection, paper based and digital method.

2.1. Limitations of paper based data collection method

In order to collect household or individual surveys, the traditional approach to date has involved using questionnaires printed on paper and filled in manually by the enumerators during the interview. In the evening, the survey supervisors and coordinator check the quality and consistency of the responses reported in the questionnaires. Once all the interviews have been conducted and the fieldwork is concluded, data-entry clerks transcribe the information from the paper questionnaire into a digital format (3).

There are two main problems with the process as it stands:

2.1.1. The quality of the data

There are a number of opportunities for the introduction of errors during the data-collection and data-entry processes.

2.1.2. The time lag between data collection and when the data is ready for analysis

This can prevent or significantly delay feedback to communities.

Reducing the amount of errors is particularly important in the case of impact evaluations with a limited sample size.

Given the high probability of error during the data-entry process, this is normally conducted twice by two different data-entry clerks. Where there is a mismatch between the two entries, a third check is required. This process can take up to a month and costs roughly 10 per cent of the total budget for data collection. Given the timescales, it becomes challenging to analyze the data in time to offer feedback and verify findings with the communities that have been surveyed, this being an important accountability process for the communities involved in the study (3).

2.2. Key advantages of digital data collection

This section will describe the considerations used and the advantages found in using digital devices. These are summarized under five thematic areas: accuracy, timing, costs, accountability, and data security.

2.2.1. Timing

Using digital devices has the potential to reduce the time it takes to complete the data-collection process. Firstly, introducing digital processes reduces the time required to conduct an interview. This can be seen in household surveys, which can be long and complicated, particularly in sections related to household/individual consumption. While with paper the enumerator has to learn when and how to skip questions that do not apply, the digital software assists the automation of the presentation of questions for the enumerator. Questionnaires can be programmed so that questions are presented interactively and questions that should not be asked are automatically skipped (3).

Secondly, and possibly most importantly, using digital devices reduces the time required for researchers to obtain the data, due to the removal of the data-entry process. Converting data collected on paper into a digital file could take up to a month, but the use of digital devices allows access to the data almost instantly, as the supervisors or enumerators upload the data nightly (3).

Finally, using digital surveys also improves the quality of the data collected, which means that the time required for data cleaning is also reduced. Before being able to conduct statistical analysis, data need to be cleaned and variables properly labeled. This process can take several days. However when data are collected digitally, the structure and control imposed in the software means data are ready for variable construction in a significantly shorter length of time. This is because collecting data via digital surveys reduces the prevalence of outliers and automatically assigns a label to the variable based on the survey question (3).

However, despite an overall improvement in time taken to obtain an aggregated data set, it should be noted that preparing for a digital survey requires time to be allocated during earlier steps in the fieldwork process. Similarly, additional time needs to be added to train the enumerators in conducting digital surveys (3).

2.2.2. Accuracy

There are two main reasons why digital data allow more accurate measurements than data collected through the paper process. Firstly, the data-entry process is not needed, thereby removing several steps involving different people where errors can be introduced. Secondly, depending on the tool selected, digital software can support the use of data-quality checks that improve the accuracy of data received (3).

The technology also supports the remote monitoring of the data collected by each enumerator, raising flags if a particular enumerator is performing differently or collecting information that is significantly different from that of the rest of the team.

Data-quality previously relied on the ability and diligence of the survey manager in checking all of the questionnaires and entries manually each evening. By automating much of this process, survey managers, as well as key stakeholders, are able to monitor aggregated data, which automates much of a previously time-consuming process (3).

2.2.3. Accountability and participation

One key problem with data-collection processes based on paper questionnaires is the inability to analyze data quickly and the failure to provide prompt feedback to the communities interviewed. Using digital data-collection tools allows the researchers who set up the data collection process to access data instantly; generating preliminary summary statistics while data collection is still taking place in the field (3).

These preliminary statistics can be used for accountability and to feed back the results to those interviewed. Feedback has suggested that communities often feel that there is an abundance of data-collection taking place in their villages; however, they feel they have little information about the results and findings of these studies. Using digital surveys means that basic summary statistics and graphs can be generated and shared almost instantly while the data-collection team is still in the field. It should be noted that this process shouldn't in any way replace the need to share and circulate the results of the final evaluation to the communities (3).

2.2.4. Data security

Data security must be a priority for anyone collecting identifiable or personal information. Paper surveys, in particular, can leave data very vulnerable as the process requires a number of steps where raw data is exposed. The information is physically

stored on paper and so if the questionnaires are lost or stolen, either during the fieldwork or after it is concluded, it is relatively easy to access and interpret the information collected and transcribed (3).

There are also more people involved in seeing the data: the enumerator, data-entry clerks, consultants and headquarters staff at a minimum. With digital surveys, only the enumerators (at the point of data entry) and selected staff with administrator rights are able to see all of the information. Others, such as the survey supervisors and survey coordinator, while monitoring the quality of the data, may see parts, but this can exclude anything deemed sensitive (3).

Informed consent and confidentiality agreements for data handlers remain in place regardless of whether the process is carried out in a digital or paper format. An additional paragraph is added to the informed consent for the digital survey explaining the use and effect of digital devices in data collection (3).

2.2.5. Cost

The cost of digital surveys varies depending on the hardware and software used. The cost of the software is minimal compared with the typical cost of data entry, with offices already having tablets and mobile devices that are regularly used to conduct data collections. Where hardware is not available, the money saved on data entry is unlikely to cover the full cost of procurement; it would depend on the local cost of devices and the number of devices required, as well as the sample size for the household survey (3). Therefore, buying devices for a one-off evaluation might not be justified in terms of value for money. However, country teams are increasingly using mobile devices, and so where there is interest and willingness to extend their use more widely to local data-collection exercises, the investment in deciding to 'use digital' may well be worth considering. The cost would vary by country, but if long-term use is planned for the devices, costs would be recouped through the savings made on data entry within a relatively short period of time (3).

2.3. Other related studies

So many other studies were conducted relating the used of Digital instruments for community data gathering and paper based from different places around the world. Here below are some of the conducted studies.

Dr Thomas Bart in his article entitled “Comparison of Electronic Data Capture with Paper Data Collection – Is There Really an Advantage?” has mentioned the cost reduction when gathering data using digital means in the following words.

All the aforementioned analyses have one thing in common: they underline the value of EDC as a cost and time-saving instrument in modern clinical research (8).

Regardless of method and trial, EDC could fulfill in all examined parameters its promises, realizing cost savings of up to a factor of 5.8 in comparison with paper data capture (8).

There exists a multitude of reasons for the relatively slow adoption of this new technology, for example inertia of a conservative, heavily regulated market, service providers feeling uneasy of adopting a new method capable of transforming their entire business model, the extreme frequency of change both in hardware and software products, etc. However, the message is clear: EDC will acquire a clear majority of the market for data capture and data processing in clinical research in the near future (8).

Even those who are skeptical about too optimistic expectations regarding EDC can save precious time to market and reduce financial commitments in development. EDC will contribute to this goal, which is inevitable in today’s cost-sensitive environment.

With increasing experience and availability of more objective data on EDC, it will become more and more difficult, perhaps impossible, to cast away a technology that is capable of delivering significant business value to the client in reducing overall costs and accelerating development time. It is our conviction that EDC will sooner or later be the standard in clinical research data capture (8).

Kizito Shirima, Oscar Mukasa, Joanna Armstrong Schellenberg, Fatuma Manzi, Davis John, Adiel Mushi, Mwifadhi Mrisho, Marcel Tanner, Hassan Mshinda and David Schellenberg in their article entitled “The use of personal digital assistants for data entry at the point of collection in a large household survey in southern Tanzania” published in 2007 have mentioned the advantages of using PDA for household surveys in Tanzania.

The use of PDAs eliminated the usual time-consuming and error-prone process of data entry and validation. PDAs are a promising tool for field research in Africa (9).

Kamala Thriemer, Benedikt Ley, Shaali M Ame, Mahesh K Puri, Ramadhan Hashim, Na Yoon Chang, Luluwa A Salim, R Leon Ochiai, Thomas F Wierzba, John D Clemens, Lorenz von Seidlein, Jaqueline L Deen, Said M Ali and Mohammad Ali have mentioned

also the advantages of using electronic data entry in their article entitled “Replacing paper data collection forms with electronic data entry in the field: findings from a study of community-acquired bloodstream infections in Pemba, Zanzibar” published in 2012.

Electronic data collection offers direct data entry at the initial point of contact. It has numerous advantages and has the potential to replace paper-based data collection in the field. The availability of information and communication technologies for direct data transfer has the potential to improve the conduct of public health research in resource-poor settings (10).

Christian Schuster and Carlos Perez Brito in their article “Cutting costs, boosting quality and collecting data real-time – Lessons from a Cell Phone-Based Beneficiary Survey to Strengthen Guatemala’s Conditional Cash Transfer Program” published in 2010, are highlighting the advantages of collecting data using mobile phone.

Mobile phones are increasingly powerful tools for data collection. In the future, ongoing technological advances and increased access will further improve the potential of mobile phones for accurate data collection. Mobile phones with Global Positioning System (GPS) capabilities, for example, could detect the aforementioned data fabrication. Recognizing and harnessing this potential can provide high returns for future survey exercises and, as such, strengthen program governance in a quick, accurate and cost-effective manner -- in particular in rural and marginalized areas (11).

CHAPTER 3: METHODOLOGY

3.1. Study Area

The study was conducted at the college of Medicine and Health sciences, University of Rwanda. UR-CMHS is an academic institution which is located within six campuses, Nyarugenge, Nyamishaba, Huye, Byumba, Kibungo and Kicukiro. It is chosen because it is the only one college in the University of Rwanda which is deals much with the community health.

3.2. Study Design

This was a cross-sectional study. This quantitative study involved the use of numbers to assess information, which information was later analyzed by the use of statistical analysis.

3.3. Study Population

The study population was all University of Rwanda, College of Medicine and Health Sciences staff. That is including both Academics and Administration. They total up to **422** persons.

3.4. Study Sample

a. Definitions

Margin of error

The margin of error is the level of precision you require. This is the plus or minus number that is often reported with an estimated proportion and is also called the confidence interval. It is the range in which the true population proportion is estimated to be and is often expressed in percentage points (e.g., $\pm 2\%$). Note that the actual precision achieved after you collect your data will be more or less than this target amount, because it will be based on the proportion estimated from the data and not your expected sample proportion (13). For this study the margin of error used was $\pm 10\%$.

Confidence level

The confidence level is the probability that the margin of error contains the true proportion. If the study was repeated and the range calculated each time, you would expect the true value to lie within these ranges on 95% of occasions. The higher the confidence level the more certain you can be that the interval contains the true proportion (13). For this study a confidence level of 95% was used.

Population size

This is the total number of distinct individuals in your population. In this formula we use a finite population correction to account for sampling from populations that are small. If your population is large, but you don't know how large you can conservatively use 100,000. The sample size doesn't change much for populations larger than 100,000 (13). For this study the population size is **422** persons.

Sample proportion

The sample proportion is what you expect the results to be. This can often be determined by using the results from a previous survey, or by running a small pilot study. If you are unsure, use 50%, which is conservative and gives the largest sample size. Note that this sample size calculation uses the Normal approximation to the Binomial distribution. If, the sample proportion is close to 0 or 1 then this approximation is not valid and you need to consider an alternative sample size calculation method (13).

Sample size

This is the minimum sample size you need to estimate the true population proportion with the required margin of error and confidence level. Note that if some people choose not to respond they cannot be included in your sample and so if non-response is a possibility your sample size will have to be increased accordingly. In general, the higher the response rate the better the estimate, as non-response will often lead to biases in your estimate (13).

b. Formula

$$n = N * X / (X + N - 1),$$

where,

$$X = Z_{\alpha/2}^2 * p * (1-p) / MOE^2,$$

n is the needed sample size,

N is the population size

$Z_{\alpha/2}$ is the critical value of the Normal distribution at $\alpha/2$, for this study the confidence level is 95%, α is 0.05 and the critical value is 1.96,

MOE is the margin of error, for this study it is +/- 10%,

p is the sample proportion (13).

Making all necessary calculations, I have got a sample size of **79** participants.

3.5. Sampling Strategy

Purposive sampling method was used to get a sample of the present study.

Inclusion criteria: Study population who would consent to participate.

Exclusion criteria: participants who would decline to consent.

3.6. Data Collection Methods and Procedures

A self administered questionnaire was distributed to the study participants and used to gather information for the current study. (See appendix II). That structured questionnaire was adapted from the questionnaire used for another study titled “A Comparative Analysis of Data Collection Systems Used in Radiography Educational Programs and the Role Mobile Electronic Devices Play”, conducted at *East Tennessee State University in 2015* (4).

Ninety surveys were distributed to staff of U-RCMHS and among them 82 completed surveys were returned, which makes 91.1% participation. All data gathered on the returned surveys were entered in an Excel master file.

3.7. Data Analysis

Descriptive Statistics was used. The analyses were generated using Stata version 13 Data Analysis and Statistical Software. The Microsoft Excel package was also used generate figures.

3.8. Study Limitations

This study had two limitations.

The first one was that during the data collection, there was examination at the college of Medicine and health sciences and most of the staff was very busy and this led to failure of some participants to fill the questionnaire.

The second limitation is that the study was supposed to be completed within a specified time period to meet the academic requirements.

Despite these limitations, the outcomes and information obtained are enough to be used to compare digital and paper based data collection methods.

3.9. Ethical Considerations

Permission to conduct the study was sought from the Institutional Review Board (IRB) of the college of Medicine and health sciences, University of Rwanda. (Appendix IV). The authorization to conduct data collection was granted by the Principal of the college of Medicine and Health sciences. (Appendix V). Informed approved consent forms were signed by the participants.

Participants were informed that their participation was entirely voluntary. Information from the participants was kept confidential and used for study purposes only. To preserve the anonymity of the participants' information, the researcher gave codes to questionnaires instead of participants' names.

CHAPTER 4: RESULTS

4.1. Introduction

In this chapter, the results of the study were analyzed using STATA SE 13 Data Analysis and Statistical Software. The data were presented and described by means of tables and charts. The data presentation is also based on the questionnaire used for information gathering.

Demographic data for Age, sex, Residence and working position were based upon the total sample size of 82 respondents who provided complete data. These descriptive statistics are presented in frequency distribution tables for each demographic variable.

4.2. Social demographics

Age in Years

Respondents were asked to indicate their age, according to 10-years ranges. They could indicate 20-30, 31-40, 41-50, 51-60 and 61 and above. In this study, the majority of respondents (55 individuals) was reported being in the 31-40 age group. This represented 67.07 percent of 82 total respondents. The 41-50 age group and the 20-30 age group represented 17.07% and 12.2% of the respondents respectively. Three individuals identified themselves with the 51-60 age group which represented 3.36% of all respondents. No participant fell within the 61 and above age group. (See Table 4.1)

Sex

Respondents were asked to indicate their gender. In this study, 53.09% of the respondents were female and 46.91% were male. Only one respondent did not complete this question. (See Table 4.1).

Residence

Respondents were asked to indicate where they live. In this study, 83.75% of the respondents were living in Urban and 16.25% were living in rural areas. Only two respondents did not complete this question. (See Table 4.1).

Working position

Respondents were asked to indicate their working position. In this study, 92.59% of the respondents were academic staff and 7.41% were administrative staff. Only one respondent did not complete this question. (See Table 4.1).

Table 4. 1: Social demographics

		Frequency	Percentage
Age in years	20-30	10	12.2(%)
	31-40	55	67.07(%)
	41-50	14	17.07(%)
	51-60	3	3.66(%)
	Total	82	100
Gender	Male	38	46.91(%)
	Female	43	53.09(%)
	Total	81	100
Residence	Urban	67	83.75(%)
	Rural	13	16.25(%)
	Total	80	100
Working position	Academics	75	92.59(%)
	Administration	6	7.41(%)
	Total	81	100

4.3. Data collection and Research experience

Working experience: Number of years in the academic field

Respondents were asked to indicate the number of years they had worked in the academic field. Responses ranged from zero to 8 years and above of experience. The highest percentage of respondents fell within the 2-4 years category and made up 55.56 percent of total respondents. Respondents who had worked in the academic field for 4-6 years made up 17.28 percent of total respondents. Respondents who had worked in the academic field for two years or less made up 12.35 percent of total respondents. Respondents who had worked in the academic field for 8 years or more made up 9.88 percent of total respondents. Respondents who had worked in the academic field for 6-8 years made up 4.94 percent of total respondents. (See Table 4.2).

Participation in data collection activities

Respondents were asked to indicate whether they have participated in data collection activities or not. Of 82 respondents in this study, 90.24% of the respondents had participated and 9.76% did not participate. (See Table 4.2).

Previously used method

Respondents who had participated in data collection activities were asked to indicate which data collection method they have used. Of 74 participants who had participated in data collection activities in this study, 74.32% respondents have used paper based data collection method, 22.97% respondents have used digital data collection method and 2.7% respondents have used other methods. (See Table 4.2).

Reason for not using DDC method

Respondents who had used other data collection methods than digital were asked to indicate the reason why they did not chose DDC method. Of 57 participants who have used other data collection methods than DDC in this study, 59.65% respondents have indicated that it is the lack of fund, 36.84% respondents have indicated that it is the lack of enough information about Digital data collection method and 3.51% respondents have indicated that there were other reasons. (See Table 4.2).

Table 4. 2: Data collection and Research experience

		Frequency	Percentage
Working experience	0-2	10	12.35(%)
	2 to 4	45	55.56(%)
	4 to 6	14	17.28(%)
	6 to 8	4	4.94(%)
	8 and above	8	9.88(%)
	Total	81	100
Participation in data collection	Yes	74	90.24(%)
	No	8	9.76(%)
	Total	82	100
Previously used method	Digital	17	22.97(%)
	Paper based	55	74.32(%)
	Others	2	2.7(%)
	Total	74	100
Reason for not using DDC	Lack of info	21	36.84(%)
	Lack of fund	34	59.65(%)
	Others	2	3.51(%)
	Total	57	100

4.4. Data collection methods comparison

Data quality comparison

Respondents were asked to compare the quality of data collected using each of the data collection methods digital and paper based. Of 78 participants who responded to this question, 67.95% indicated that data collected using DDC has better quality than data collected using PBDC. Conversely, 30.77% indicated that data collected using PBDC method has better quality than data collected using DDC and 1.28% did not know the answer. (See Table 4.3)

Cost comparison

Respondents were asked to compare the cost involved in collecting data using each of the data collection methods DDC and PBDC for short and long term. Of 79 participants who responded to this question, 68.35% indicated that DDC is cheaper than PBDC.

Conversely, 29.11% indicated that PBDC is cheaper than DDC and 1.28% did not know the answer. (See Table 4.3)

Timing comparison

Respondents were asked to compare the time involved in collecting data using each of the data collection methods DDC and PBDC. Of 79 participants who responded to this question, 77.22% indicated that DDC is faster than PBDC. Conversely, 22.78% indicated that PBDC is faster than DDC. (See Table 4.3)

Next choice comparison

Respondents were asked to make a choice of the next data collection method they should use if they were given an opportunity to conduct a full sponsored research. Of 75 participants who responded to this question, 74.67% have chosen DDC; conversely, 25.33% have chosen PBDC. (See Table 4.3).

Table 4. 3: Data collection methods comparison

		Frequency	Percentage
Good quality choice	DDC	53	67.95(%)
	PBDC	24	30.77(%)
	Don't know	1	1.28(%)
	Total	78	100
Good cost choice	DDC	54	68.35(%)
	PBDC	23	29.11(%)
	Don't know	2	2.53(%)
	Total	79	100
Good time choice	DDC	61	77.22(%)
	PBDC	18	22.78(%)
	Total	79	100
Next choice	DDC	56	74.67(%)
	PBDC	19	25.33(%)
	Total	75	100

CHAPTER 5: DISCUSSION

5.1. Introduction

This chapter discusses the findings of this study which involved 82 participants from the College of Medicine and Health sciences/University of Rwanda. This study was done with the aim of comparing two community data collection methods, digital and paper based, in terms of quality of collected data, cost involved in collecting data and time involved for collecting data. The order of the discussion is as follows based on the study objectives: Firstly demographic data. Secondly, Research and community data collection experience. Thirdly, data collection methods comparison.

5.2. Demographic data

Age in years: In this study, a big number of UR-CMHS staff ranges from 31-40 (67.07% from Table 4.1). Probably this is due to the fact that being a staff of UR-CMHS you must be at least holding a bachelor's degree, and this institution is employing so many young graduates holding bachelor's as well as master's degrees.

Sex: In this study the gender is almost balanced at the UR-CMHS. From Table 4.1, Staff male is represented by 46.91% whereas female staff is represented by 53.09%.

Residence: In this study, 83.75% of UR-CMHS staff is living in urban. This is due to the fact that most of UR-CMHS campuses are located in urban areas.

Working Position: In this study, a big number (92.59% from table 4.1) of participants is from academic staff. This is due to the fact that Administrative staff has denied to participate in the study, saying that it does not know anything about research.

5.3. Data collection and research experience

Working experience: In this study, a big number (55.56% from Table 4.2) of participants is ranging in 2 to 4 years of experience. This has a relationship with the fact that UR-CMHS is employing a big number (67.07% from table 4.1) of young graduates ranging from 31 to 40 years old, as it was stated earlier.

Participation in data collection activities: In this study almost all participants (90.24% from Table 4.2) have participated in data collection or research activities. This is due to the fact that those who did not participate even once have denied taking part in this study.

Previously used data collection method: From this research, researchers from UR-CMHS used much more paper based data collection method (74.32% From Table 4.2) than digital data collection method (22.97%).

These numbers are confirming the problem statement which stated that “Most of researchers from UR-CMHS are using paper based data collection method to collect health information from the community”.

Reason for not using Digital data collection method: In this study, 59.65% (From Table 4.2) of participants who answered this question said that it is due to lack of fund and 36.84% said that it is due to the lack of information. In the coming discussions it will be shown that “lack of fund” had not to be the reason of not using Digital Data collection method.

5.4. Data collection methods comparison

Data quality comparison: In this study, 67.95% of respondents (From Table 4.3) have chosen Digital data collection method as the one providing data with good quality against 30.77% who has chosen paper based data collection method. These numbers are responding to the specific objective number one, which was “To evaluate the quality of data collected using each of the two data collection methods”. They also confirm the statement of Emily Tomkys and Simone Lombardini in their article “GOING DIGITAL” published in September 2015, which said that the quality of data collected using digital devices is higher than that of data collected using paper based data collection method (3).

Cost comparison: In this study, 68.35% of respondents (From Table 4.3) have chosen Digital data collection method as cheaper against 29.11% of respondents who have chosen paper based data collection method. This confirms the findings from Dr Thomas Bart in his article entitled “Comparison of Electronic Data Capture with Paper Data Collection – Is There Really an Advantage?” which mentioned the cost reduction when gathering data using digital means in the following words.

It says that “All the aforementioned analyses have one thing in common: they underline the value of EDC as a cost and time-saving instrument in modern clinical research (8).

These numbers are responding to the specific objective number two, which was “To assess the cost involved in collecting community health data using each of the two data collection methods in long and short terms”.

Timing comparison: In this study, 77.22% of respondents (From Table 4.3) have chosen Digital data collection method as faster against 22.78% of respondents who have chosen paper based data collection method. These numbers are responding to the specific objective number three, which was “To compare the time consumed while collecting community health data using each of the two data collection methods”. They also confirm the statement from Emily Tomkys and Simone Lombardini in their article “GOING DIGITAL” published in September 2015, which said that “Using digital devices has the potential to reduce the time it takes to complete the data-collection process” (3).

Next choice comparison: In this study, respondents were asked to make a choice among the two data collection method for the next data collection activities, if they were given an opportunity to conduct a full sponsored research. 74.67% of participants (From Table 4.3) have chosen to use Digital data collection method against 25.77% who have chosen to use paper based data collection method. These numbers are responding to the specific objective number four, which was “To determine which data collection method to be recommended to the researchers of the College of Medicine and Health Sciences at the University of Rwanda for community health data collection”.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 CONCLUSIONS

This study has compared two community data collection methods, Digital versus Paper based, used at the College of Medicine and Health Sciences, University of Rwanda, based on three factors, the quality of collected data, the cost involved for collecting data and the time consumed while collecting data.

The final results of this study show that Digital Data collection method is the best one when it is compared to paper based data collection, since it presents good data quality, it is cheaper when used in long term and it is faster than paper based, which accelerate provision of the feedback to the community.

6.2 RECOMMENDATIONS

Given the advantages of Digital data collection method, when compared to paper based data collection method for community health survey, I would like to recommend the following:

- In order to facilitate UR-CMHS researchers in their research activities, the College of Medicine and Health Sciences should avail Digital devices (Tablets or Smart phones) to be used for community data collection.
- This study was conducted at the college of Medicine and Health Sciences only and may not be indicative of responses from other colleges of The University of Rwanda. I would suggest future study to collect data from different colleges of the University of Rwanda and make the same study for the whole University of Rwanda.
- This study was conducted during a limited time. It would be more advantageous if it was given enough time for gathering more ideas from different informants.
- Researchers of UR-CMHS should move from paper based data collection method and start using Digital data collection method if they want to reduce the errors occurring during data collection activities, to reduce the cost involved during the data collection activities as well as to reduce the time consumed for data collection.

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APPENDICES

APPENDIX I: INFORMED CONSENT

Part I: Information sheet

Dear Madam/ Sir,

I am NSHIMIYIMANA Alexis, Student at the School of Public Health, College of Medicine and Health Sciences, University of Rwanda. I am here as a researcher to conduct a study on community data collection methods, titled “**a comparative study of data collection methods; digital versus paper based for community health surveys**”.

In this study I want to compare two community health data collection methods Digital and Paper based to find out which one is better, in terms of quality of data, cost effectiveness and time consumption. You are being invited to take part in this research because I feel that your working experience can contribute much to my understanding and knowledge on community health data collection methods.

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. If you choose not to participate, the choice that you make will have no bearing on your job.

If you accept, you will be asked to respond to the questionnaire which will be given to you. If you do not wish to answer any of the questions, you may skip it and move on to the next question. Your answers are confidential, and no one else except the researcher will access the information provided.

There will be no direct benefit to you, but your participation is likely to help me find out more about how to improve the quality of the Community Data collection activity at the college of Medicine and Health Sciences. You will not be provided any incentive to take part in the research.

The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. I will lock that information up with a lock and key.

If you have any questions, you can ask them now or later. If you wish to ask questions later, you may contact me on any of the following: NSHIMIYIMANA Alexis, phone number +250781521070 or e-mail nsalexis@khi.ac.rw.

This proposal has been reviewed and approved by CMHS-IRB, which is a committee whose task is to make sure that research participants are protected from harm. If you wish to find more about the CMHS-IRB, you can contact Brenda Asimwe Kateera on e-mail bkateera@gmail.com.

Part II: Certificate of Consent

I have been invited to participate in research about community data collection methods at the University of Rwanda, College of Medicine and Health Sciences.

I have read the foregoing information. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Name of participant: _____

Signature of Participant _____

Date ____/____/____

Day/month/year

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the survey about community data collection methods will take place.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this Informed Consent Form has been provided to the participant.

NSHIMIYIMANA Alexis

Signature _____

Date ____/____/____

Day/month/year

APPENDIX II: QUESTIONNAIRE

Form ID No:

Institution: **UNIVERSITY OF RWANDA**

College: **College of Medicine and Health Sciences**

School:

Campus:

Date:/...../.....

Introduction:

Dear participants,

Good day, my name is NSHIMIYIMANA Alexis, a student in the department of Health informatics, School of Public Health, College of Medicine and Health sciences of the University of Rwanda. As part of fulfillment of the criteria for completion of my master's studies, I have to write a research project.

The title of my research project is “**A COMPARATIVE STUDY OF DATA COLLECTION METHODS; DIGITAL VERSUS PAPER BASED FOR COMMUNITY HEALTH SURVEYS**”.

Through this brief survey, your answer will help me in completing this research project. This survey will take only 3 to 4 minutes to complete. Be assured that all answers you provide will be kept in the strictest confidentiality and only used for survey purposes. Your participation is entirely voluntary. In case you have any questions regarding the survey, please call me on 0781521070 or email me on nsalexis@khi.ac.rw.

Questions:

Directions: Please indicate your choice for each of the statements by checking in the box of your answer.

Section I: Social demographics

Q001: Age in years

1. (20-30) years
2. (31-40) years
3. (41-50) years
4. (51-60) years
5. (61 years and above)

Q002: Gender

1. Male
2. Female

Q003: Residence

1. Urban
2. Rural area

Q004: Working position

1. Academics
2. Administration

Section II: Data collection and Research experience

Q005: Working experience

1. (0-2) years
2. (2-4) years
3. (4-6) years
4. (6-8) years
5. (8 years and above)

Q006: Have you ever conducted/ participated in any academic research?

1. Yes
2. No

Q007: Have you ever conducted/ participated in data collection activities?

1. Yes
2. No

Q008: During that that data collection activities which data collection method have you used?

1. Digital (Tablet)
2. Paper based (Hard copy)
3. Others (specify)

Q009: Before starting that data collection activities, were you aware that digital data collection method (using smart phone or tablet) were existing?

1. Yes
2. No

Q010: If yes and if you have chosen another method than digital data collection, what were the main reasons of your choice?

1. Not having enough information
2. Not having enough fund to purchase materials
3. Other (specify)

Section IV: Data collection methods comparison

Q011: Can you rate the quality of data collected using paper based data collection method?

1. Very good
2. Good
3. Uncertain
4. Bad
5. Very bad
6. Don't know

Q012: Can you rate the quality of data collected using Digital data collection method?

1. Very good
2. Good
3. Uncertain
4. Bad
5. Very bad
6. Don't know

Q013: Among the two data collection methods which one has a good data quality?

1. Digital Data collection method
2. Paper based data collection method
3. Don't know

Q014: Can you rate the cost involved in collecting data using paper based data collection method?

1. Very cheap
2. Cheap
3. Moderate
4. High
5. Very high
6. Don't know

Q015: Can you rate the cost involved in collecting data using digital data collection method?

1. Very cheap
2. Cheap
3. Moderate
4. High
5. Very high
6. Don't know

Q016: Among the two data collection methods which one is cheaper than another?

1. Digital Data collection method
2. Paper based data collection method
3. Don't know

Q017: Can you rate the time used when collecting data using paper based data collection method?

1. Very short
2. Short
3. Moderate
4. Long
5. Very long
6. Don't know

Q018: Can you rate the time used when collecting data using digital data collection method?

1. Very short
2. Short
3. Moderate
4. Long
5. Very long
6. Don't know

Q019: Among the two data collection methods which one is faster than another?

1. Digital Data collection method
2. Paper based data collection method
3. Don't know

Q020: If you were given an opportunity to conduct a full sponsored research, involving community data collection, which method would you choose to use?

1. Digital Data collection method
2. Paper based data collection method
3. Other (specify)

This is the end of the questionnaire and I thank you very much for your participation!

APPENDIX III: RECOMMENDATION LETTER



College of Medicine and Health Sciences
School of Public Health

OFFICE OF THE DEAN

RECOMMENDATION

This is to testify that **Mr Alexis NSHIMIYIMANA** with registration number **216336864** is a last year student in Master's of Science in Health Informatics at the University of Rwanda, College of Medicine and Health Sciences, school of Public Health, during the academic year 2015- 2016. The student is doing research for final thesis titled:

" A COMPARATIVE STUDY ON DATA COLLECTION METHODS; DIGITAL VERSUS PAPER BASED FOR COMMUNITY HEALTH SURVEYS".

Any assistance rendered to him/her is highly appreciated.

Yours sincerely,

Done at Kigali, on 29th April, 2016.

A handwritten signature in blue ink, appearing to read 'Manasse NZAYIRAMBAHO', written over a horizontal line.

Prof. Manasse NZAYIRAMBAHO



Acting Dean

APPENDIX IV: ETHICAL CLEARANCE



UNIVERSITY OF
RWANDA COLLEGE OF MEDICINE AND HEALTH SCIENCES

CMHS INSTITUTIONAL REVIEW BOARD (IRB)

Kigali, 14/June/2016

NSHIMIYIMANA Alexis
School of Public Health, CMHS, UR

Approval Notice: No 256 /CMHS IRB/2016

Your Project title "*A Comparative Study On Data Collection Methods; Digital Versus Paper Based For Community Health Surveys*" has been evaluated by CMHS Institutional Review Board.

Name of Members	Institute	Involved in the decision		
		Yes	No (Reason)	
			Absent	Withdrawn from the proceeding
Prof Kato J. Njunwa	UR-CMHS		X	
Prof Jean Bosco Gahutu	UR-CMHS		X	
Dr Brenda Asiimwe-Kateera	UR-CMHS	X		
Prof Ntaganira Joseph	UR-CMHS		X	
Dr Tumusiime K. David	UR-CMHS	X		
Dr Kayonga N. Egide	UR-CMHS		X	
Mr Kanyoni Maurice	UR-CMHS	X		
Prof Munyanshongore Cyprien	UR-CMHS	X		
Mrs Ruzindana Landrine	Kicukiro district		X	
Dr Gishoma Darius	UR-CMHS	X		
Dr Donatilla Mukamana	UR-CMHS		X	
Prof Kyamanywa Patrick	UR-CMHS		X	
Prof Condo Umutesi Jeannine	UR-CMHS		X	
Dr Nyirazinyoye Laetitia	UR-CMHS		X	
Dr Nkeramihigo Emmanuel	UR-CMHS		X	
Sr Maliboli Marie Josee	CHUK	X		
Dr Mudenge Charles	Centre Psycho-Social	X		

After reviewing your protocol during the IRB meeting of where quorum was met and revisions made on the advice of the CMHS IRB submitted on 14th June 2016, **Approval letter has been granted to your study.**

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 enrolment of participants.
3. All consent forms signed by subjects should be retained on file. The IRB 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 IRB 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
6. Notify the IRB committee once the study is finished



Sincerely,

Professor Kato J. NJUNWA
**Chairperson Institutional Review Board,
College of Medicine and Health Sciences, UR**

Date of Approval: The 14th June 2016
Expiration date: The 14th June 2017

Cc:

- Principal College of Medicine and Health Sciences, UR
- University Director of Research and Postgraduate studies, UR

APPENDIX V: DATA COLLECTION AUTHORIZATION



COLLEGE OF MEDICINE AND HEALTH SCIENCES

OFFICE OF THE PRINCIPAL

Kigali, June 15, 2016
Ref.N° *657*/UR-CMHS/16

Mr. NSHIMIYIMANA Alexis,
College of Medicine and Health Sciences (CMHS)
University of Rwanda
Tel.: 07 88231816

Dear Alexis,

RE: Response to your letter

Reference is made to your letter dated June 14, 2016 requesting for permission to carry out a research within UR-CMHS, which is one of the requirements to complete your Masters in Health Informatics program.

I hereby inform you that your request is granted for June and July , 2016 and you need to work in collaboration with *Research Unit* at the College of Medicine and Health Sciences before you collect data. This is to ensure that you fulfill all the requirements.

We wish you all the best while carrying out your research.

Regards,

Dr. Jeanne Kagwiza (PhD)
Ag. Principal, College of Medicine and Health Sciences, University of Rwanda



Cc.

- Director of Research, Technology Transfer and Consultancy, UR-CMHS
- Dean, School of Public Health, UR-CMHS

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Website: www.ur.ac.rw