PERFORMANCE EVALUATION OF INTEGRATED DISEASE SURVEILLANCE AND RESPONSE (IDSR) SYSTEM: A CASE OF MANAGING SUSPECTED CHOLERA CASES IN NAIROBI CITY COUNTY

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DECLARATION

I declare that this is my original work and has not been presented to any institution or university other than the University of Nairobi for examination.

Signed. ..... Date .....

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D61/67936/2013

This research has been presented for examination with my approval as the University of Nairobi Supervisor

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DEDICATION

I dedicate this research project to my wife Christine, who is my best friend and a source of great inspiration. To my three children, Pauline, Caleb and Uzziel, who encourage me and make me to keep fighting.

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ABBREVIATIONS AND ACRONYMS

DHIS2 …… District Health Information Systems 2

IDSR ……...Integrated Disease Surveillance and Response System

WHO……World Health Organization

D&M ……. DeLone and McLean

IBS ……. Indicator-Based Surveillance

EBS……. Event-Based Surveillance

CDC ……Centre for Disease Control

IHR ……. International Health Regulations

IT …… Information Technology

IS …… Information Systems

HIS ……. Health Information System

GIS ……. Geographic Information System

MOH ……... Ministry of Health

HF ……... Health Facility

TAM…… Technology Acceptance Model

DSO……. Disease Surveillance Officer

CHW……Community Health Worker

CHV…….…Community Health Volunteer

ABSTRACT

The research study aimed at assessing how the Integrated Disease Surveillance System (IDSR) was performing in managing disease outbreaks in Nairobi County. In particularly it sought to find out how the system was meeting its intended purpose of early warning and providing information necessary for carrying out health action to mitigate morbidity and mortality during outbreaks such as cholera or even highly communicable disease such as Ebola. To achieve its key objective, the research focused on studying four areas including determining the adequacy of IDSR as an early warning system, establishing the relevance of the IDSR data, determining the effective usage of IDSR information and the establishing the status of community-based surveillance/event-based surveillance. The study deployed both qualitative and quantitative methods of data collection. The ongoing response to cholera in Nairobi provided the research with an opportunity to obtain information from an actual outbreak response. The study used descriptive analysis, Chi-square and correlation analysis to analyze the quantitative data while the process of coding was used to organize and analyze the data. IDSR as it is, provides relevant data for health action against outbreaks such as cholera. However, for large outbreaks, the system could fail in providing timely and complete data to manage such outbreaks. This is occasioned by late reporting, frequent server downtime, inadequate capacity in case detection and inconsistency in the flow of data from the community. Limited ability to analyze data at the ward level is also a hindrance to utilization of data. In conclusion, the system is meeting its core functions of disease detection, registration, reporting, confirmation through laboratory and epidemiology, analysis and interpretation and feedback, even though the above issues need to be fixed. It is recommended that the national and as well as the county government should build the capacity of the health workers at the ward and health facility levels and of the community health workers. The ministry of health should invest in performing similar studies in the country.

CHAPTER ONE: INTRODUCTION

1.1 Background of Study

Kenya has experienced many cholera epidemics leading to high morbidity and at times mortality. About 15 outbreaks occurred between 1971 and 2010, while another epidemic was witnessed in 2017 (Mohammed et al. 2012; WHO, 2017). Outbreaks occur every year in the country with epidemics being observed every 5-7 years (WHO, 2017). In Kenya, cholera is monitored using the integrated disease surveillance and response (IDSR) system. The system was sanctioned by WHO in 1998 to strengthen surveillance capacities of member states (Kebede et al. 2010). IDSR is implemented through District Health Information Systems (DHIS2) platform. Cholera and other diseases are identified, monitored and information managed through the surveillance system. This study will assess the performance of IDSR system in managing Cholera disease in Nairobi County. The success of healthcare service delivery is influenced by proper management of disease outbreaks and individual case patients (Tanner & Lemgeler, 1993; Tugwell et al., 1985).

Evaluating the performance of information systems involves assessment of hardware, software, data, networks and users for the purposes of improving the functionalities of the system. Evaluation determines how successfully the Information System (IS) is fulfilling its objectives efficiently and effectively (Platisa & Balaban, 2009). Hamilton & Chervany (1981) define success of information systems (IS) in two ways. The first is the goal-centred view that measures the effectiveness and efficiency by comparing the system performance with the expected functionalities. The second view is the systems-resource approach which considers the users' perspective on whether the system is serving their needs. This study will utilize a goal-free summative approach to assess the performance of the system. The D&M model will be used in interpreting data.

1.1.1 Disease Surveillance Systems

Thacker & Berkelnan (1988) describe surveillance system as a crucial 'public health function' defined by continuous organized data collection of diseases and events, compilation and processing of data, analysis and interpretation of laboratory and reported data, information visualization and the dissemination of this information to avert or minimize possible threats to public health either nationally or internationally.

Surveillance systems are designed to monitor routine and ad hoc data within and outside the health system. Information from surveillance system informs analysis of the burden and geographic distribution of public health events, prioritization of health interventions, monitoring the impact of immunization and identification of emerging health illnesses (Groseclose & Buckeridge, 2017).

A national surveillance system is made up of two components (WHO, 2014). First, is the indicator-based surveillance (IBS) which is meant to monitor the frequency, origin and geographic distribution of reportable diseases of national and international importance. Cases are reported from surveillance sites (health facilities), laboratories, medical stores and other routine reporting channels. One limitation of IBS is that cases remain unidentified if cases are not identified and registered through a routine reporting system. The second, is the event-based surveillance (EBS) component which compliments the IBS component as it is designed to recognize events not captured by the routine systems (WHO, 2014). The system scans the Internet, the media, and sources of big data, and by making ad hoc contact with health providers and others in the community (such as at schools, workplaces, border control) to detect potential risks.

WHO (2006) lists six core functions of a surveillance system. These include case detection where diseases are detected at health facilities or at the community level. Case registration in the registers, case confirmation through laboratory and investigation reporting through at all levels ensures that the reported cases are captured in the information system. Data analysis and interpretation for possible health action, response and feedback to data providers and other stakeholders define the use of reported data. CDC (2001), in its weekly report identifies the key attributes of surveillance and reporting systems. Critical attributes for an efficient surveillance system are stability, timeliness, usefulness and sensitivity. Positive predictive value, data quality, completeness and representativeness are important in characterization of health events. Flexibility, simplicity and acceptability reflect the sustainability of the system.

1.1.2 Global Public Health Surveillance

The massive international travel makes it necessary that WHO and its member states think of health from a global perspective. Global health is plays a vital in ensuring

that other counties are protected. The world continues to face emerging and re-emerging illnesses that continue to cause morbidity and mortality in some counties especially those economically challenged, making global health surveillance a necessity. The International Health Regulations (IHR), agreement binds member state countries to be individually responsible for surveillance activities in their countries. The IHR 2005 requires that countries monitor disease detection, verification and health action (Louis, 2012). The member states notify WHO, all health events or health risks that have the potential to lead to global health emergencies (Baker & Fidler, 2006).

1.1.3 Information System performance evaluation

Information system is an important strategic component that enables an organization to achieve its objectives, meet its challenges and compete successfully (Lu et al., 2012). In some organizations, it is a driver for competitive advantage. In the health sector, information is vital in patient management, coordination and health action planning for the sector. Healthcare providers and policy-makers need health information for decision-making (Lippeveld et al., 2000). Evaluation of Information System involves gauging how well the system is meeting its expectations, objectives or organizational needs (Hirschheim & Smithson 1999). Willocks (1992) describes information system evaluation as an activity that determines quantitative and qualitative value of information technology (IT) to an organization. IS effectiveness is reflected in the accomplishment of its main functions or objectives and is of importance to the organization's management, the end user, the developer and system auditors.

Winter et al. (2001), asserts that IS comprises the entire information processing an organization and the users as well as IT systems. Therefore, during evaluation both the IS system and the interaction between system and the users in the information processing environment should be evaluated. Evaluation can either take a formative or a summative approach. Formative approach provides information to developers for improving systems. Summative approach is intended show the status of an information system on routine programs (Friedman & Wyatt, 1997).

Evaluation of information systems is vital in deciding which IS to invest in, this, to ensure that they get value in expenditures as capital investment (Serafeimidis &

Smithson, 1994). Many researchers consider IS evaluation as a problematic process as identifying performance measures have proved difficult (Symons, 1990).

1.1.4 Health Information System in Kenya

The Ministry of Health (MOH) in Kenya adopted the District Health Information System (DHIS2), a web-based application as way of managing the country's health information. Key features of the system include data entry at health facility level, analysis tools, user-defined dashboards and GIS interface. The application was installed in central server in the ministry of health and is available to all users (Ayub et al., 2012). DHIS2 was expected to provide decision makers with quality and timely data. The data is useful in surveillance of infectious diseases such as cholera to prevent or control outbreaks and in developing strategies for health service delivery (Karuri et al., 2014).

The IDSR strategy was instituted by WHO in 1998. The system performs the functions of detection, reporting, investigating, confirming, and response priority diseases (WHO, 1998). This was in response to large outbreaks in Cholera and Ebola with high mortality and morbidity in the continent (Griffith DC et al. 2006). The IDSR strategy was adopted in Kenya in 1998 with implementation beginning in 2002. A total of 36 priority epidemic prone diseases were identified for surveillance and are targeted for eradication (MOH Kenya, 2012). The system has since been integrated into DHIS2 which is web-based and with mobile phone capability (Joseph Wu T-S, 2018).

Timeliness has been observed to be a major hindrance in prompt response to disease outbreaks. Some member states are now adopting mHealth methods to improve timeliness during reporting and record data real-time to improve outbreak monitoring and case management (Kazi et al., 2016). To overcome delays in reporting, MOH in Kenya initiated a mHealth system called mSOS. This is an SMS-based disease reporting and alert system in 2014 (Mitsuru et al., 2017). mSOS is a text-messaging system for communication between health facilities and the ministry of health and uses web portal to monitor disease outbreak and response activities (Mitsuru et al., 2016).

1.1.5 Kenya Healthcare System

Richard et al. (2004) provide an overview of Kenyan healthcare system is composed of both public and private stakeholders and has 11,991 health facilities. The health system levels include dispensaries, health centres, district hospitals, provincial general hospitals and national referral hospitals.

The IDSR integrated into DHIS2, is a weekly reporting system. A suspected case from the community is reported to the health facility (HF). The reporting officer at the HF reports to the sub-county Disease surveillance officer through mobile phones or using hard-copies. The surveillance officer enters the data into the reporting system where it can be accessed by county and national health management teams.

1.2 Problem Statement

Health actors demand information that will inform policy, decision-making which include prioritizing, resource mobilization and allocation and monitoring progress and impact of programmes (Rommelmann et al, 2005; Shaw, 2005). HISs are the medium through which data including disease surveillance and routine health data is collected and processed to provide information needed by the actors. Such data need to be reliable, timely and accurate (Lippevield, 2001). Often a lot of money from governments and at times donors is used in deploying HIS resulting in demand for value for money and added pressure to evaluate the systems periodically. Evaluating HIS is an important process that ensures efficiency, quality and relevant information that health providers, administrators and policy-makers will use (Hanmer, 1999).

Kenya continues to face cholera outbreaks on a yearly basis with the last outbreak occurring in 2017. Recurring epidemics are observed every 5-7 years at times lasting for three years (WHO, 2017). During the last outbreak cases were reported in 20 out of 47 counties. Majority of the cases were reported from refugee camps in Garissa and Turkana and in Nairobi County. Various physical, socio-political and environmental factors are thought to accelerate the spread of the disease. These include conflict, drought, insecurity and increased movement within the country and people fleeing conflicts (WHO, 2017).

Issah et al. (2015) assess the efficacy of IDSR in monitoring suspected Ebola cases in Ghana. They assess the core and support functions and quality of the system. They make observations on health facility surveillance registers and interview top directors.

The results reveal gaps in IDSR implementation due to limited knowledge skills and recommend strengthening of community-based/event-based surveillance (CBS/EBS) for effective disease surveillance. However, this research is inadequate as the users of the system and data managers are excluded. This study will seek to perform a similar research by assessing the IDSR in reporting and managing suspected cholera cases by engaging both the system and information users at the health facility, sub-county and county levels.

Masiira et al. (2019) carried out an assessment IDSR system in Uganda. The evaluation employed mixed methods and assesses IDSR performance and competency of the users. Despite the improvements in reporting, they discover gaps competency of the users in understanding and use of IDSR system and recommend improved funding, training for health workers and strengthening support supervision. This study will seek to study how IDSR is delivering on its core and support functions, knowledge and competencies of system users and the usability and relevance of the information received from IDSR.

Tsung-Shu et al. (2018) carry out research on IDSR in Malawi to understand variances in the system performance and the expected objectives and challenges for timely alerts. They use mixed-method their survey and analyze completeness and timeliness attributes of surveillance system. They discover challenges in achieving the core functions, that is, case identification, timely submission and limited funding. This study will provide the health actors with an opportunity to understand the IDSR in Kenya since implementation and extrapolate the findings to other counties in the country.

This study will focus on performance of IDSR with a case on managing cholera in Nairobi County and specifically areas prone to cholera outbreaks and will seek to answer the question: Is IDSR in Kenya meeting its goal of early detection disease cases in communities and is the information good enough to inform health action against outbreaks?

1.3 Research Objectives

To establish to what extent IDSR is delivering on its core functions and the effective use of surveillance data in efficient health action.

1.3.1 Specific Objectives

1. To determine the adequacy of IDSR as an early warning system for epidemic prone diseases with cholera outbreaks as case study.
2. To establish the relevance of the information received from IDSR.
3. To determine the effectiveness of usage of IDSR information
4. To establish community-based surveillance/event-based surveillance status.

1.4 Value of study

The aim of surveillance is timely notification of diseases and health events especially high infectious or communicable diseases, leading to timely interventions that will avert loss of life. It critical that the data produced by IDSR is relevant and timely and of high integrity in view of completeness and representativeness and is utilized by health officers and epidemiologists to respond to outbreaks at sub-county, county and national levels and other stakeholders (Issah et al., 2015).

This study will be useful to the national and county government as they will be able to understand if IDSR is meeting its core functions. The national government will use the results of this study and recommendations to improve the system. The study will provide them with understanding of where there are gaps meeting its support functions which include proving standards and guidelines to the health sector actors, training to IDSR users, supervisory visits and helpdesk support, communication facilities for reporting, funding, monitoring and evaluation and coordination. The sub-counties and the health facilities responsible for reporting will benefit from this study as their needs and limitations will be reported where necessary. This study can be used to inform a more detailed performance evaluation for the whole country. Further, World Health Organization (WHO) will benefit from this study as they are the custodians of IDSR and are responsible for global health surveillance. The study will be of great value to academicians and IS practitioner who can use it as a model for further research in IS field.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter discusses health information system and highlights some reasons put forward by some researchers on reasons for success or failures of information systems. The chapter further discusses various IS theories and approaches used for evaluating information systems. The theories highlighted in this study include TAM, D&M and Updated D&M. Summative and formative evaluations, goal-based, goal-free and criteria-based approaches are also discussed. The chapter further highlights some empirical studies in evaluation of performance of disease surveillance systems.

2.1.1 Health Information Systems (HIS)

HIS is the intersection between health service delivery processes and IS to deliver effective healthcare services (Anshari & Almunawar, 2011). Like other IS, it consists of interrelated components which are information processing and HIS management structure. Raw data (inputs) is transformed into information through processing. Information process includes data capture, data reporting, data processing, data analysis, visualization and dissemination of information (Lippeveld & Sauerborn, 2000).

2.1.2 Components of Health Information Systems structure

Figure 2.1 illustrates various components of health information system. This consists of data collection which occurs at community and health facility levels, data reporting through various mechanism such as emails and mobile-based messaging SMS, data analysis and interpretation and data presentation. The information is used by health actors at various levels for decision making and policies.

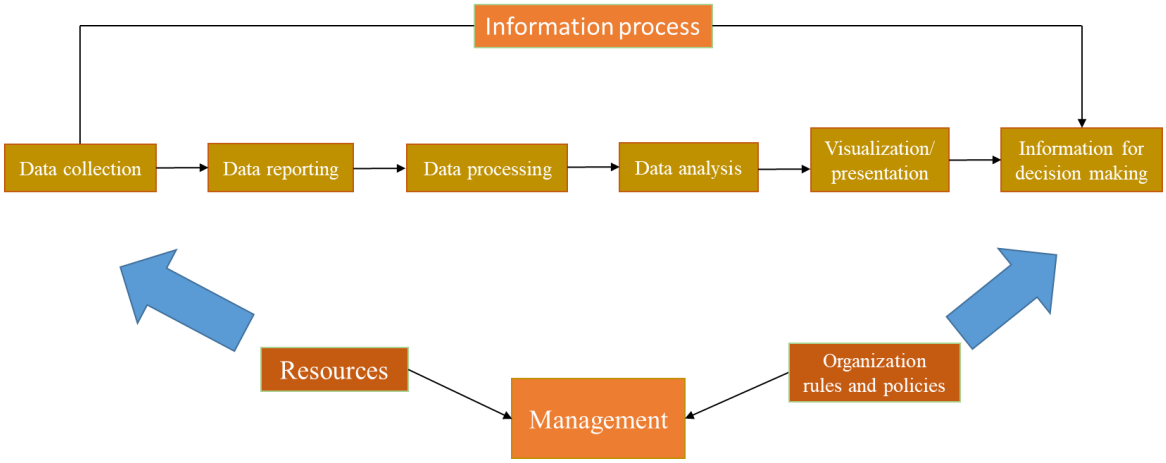


Figure 2. 1: Health information system components

The efficiency of information process requires a well-coordinated and efficient supporting management structure. Brender et al. (2006) indicates that for IS development success, management support with finances and commitment are paramount. Studies have shown that IS success is dictated by successful interface with the environment in which its being implemented.

2.2 Health Information System Success and failures

Studies on IS failure have mainly focussed on gap between the actual and the expected performance (Rchard, 2005). The early studies focussed on social and organizational views (Lyytinen & Hirschheim (1988). The later studies have focussed on IS projects. Nelson (2007), studies several projects and identifies mistakes which can lead to failure. He categorizes them into process, people, product, and technology. Strong and Volkoff (2010) explain IS failure using a technology focussed "organization-enterprise system misfit" concept. They assert that any misfit in functionality of the system, information generated by the system, usability and organizational behaviour can lead to IS implementation failure.

2.3 Information System Evaluation Theories and approaches

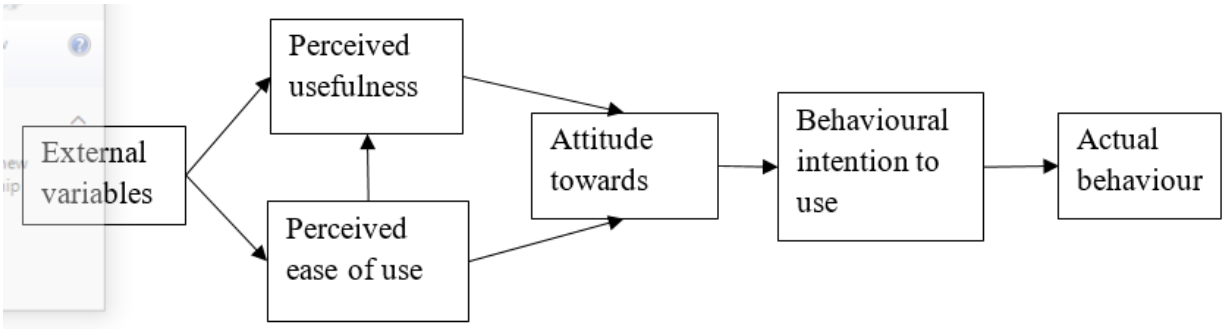
Several IS researchers have suggested a number of theories and approaches to measuring and evaluating system performances. (Cronholm, 2004) suggests using either goal-based or goal-free and criteria-based approaches in evaluating systems.

2.3.1 Technology Acceptance Model (TAM)

Davis et al. (1989) proposes Technology acceptance model (TAM) to help determine the acceptance of an information system by users in an organization. TAM, an extension to the theory of reasoned action (TRA), is meant to illustrate and predict the

behaviour of system users. The model asserts that perceived ease of use (PEOU) is determines if a user will readily accept a system. They further posit that perceived usefulness (PU) determines if a user will continue to use the system depending on the value he/she attaches to it.

The TAM critiques highlight a number of weaknesses of the model. Salovaara & Tamminen (2009) argue that a user may accept technology initially and later cease to use due to personal or reasons beyond their control. The technology studied using TAM are mostly simple and individual-oriented (Venkatesh et al., 2003) as opposed



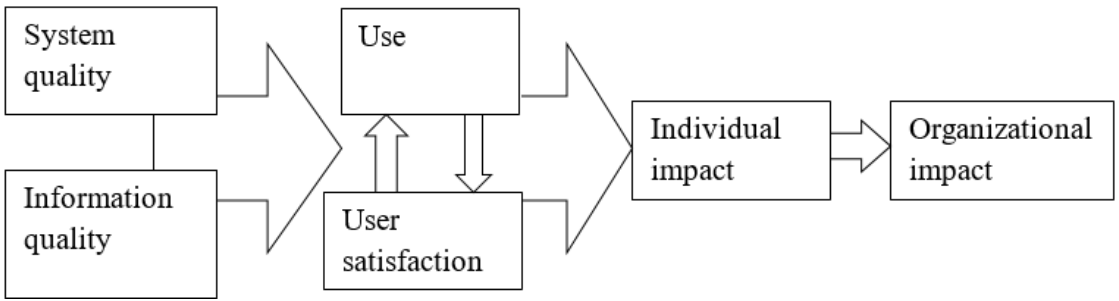
to complex organizational systems that are a concern to the management. Legris et al. (2003) support this view and assert that the system needs to be a "business process application". They further argue that the use of self-report in most studies do not actually measure system use but rather the variance in self-reported use, as presented in Figure 2.2.

Figure 2. 2: Technology Acceptance Model (TAM)

Source: Davis et al., 1989

2.3.2 DeLone and Mclean (D&M) Information System Success Model

The DeLone and McLean first advanced the D&M model success model in 1992. They relied heavily on previous work done by various researchers on IS success and was intended to synthesize the researches into a single model incorporating different views. This resulted into six dimensions of measurement which included: systems quality that measured the status of technical success; information quality measured acceptability of the information generated; use, user satisfaction, individual impacts and organizational impact measured the efficiency of the system (DeLone & McLean,

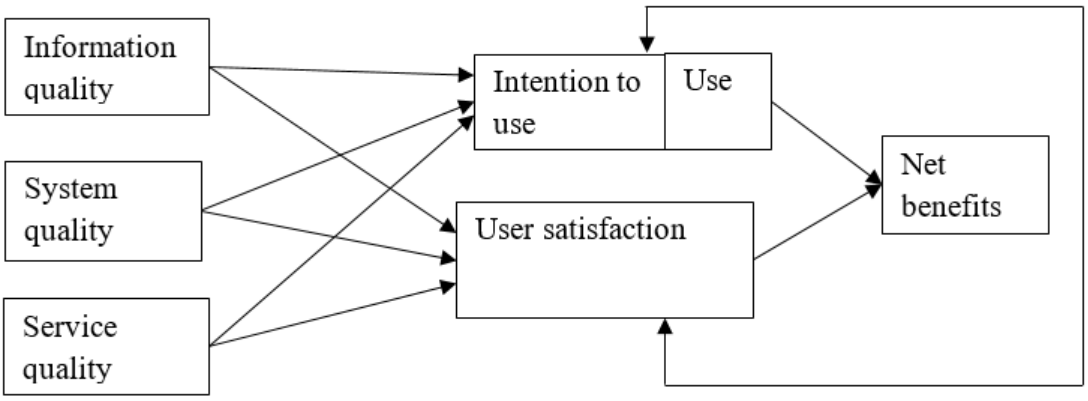


1992), as illustrated in Figure 2.3.

Figure 2. 3: D&M Information system success model

Source: DeLone & McLean, 1992

As the information system is used in an organization, the system users and the managers who depend on the information generated by the system to make decisions, express their satisfaction with the IS and its products or dissatisfaction. Utilization of the IS and its products influences the value attached by an individual to the system and together define the impact in an organization. Despite a good number of research studies validating the model, many more have critique or attempted to make changes



to the model (DeLone & McLean, 2003). DeLone and McLean use these views from researchers and critics to propose an updated model which was also meant to capture changes in role and use of IS. The model is presented in Figure 2.4

Figure 2. 4: Updated D&M information system success model

Source: Delone & McLean, 2003

2.3.3 Formative and Summative approaches

Formative and summative evaluation are important approaches in IS assessment (Chen et al. 2011). Formative evaluation provides important information during development and implementation and upgrading of an information system, to recommend improvement and inform the process of innovation or further enhancement. Summative evaluation is done after development and implementation is completed, with the goal of gathering information for decision-makers impact of developed information system.

Feature	Formative	Summative
Target	Programme managers, developers	Decision-makers, public, donors
Data collection	Qualitative with the goal of clarifying aims, content and structure of IS	Quantitative outcome measures of IS
Methodology	Qualitative design	Quantitative and experimental design
Frequency of data collection	Continuous monitoring	One round of data collection
Reporting	Face to face, mostly meetings	Formal, mostly written
Reporting period	Entire process of evaluation	After completion of evaluation

Table 2. 1: Formative and Summative evaluation approaches

Source: Chen et al., 2011

2.3.4 Goal-based, Goal-free and Criteria-based approaches

The goal-based approach is whereby business objectives of the organization drive the evaluation process. The efficiency of the system is defined by the fulfilment of its predefined objectives, the extent to which they are fulfilled and in what ways. Quantitative data collection methods are traditionally used. Researchers have critique this approach as it tends to use only quantitative methods are used and focuses on technicalities and benefits of the system and leaves out the human dimension. Cronholm and Goldkuhl (2003) suggest that qualitative methods should be adopted in this approach to examine social goals.

In the goal-free approach, there are no explicit goals and the evaluation process is inductive and situational driven. The approach is interpretive and aims at providing an insight into the nature of the object of evaluation.

In criteria-based approach clear and common criteria are used in the process of assessment. The criteria are general and are not dependant on an organisational setting. Criteria-based approaches could be checklists, principles, heuristics, or quality ideals (Cronholm, 2004).

Approach / Nature	Goal-based	Goal-free	Criteria-based
Formative	• Joint application design • Cognitive walkthroughs • Prototyping • Observation • Mixed methods	• Joint application design • Cognitive walkthroughs • Prototyping	• Feature inspection • Consistency inspection • Standard inspection • Guideline checklist inspection • Heuristic • Eye tracking
Summative	• Cognitive walkthroughs • Formal specification testing • Observation • Mixed methods • Cost-benefit analysis	• Cognitive walkthroughs • Observation • Semi-structured interviews • Focus Groups	• Cognitive walkthroughs • Heuristic

Table 2. 2: Types of evaluation methodologies

Source: Chen et al., 2011

2.4 Empirical Review of Information System Performance evaluation

Rumisha et al. (2007) monitor and evaluate IDSR in selected districts in Tanzania. Despite the adoption of IDSR in the country in 1998 effective roll out had not taken place. Important functions of the IDSR system were not fully achieved as outlined in the guidelines especially at the lower levels of the system. The weekly reporting was ineffective with districts not using the system. Time lag in the arrival of reports from the health facilities to their respective districts was observed (Mboera et al., 2005). Non-uniformity in reporting was also discovered and was attributed to inconsistency in use or lack of standard case definitions (Franco et al., 2003). They suggest that analysis of data be carried out at each level of reporting to enable prompt detection changes in disease occurrence (Mghamba et al., 2004). Low utilization of surveillance data was attributed to inadequate staffing, limited skills and demotivated health workers.

Mwanyika & Senga (2013) later perform an evaluation of IDSR in Tanzania in 2012. They collect data using interviews and questionnaires and evaluate the attributes of the system using set guidelines. They discover weaknesses in laboratory capacity and propose strengthening. They however, do not find any flaws with the system. Like the study by Rumisha et al. (2007), the study is inadequate as it gives little attention to the user and usability.

Tsung-shu et al (2018) carried out evaluation of IDSR in Malawi to determine the state of implementation and the variance between the guidelines and actual status. A mixed method research method is used where quantitative data from DHIS2 and qualitative data from interviews is collected and used in data analysis. Poor weekly reporting was observed with timeliness a major problem. The IDSR standard case definitions were not being implemented. They study showed that health facility reports arrived late and therefore ineffective in detecting cases in communities. The challenges of IDSR implementation included case identification, late compilation of reports for timely response and lack of funding. Differences between the guidelines and reality on the ground were evident. Though the project accomplishes its set goals, it fails to bring out the reasons for inadequacies.

Gathogo (2014) carries out a study to model the post-implementation evaluation of DHIS2 in Kenya. He uses a mixed method to collect data from health facilities and focus groups. He discovers that the impact of DHIS2 was positive. Though the project was adequate at the time, it is five years since then and a new valuation study is overdue. Furthermore, his focus is more on DHIS2, while our study will be focusing on disease surveillance by IDSR.

2.4.1 Summary of Literature Review and Research Gaps

Dwivedi et al. (2015) posits that using a system indicates IS success. Many researchers have invested huge efforts in studying the influence of IS/IT on usage. The quality of the system does not automatically lead to utilization. Rather, use of system is influenced by social, political and organizational culture. The complexity of user satisfaction is such that in the same organization some users may be more enthusiastic about the system than others.

We have evaluated two theories TAM and D&M and several evaluation approaches. We settled on goal-based summative as it best suits our study of evaluating the extent to which the goals of the IDSR system have been achieved. The Delone and McLean IS success model will be used to provide performance indicators.

2.5 Conceptual model

This study will carry out the performance of IDSR with the user in perspective. Success and therefore effective response to disease outbreaks is determined user of the system and information generated. By studying usage at levels of reporting from

case identification, registration, confirmation through laboratories, data analysis and interpretation and epidemiological response and at different levels of the system we can understand limitations, shortcomings and successes. Rather than evaluating the IDSR system as these researches have done through monitoring and evaluation process, this study will carry out the process through a one-time data collection, in a summative way seeking to provide health decision-makers on useful information on IDSR performance.

A combination of goal-based and summative evaluation approached will be used. This type of evaluation is utilized to assess an implemented system to determine if the business objectives are being fulfilled. The evaluation approach is also used in assessing the costs and benefits of information systems to assist decision-makers. This study will deploy a goal-based summative methodology of evaluation as the focus is in evaluating the post implementation of IDSR with regards to the extent to which it is meeting its core functions and support functions. User interaction with the system at various stages of reporting will be assessed as well as some selected quality aspects of the system. The business goals of the system include, core functions, support functions which are related to the early warning of disease outbreaks and effective health actions.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research Design

This project involves carrying out a case study on integrated disease surveillance system (IDSR). The goal of the study is to evaluate the performance of IDSR in relation to its core functions and to assess usability of the system and the surveillance data in managing cholera outbreaks in Nairobi County. Based on literature review in Chapter 2, the research approach deployed in this study is goal-based summative. The D&M model was used in the interpretation of results of the survey. A mixed method of data collection which include qualitative and quantitative was used.

3.2 Case Study Selection

Douglas et al. (1988) posits that evaluation of surveillance systems is vital in ensuring that the system meets its goals and that recommendations are necessary to improve quality. The results of an evaluation process indicate the worth of a system as a public health investment. Kenya uses IDSR in surveillance of diseases, which uses DHIS2 as its platform and integrates a mobile reporting system called mSOS. Health actors at the national and county levels depend on this system to provide information necessary for responding to disease outbreaks, planning immunization or control programmes and making health-related policies. It was therefore important to perform evaluation of IDSR to assess the extent to which it is meeting its objectives and recommend necessary improvements to ensure continuous efficiency of the system and hence effective health action. The structure of the system is represented in Figure 3.1.

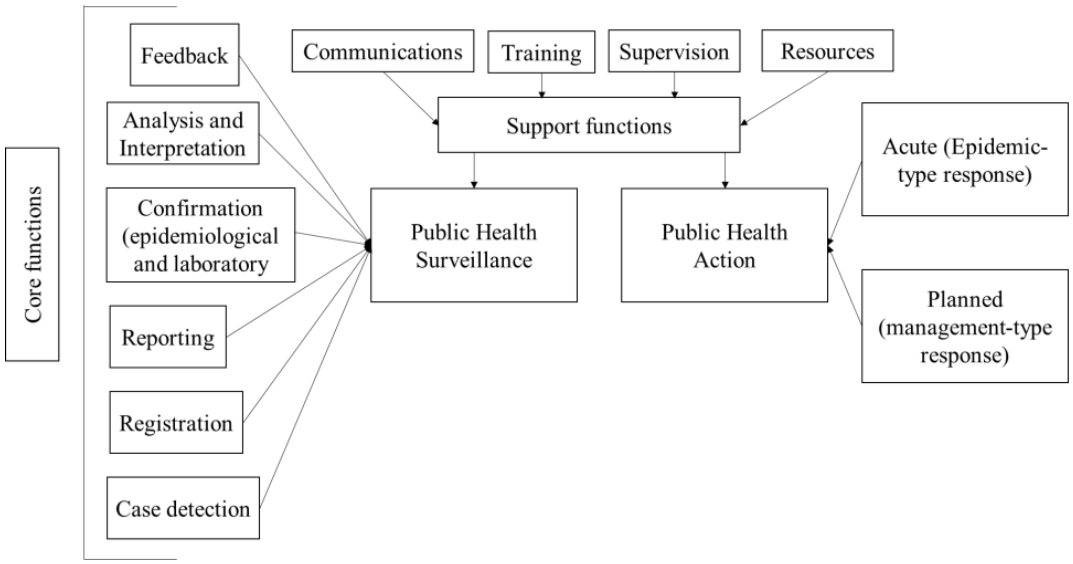


Figure 3. 1: Framework for public health surveillance

Source: McNabb et al. (2002)

3.3 Data Collection

Primary data was collected through interviews and questionnaires from the system and information users. This study used semi-structured interviews to obtain information from diseases surveillance officers in sub-counties across the county especially those that frequently report cholera cases. The ward is where data entry into the system takes and also the level of frontline response in the county. Public health officers and data managers at the county and national levels were targeted as they are the levels of data analysis and interpretation and decision-making. World Health Organization was also targeted as they are the highest level of reporting. The interviews were conducted through face-to-face mechanism.

The questionnaire was based on Likert's scale measurement. As shown in Appendix 3, the questionnaire was divided in relation to objectives of the study and the functions of IDSR system. Those to be targeted included health facilities at levels 3, 4 and 5, the sub-county and county health officials. The people here were to be targeted as they were the points of data collection, data entry and data use. Cholera data from IDSR system for year 2019 was used to aid in interpretation of data. The sub-counties under study were sampled from a total of 17 sub-counties based on historical cholera cases. A total of 51 IDSR users were targeted for survey. The IDSR users include health facilities drawn from levels 3,4,5 and 6 which are health centers, primary healthcare facilities and secondary healthcare facilities that most likely treated cholera patients. Health facilities were randomly selected in 10 sub counties in Nairobi. Secondary core on functions, supportive functions and indicators for system quality were obtained from WHO guidelines on monitoring and evaluation, indicators of IDSR (WHO, 2006).

Sub County	Facility Type	Total
Dagorreti North	Dispensary	1
	Level 2	3
Dagorreti South	Level 1	1
	Level 3	2
	Not Known	1
Embakasi Central	Level 2	1
	Level 3	2
Embakasi East	Level 2	2
	Level 3	2
	Not Known	1
Embakasi South	Faith based Organization	1
	Level 2	2
	Level 3	1
Embakasi west	Level 2	1
	Level 3	2
	Level 4	1
Kasarani	Level 2	2
	Level 3	2
Kibra	Community	1
	Private	1
	Not Known	2
Makadara	Level 2	2
	Level 3	2
	Not Known	1
Ruaraka	Level 3	3
		1
Grand Total		**41**

Table 3. 1: List of targeted sub-counties and planned IDSR users targeted

3.4 Data Analysis

Data editing to eliminate errors was carried out with spreadsheets. The completed questionnaires were scrutinized to assure data accuracy, consistency with other facts gathered, uniformity and completeness in data entering (Kothari, 2004). The study administered quantitative survey using KoBo Toolbox, where the enumerators recorded the responses using phones. Three enumerators were utilized in this exercise. The data was downloaded in spreadsheets and exported to SPSS for analysis. Descriptive analysis was used, which involved, use of charts, tables and graphs and numbers was used to describe and summarize data. This was helpful in assessing all specific objectives of study. The analysis from KoBo Toolbox was used for analysing demographic data.

CHAPTER FOUR: DATA ANALYSIS, FINDINGS AND DISCUSSION

4.1 Introduction

This chapter discusses data analysis and interpretation of the study. Data has been represented using graphs and tables. The findings are illustrated based on the specific objectives outlined in chapter one of this study. The main objective of the study was to determine if IDSR in Kenya was performing its core functions or objectives as shown in Figure 3.1 and providing information required for early warning of outbreaks and the necessary health action. A goal-based summative approach has been used in this study while the D&M model will be used in the interpretation of data. To enhance the quality of the study both qualitative and quantitative data were collected and the findings both have been presented and discussed in this chapter.

4.2 Response Rates

Of the 51 respondents targeted, there was 80% was achievement. WHO and the Ministry of Health could not be reached due to time limits and difficulties in finding the responsible staff. Some health staff interviewed in the health facilities could not tell the level of their facilities. The study further administered 9 interviews to Disease Surveillance Officers(DSOs) and two staff in the county health department. The responses were coded according to the specific objectives and further divided into parts, in accordance with questions numbers in a spreadsheet for ease of analysis. This was analyzed by going through the responses and recording different views in each field/column.

4.3 Demographics

Majority of the respondents were above thirty-five years old as shown in Figure 4.1 with 56% being female. About 61% of the respondents had over two years of experinece as shown in Figure 4.2. Research findings, reveal that majority of the respondents were convulsant with standard case definition, registration and were satisfied with the system quality, the information generated by the system was reliable and useful for health action. While not directly related, the level of experience and age show knowledge in IDSR.

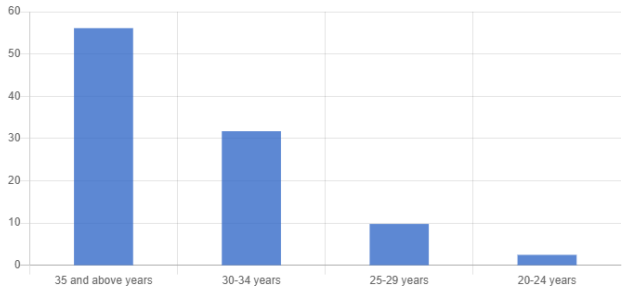
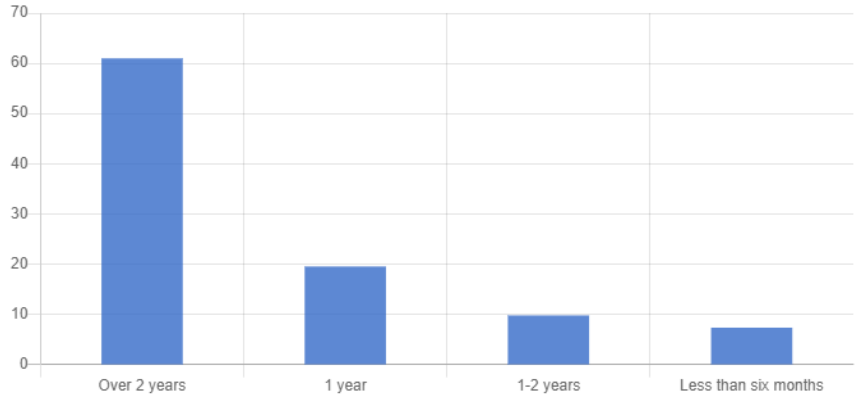


Figure 4. 1: Respondents by age group

As shown in Figure 4.2, majority of the respondents have over two years of experience indicating a good level of understanding of the system having interracted



with it more.

Figure 4. 2: Experience of the respondents

4.4 Descriptive Findings

The findings focus on the frequency of use and the four specific objectives of the project which included determining the adequacy of IDSR as an early warning system for epidemic prone diseases with cholera outbreaks as case study; establishing the relevance of the information received from IDSR; determining the effectiveness of usage of IDSR information; and establishing the status of community-based surveillance/event-based surveillance.

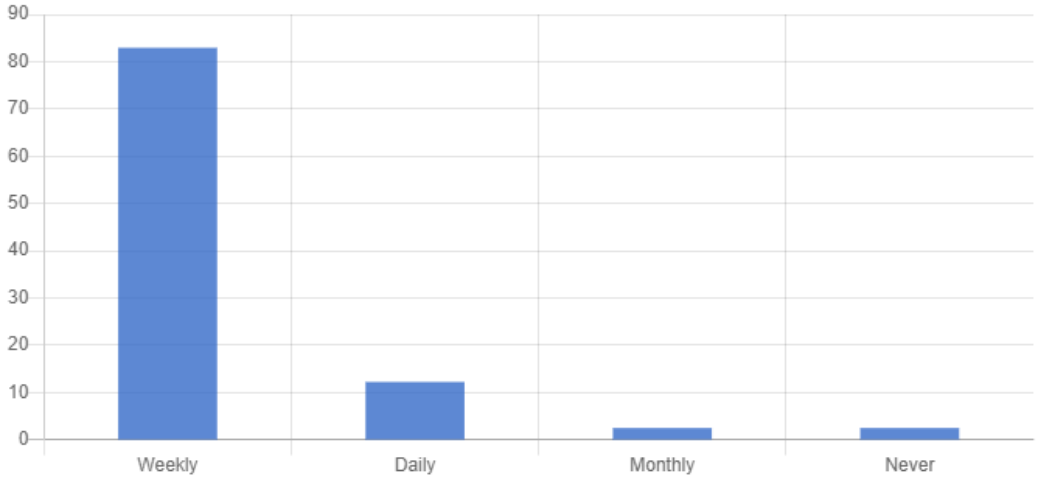
The mean of 4.7 is a positive indication that IDSR system is a useful tool in early warning according to Table 4.1, except for event and community based surveillance, where according to findings in qualitative data, there are challenges in reporting and limited capacity building which affects the rate of reporting. The relevance of the data is influenced challenges in reliability of the data due late reporting by some facilities and inadequate training in standard case definition leading to inappropriate case detection by some facilities.

4.4.1 Frequency of use

About 83 % of the respondents used the system on weekly basis, while only 12% used the system daily. This is consistent with the ministry of health reporting as the

health facilities and the disease surveillance officers are required to report on a weekly basis. However, with only few of the respondents using the system on daily basis, utilization of the system for analysis and intepretation of data is low. Despite luck of evidence of prior studies on data management of IDSR data in Kenya, studies elsewhere (Phalkey et.al, 2015), reveal limited data analysis in other countries especially at sub-national levels. Some of the reasons given are lack of skills and lack of understanding surveillance data.

Figure 4. 3: Frequency of use



4.4.2 IDSR as an early warning system for epidemic prone diseases

Effective Early Warning	N	Minimum	Maximum	Mean	Std. Deviation
C1	41	1	5	4.83	.704
C2	41	5	5	5.00	.000
C3	41	5	5	5.00	.000
C4	41	4	5	4.98	.156
C5	41	3	5	4.76	.582
C6	41	2	5	4.78	.652
C7	41	1	5	4.71	.844
C8	41	1	5	4.80	.715
C9	41	1	5	4.00	1.183
C10	41	1	5	3.95	1.341
C11	41	1	5	4.46	1.206
Overall	**41**			**4.66**	

Table 4. 1: Descriptive analysis of IDSR as an early warning system

The overall mean of 4.7 implies a satisfaction with IDSR as an early warning system amongst different actors. The supportive functions by the ministry and the county government are however inadequate, as the communication facilities are lacking in some facilities and mSOS is yet to be rolled out in some health facilities.

4.4.3 The relevance of the information received from IDSR

Relevance of IDSR information	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
D1	41	1	5	3.34	1.389
D2	41	1	5	3.66	1.407
D3	41	3	5	4.90	.374
D4	41	2	5	4.88	.510
D5	41	1	5	4.51	1.075
D6	41	1	5	4.37	1.318
D7	41	4	5	4.98	.156
D8	41	2	5	4.41	.974
D9	41	1	4	3.02	.474
Overall	**41**			**4.23**	

Table 4. 2: Descriptive analysis of relevance of the information received from IDSR

With the mean of 4.2, respondents agree that the information generated by the system was relevant and useful for carrying out health actions. There is however lack of capacity building by the responsible authorities. 48% of the respondents were not fully trained. Not all health facilities report on time, putting questions on timeliness and completeness of data.

4.4.4 The effective usage of IDSR information

Effective usage of IDSR Information	N	Minimum	Maximum	Mean	Std. Deviation
E1	41	2	5	4.85	.527
E2	41	1	5	4.56	1.026
E3	41	2	5	4.78	.571
E4	41	1	5	3.80	1.249
E5	41	1	5	2.61	1.302
E6	41	4	5	4.88	.331
E7	41	4	5	4.85	.358
E8	41	3	5	4.76	.538
E9	41	1	5	3.78	1.235
E10	41	3	5	4.90	.374
E11	41	3	5	4.90	.374
E12	41	1	5	4.02	1.255
Overall	**41**			**4.39**	

Table 4. 3: Descriptive analysis of the effective usage of IDSR information

Majority of the respondents expressed satisfaction with the information generated by IDSR for health action and health planning and indicated that they had capacity to analyze IDSR data, with a mean of 4.4. There is Lack of adequate resources at the ward level for the health actors to respond effectively. Data analysis and interpretation at the ward and facility level is also lacking. With 83% of the respondents only using the system on a weekly basis, and mainly for reporting, the utilization of the system for purposes of decision-making at the ward level seems low.

4.4.5 Status of community-based surveillance/event-based surveillance

Event/Community based surveillance	N	Minimum	Maximum	Mean	Std. Deviation
F1	41	2	5	4.71	.680
F2	41	3	5	4.78	.475
F3	41	1	5	3.63	1.577
F4	41	1	5	2.24	1.261
Overall	**41**			**3.84**	

Table 4. 4: Descriptive analysis of the Status of CBS/EBS

The low mean value of 3.8, indicates lack of satisfaction in some aspects of event/community based surveillance, particularly with regards to training and the flow of data from the community to the health facilities. Training of the both the DSOs, the health facilities and community health workers is necessary to improve reporting.

4.4.6 System Quality

To be able to find out how various dimensions of D&M model associated with other further information on system quality of IDSR was collected. This to help understand user satisfaction with the system.

Table 4. 5: Descriptive analysis of System Quality

System quality	N	Minimum	Maximum	Mean	Std. Deviation
G1	41	3	5	4.80	.459
G2	41	3	5	4.71	.602
G3	41	3	5	4.80	.459
G4	41	1	5	4.54	1.098
G5	41	1	5	3.61	1.394
G6	41	1	5	4.29	1.123
G7	41	1	5	4.39	1.202
G8	41	1	5	3.83	1.430
G9	41	1	5	4.34	1.063
Overall	**41**			**4.37**	

There is some level of satisfaction and acceptability with the quality of the system, with a mean of 4.4 being recorded. However, despite the roll out of mSOS, more still need be done to have all facilities report using online means which is both timely and accurate.

4.5 Interview findings

Majority of the respondents believe that IDSR was an effective system for early warning during disease outbreaks. One respondent reported that IDSR system provided an indication of ‘disease progression and trends’ during outbreaks. The system was said to be easy to use and understand. The system was found to be useful for analysis and planning public health action and mSOS an important aspect of IDSR as it improved timeliness. Poor internet connectivity was identified as a hindrance to timely reporting and uploading of data into the system, especially during system maintenance and upgrade. One respondent reported that ‘at times, the server is completely unavailable or dysfunctional’. This led to late reporting by the health

facilities (HF) and the disease surveillance officers (DSOs) at the ward levels. The system was limited in providing cause and effect relationship and did not help in cause and effect analysis. Inadequate resources such as laptops, phones and airtime for timely and effective reporting hampers effective reporting. Lack of surveillance focal points at the HFs means that there is inadequate surveillance coordination between the DSOs and the health facilities. High staff turnover means standard case definition trainings must be carried out repeatedly and led to inconsistency in reporting. While the functionalities of the system are useful, use of personal laptops and airtime means that accountability in reporting is compromised.

Majority of the respondents reported that IDSR information was relevant for early warning especially with regards to the current ongoing cholera response in Nairobi County. Several challenges were however identified that proved that the data could not totally be relied upon in large outbreaks. Some respondents reported that as it were, the system was not ideal for early warning as it was characterized by 'late reporting'. Poor reporting rates and lack of data analysis at some facilities, means that some wards may fail to identify upsurge of cases in time. The weekly reporting rather than daily reporting means that cases are reported late as does not help in early detection of diseases. Capacity building is needed at the HFs and for the health workers to improve case identification. The data was not always complete as cases may not be reported in the system and yet will be found on the ground during visits to health facilities.

As far as effective usage of IDSR data was concerned, majority believe, the information was beneficial as in both epidemiological and laboratory investigations and helps in identifying trends and disease progression and assist in developing key messages with regards to affected communities, data analysis of the affected areas and carrying out targeted response. The health sector at the county level relies on IDSR information to make critical response decisions, send early warning or alerts and in activating emergency or disaster committees. Challenges facing utilization of information included inadequate knowledge of standard case definition leading to compromised quality of information, weekly reporting, making the system not ideal for early warning.

Reportedly CBS was operational across the county. Some wards had developed simplified case definitions for training community health workers or volunteers.

Though the CHWs or CHVs refer case cases to health facilities, this was not always the case as some disease cases missed to be reported. Challenges facing CBS included high turnover of CHWs as majority of the community workers were involved in other activities. Capacity building is required as some are not familiar with standard case definitions. Lack of financial support by the ministry of health (MOH), means that CHWs are not motivated to work for the ministry. This often led to inadequate case finding, referral and follow up.

4.6 Discussion of the Findings

Phalkey et.al (2015) carry out studies on challenges with IDSR implementation using secondary data from different countries. The study discovers a lot of weaknesses in reporting from the communities, inadequate use of stadard case definitions,problems with data entered in registers, lack training in laboratory and epidemiologocal confirmation of cases, late reporting and lack evidence of data analysis. With little evidence of similar studies in Kenya, this reseach makes refernce to this study as it covers IDSR research in different countries. Using the goal-based summative approach is used to compare the findings on the IDSR core functions in Kenya in reference to the above study.

In this study it is clear that, IDSR can not fully be relied upon if Nairobi County was faced with huge cholera outbreaks or other communicable diseases such as Ebola. There is inadequate knowledge of standard case definition from the ward, health facility and community levels. The shortcomings in timely reporting due to frequent server problems, lack of adequate resources and late reporting by some facilities hamper effective early detection of diseases.

Challenges to relevance of IDSR the include untimely reporting, weekly reporting which means diseases are reported after one week. However, the data is mostly relevant for health action but not necessary for timely health action as not all data is sent to the disease surveillance officers. The introduction of mSOS should strengthen timeliness and improve accuracy of data transmission. The synergy between the IDSR and DHIS2 should improve data accuracy (Nsubuga, et al. 2010).

Under utilization of IDSR data is not only a problem to Nairobi but a general problem across many countries due to low investment in buiding skills of the the surveillance staff at the ward level. Phalkey et al (2015) assert that this was due to lack of culture of analysis and lack of acknowledgement of the relevance of data at the lower levels. Regular training of staff is mandatory to overcome this issue (CDC, 2003).

Despite community/event-based surveillance being operational in Kenya, low reporting rates are being recorded in the county. Training is also lacking at the community level for the community health workers. Lacking of movitation to these group at the lowest level of reporting, hampers effective case detection.

The findings in this study are in agreement with the studies carried out by Phalkey et al (2015) which also relates to other studies. Numerous challenges ranging from case detection, data reliability and usage of IDSR data do exist and there is need for county to invest in ensuring the the system is useful early warnng and action. Community-based needs investment to improve reporting.

Key factors that affect the relevance of the data for early warning such as timeliness of reporting, completeness of the data and inadequate knowledge of standard case definition influnced early warning and timely health action, implying a relationship between service quality and net benefits of IDSR system. Under-utilization of information at the ward level means that disease upsurge may be discovered late. The weekly reporting also means that trends may be dicovered more than a week later leading to late health action. This indicates that use or intention to use clearly influences the net benefits of IDSR such as timely and effective health inteventions.

Despite the existing criticism of the D&M model, this study provides evidence for D&M as IS theory.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter gives the summary of findings, the conclusions and recommendations based on the main and specific objectives of the study. The recommendations are informed by the findings. The chapter also highlights various limitations and gives suggestions for further studies.

5.2 Summary of Findings

The aim of the research study was to establish the extent to which IDSR was delivering on its core functions of and the extent to which the surveillance data was useful in humanitarian action in disease outbreaks such as cholera. To achieve this, the study focused on determining the usefulness of IDSR for early warning and outbreak detections, the relevance of the information received from various health facilities in Nairobi County, if the information received was being used effectively for mitigate outbreaks and the status of community/event-based disease surveillance in the county.

The study established that IDSR was not an effective tool in early warning of disease outbreaks as it could not be relied upon to provide timely data during large disease outbreaks. The system was more useful in outbreak monitoring through analysis disease patterns, trends and progressions.

The relevance of IDSR information for early is a concern due to late reporting and lack of reporting by some facilities. Lack of adequate training on IDSR raises questions of reliability of the data both at health and community levels. High-turnover in staffing means gaps in IDSR knowledge if there is no regular training.

Under-utilization of data is evident as the system was mostly accessed once a week and there is clear lack of skills in analysing and interpreting the data. Analysis would help in identifying disease clusters at the ward level. This is the first level of response.

Community-based surveillance is operational but need support to improve reporting. Capacity building for health facilities and community health workers (CHWs) is necessary to improve accuracy in disease detection through proper case definition.

The health sector in the county relies on IDSR information for policy, decision-making and planning response to outbreaks. The information is useful for case management and epidemiological investigation of cholera cases. One major challenge

appears to be frequent server unavailability. Poor connectivity and at times server problems meant late reporting by facilities and the DSOs. The system was also limited in providing information necessary for cause and effect analysis.

In conclusion, the system was not fully delivering on its core functions and in case of a mega outbreak it may not deliver on early warning and action.

5.3 Conclusion

The IDSR system cannot currently be relied upon for timely information required for early warning due unreliable case detection in some instances as IDSR training was lacking, late reporting and incomplete data. While the synergy between DHIS2 and IDSR, alongside the introduction of mSOS was meant to improve timeliness, frequent server downtime has not helped in achieving this.

The information received in IDSR was relevant for monitoring but not for timely interventions. This due to weekly reporting and late reporting. The reliability of information was not guaranteed as it was inconsistent and the community health workers were not well trained and motivated to work.

There is underutilization of data at the lower levels. Perhaps due to lack of appropriate skills in data usage or due lack of a culture of data analysis and interpretation. The system is mostly used for reporting and not for analysis.

There is need for adequate investment by the government on community health workers. The analysis reveals that despite community-based surveillance being operational in most wards, the data reported to the health facilities is not consistent.

5.4 Recommendations

This study reveals that IDSR was not reliable in in effective early warning of disease outbreaks. There is need for the Nairobi County and the Kenya's Ministry of Health to invest in building the capacity at the health facility level to improve case detection and roll out mSOS in all facilities and provide training to ensure timely reporting at the health facility level. Inconsistent reporting at the community level can be overcome through investment in training and motivating the CHWs.

Diagnosis of the system is required to eliminate downtime periods and therefore improve timeliness in reporting.

An effective training programme need to be developed to provide training in IDSR to overcome the challenges of high staff-turnover and ensure gaps in knowledge of IDSR are eliminated.

There is need to improve support to the community health workers who are mainly

volunteers and majority job seeking individuals. Investing in this group will improve accuracy of reporting, referrals to health facilities and follow-up or case management.

Investing in training of visualization applications at the ward level for DSOs' offices is required to enhance data management and analysis at this level. The culture of data analysis and interpretation at ward level should be encouraged.

5.5 Limitations of the study

Despite the plans to interview some respondents from the ministry of health and WHO, this was not achieved due to limitations in time and unwillingness to be interview. Even though there was a letter from the Nairobi County government authorizing the survey, the ministry of health demanded a separate authorization from them and some DSOs demanded a letter from the government too. Some DSOs refused completely to be interviewed or authorize questionnaire surveys in facilities in their areas of operation. There appeared to be general biasness in replying to some questions. Perhaps due to time limits or fear, knowing that the final document will be seen by the higher authorities. Carrying out the survey during the working hours meant inconvenience to the respondents' normal working schedule and could have contributed to biasness. The survey was more of self-reporting and could have led to positive reporting. It would have been good to confirm the information by observing the patient registry forms and the system.

Having had to travel due for work commitments, I was forced to hire enumerators to carry out the survey. Despite the training, there was still limitations in understanding the questions and being able to explain them to the respondents. Some questions were not properly answered in the qualitative data collections.

5.6 Suggestions for further research

While the study focused on Nairobi County. There is need for the ministry of health to extend this survey to other counties in Kenya and improve reporting across board. A separate survey focusing on community- based surveillance in the county and in the county, would help in identifying the existing challenges and help channel resources in focused manner. Contrary to this study which is private in nature, a county led survey through independent evaluator would be useful as observations can be made at the health facilities and the system.

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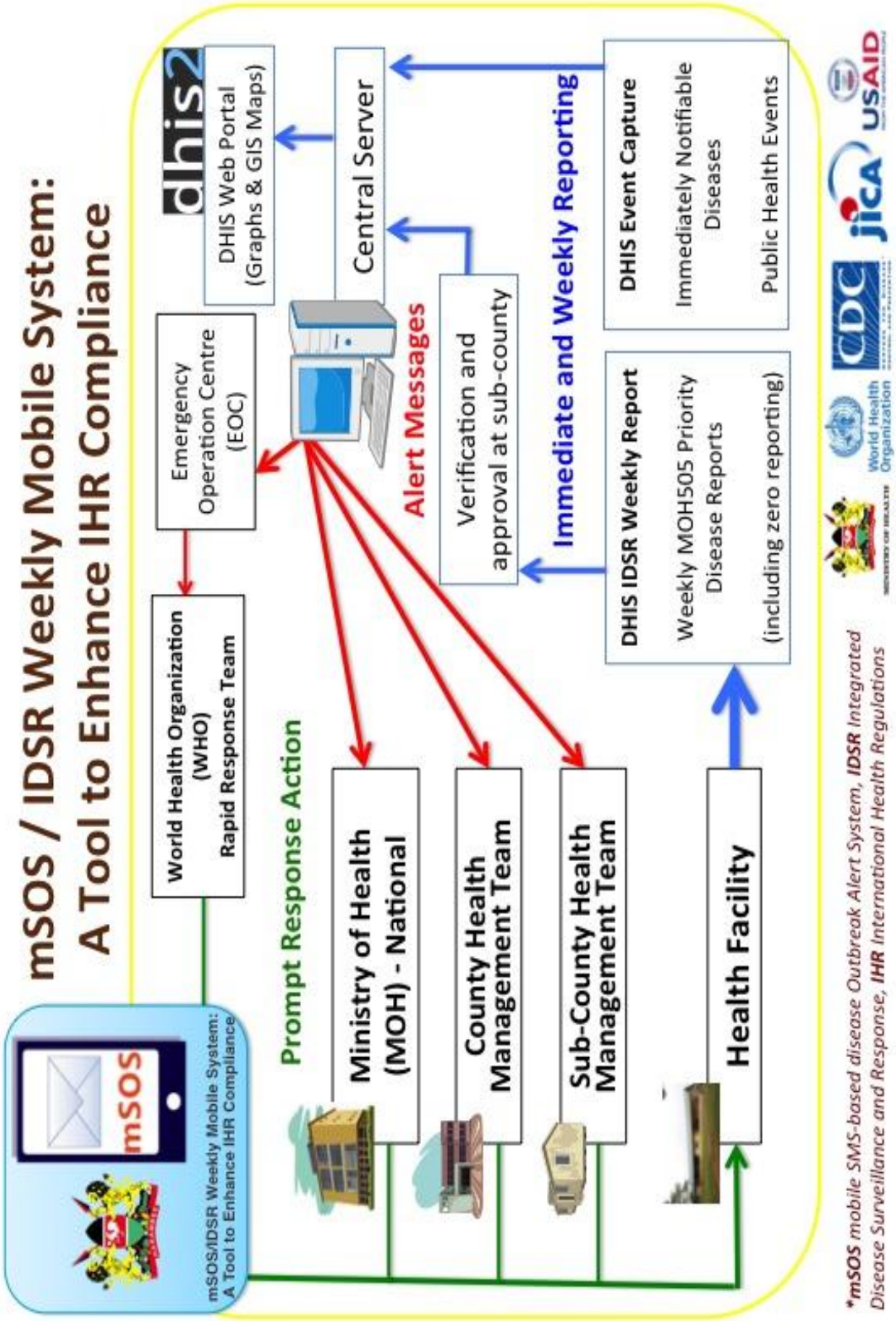
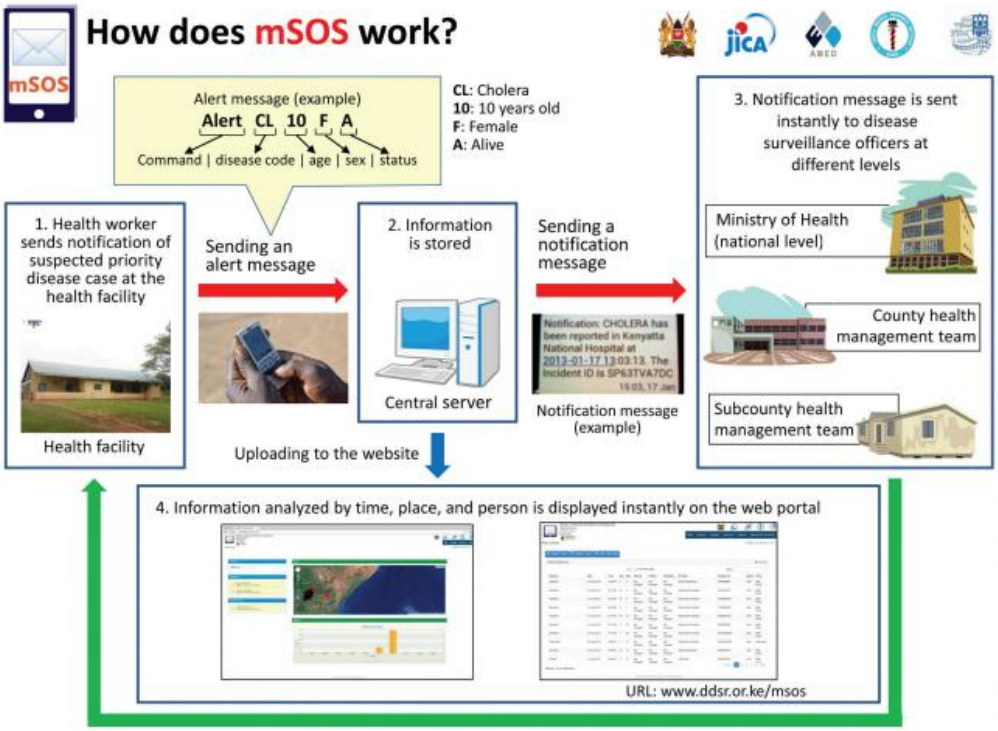
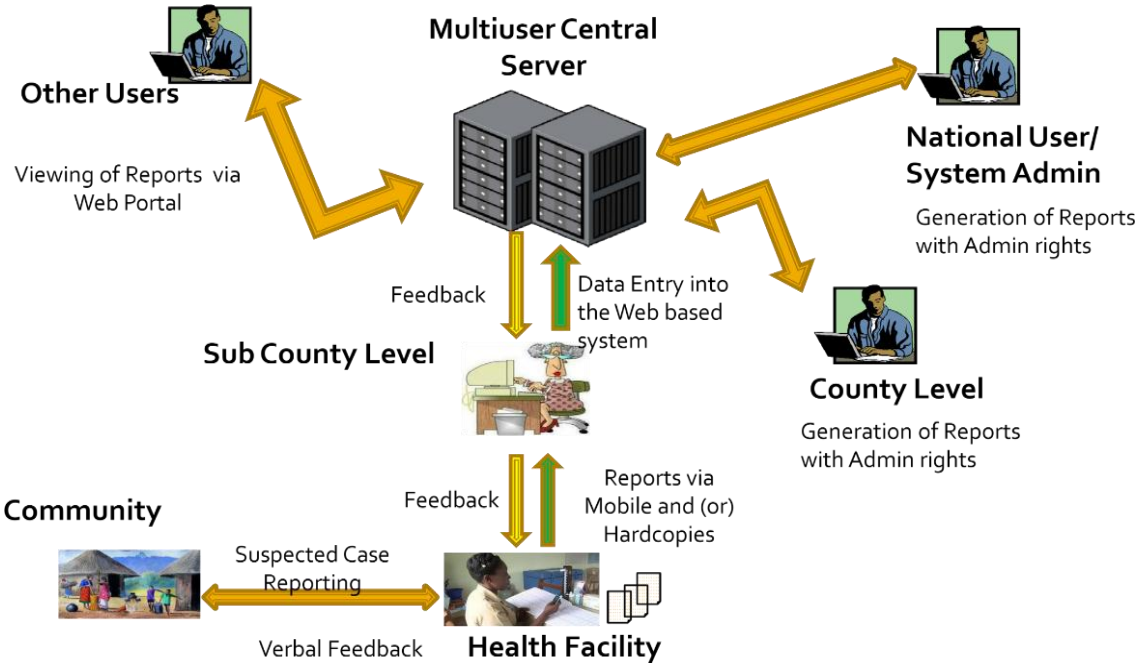
APPENDICES

Appendix 1: Data flow framework



Appendix 2: mSOS and IDSR reporting structure





Appendix 3 : Questionnaire

PART A: GENERAL INFORMATION

1. Name of the respondent (optional): …….

2. Age: ☐ 20-24 years ☐ 25-29 years ☐ 30-34 years ☐ 35 and above

3. Gender: ☐ Female ☐ Male

PART B: EXPERIENCE

How long have you used IDSR? Please select appropriately

☐ Less than 6 months ☐ 1 year ☐ 1-2 years ☐ Over 2 years

How often do you use IDSR in your work? Select appropriately

☐ Daily ☐ Weekly ☐ Monthly ☐ Never

PART C: Usefulness of IDSR for Early warning of cholera outbreaks

In the scale of 1 to 5, please as appropriate as indicated below

Strongly agree	Agree	Disagree	Strongly disagree	Never
5	4	3	2	1

1. We often use standard case definitions					
2. I am fully trained on case definition					
3. We register all the cases					
4. Event-based mechanism for case detection is operational (e.g. from the community, media or other informal sources)					
5. We Include unusual/abnormal health events in the surveillance system for immediate reporting					
6. In your view majority of the cases are detected on time					
7. We submit surveillance reports (immediate, weekly, monthly) to the next higher level on time					
8. We notify all cholera suspected cases on time (within 24 hours)					
9. We report cholera cases using mSOS (mobile phones)					
10. Reporting facilities including phones, tablets are available					
11. We promptly/timely refer samples to reference labs for rapid confirmation of causative agents					

PART D: Relevance of information on cholera cases registered in IDSR

1. I am fully trained on case definition and IDSR					
2. I have a problem with filling registers correctly					
3. I always validate all data received before registration?					
4. All detected cases are registered in the system					
5. We confirm all suspected cases through lab tests					
6. We report laboratory confirmed cholera cases in IDSR					
7. We normally submit our reports regularly even if late					
8. Number of cases reported always compare with known number of cases					
9. All facilities send their reports as required					

PART E: Usage of IDSR information in managing cholera outbreaks

1. We have capacity to analyse and interpret reported data					
2. The routine laboratory data is analysed and interpreted regularly					
3. All data received is analysed, and visualized for intervention and decision-making					
4. We visualize the data using maps, charts, tables, graphs					
5. We have enough resources to manage cholera epidemics					
6. The information generated is useful and adequate for health action					
7. The information generated is adequate for case management					
8. The information is useful for timely response					
9. We receive bulletin, situation reports, maps, dashboards from the county					
10. The information received is very useful					
11. The analysed data is very useful					
12. The dashboard and the maps generated by the system are helpful					

PART F: Event/community-based surveillance of cholera outbreak

1. Event-based mechanism for case detection is operational (e.g. from the community, media or other informal sources)					
2. We Include unusual/abnormal health events in the surveillance system for immediate reporting					
3. I have received information on cholera cases from the community in the last 6 months					
4. I have received training on how on community-based surveillance					

PART G: System quality

1. Data entry and reporting in the system is very easy					
2. The IDSR platform (DHIS2) is user friendly					
3. I prefer reporting through mSOS					
4. Reporting through printed forms is preferable					
5. Data analysis in the system is very simple					
6. I am satisfied with the systems functionalities					
7. The IDSR platform (DHIS2) is reliable					

Appendix 4: Proposed Interview with Key Informants

PART A: Usefulness of IDSR for Early warning of cholera outbreaks

Q1: First, we'd like to hear about your experience of using the IDSR system. What is your general feeling regarding the usefulness of IDSR in early warning of disease outbreaks?

Probes:

a) How has the IDSR system been of help to you in detecting and reporting cholera cases?

b) In what ways do you feel that the IDSR system falls short of your expectation?

Q2: What would you say are the challenges you face when using the IDSR system?

Probes:

a) What would you say about the different functionalities of the IDSR system? Are they useful?

c) How reliable is the IDSR in early warning?

PART B: Relevance of information on cholera cases registered in IDSR

Q1: Please comment on the relevance, reliability and usefulness of the surveillance information from IDSR.

PART C: Usage of IDSR information in managing cholera outbreaks

Q1: What would be your comment regarding the use of information generated by the IDSR system?

Probes: Remember, these can be in areas such as availability, relevance, reliability, secure access, and timeliness or any other you can think of.

b) In what ways do you feel the quality of information fails to meet your expectation?

c) Does the quality of information affect your frequency of using the IDSR system?

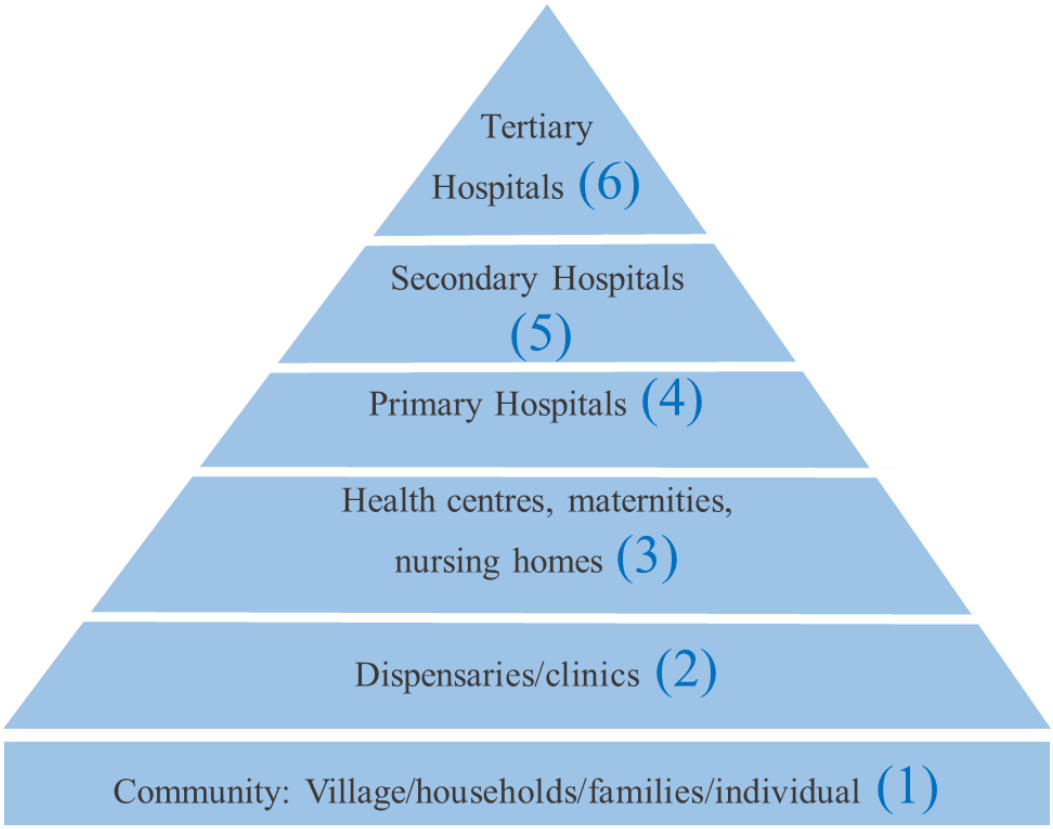
Q2: What would you say are some of the benefits of using the IDSR system in timely response? Remember these can be in areas such as task performance, efficiency, effectiveness, error reduction or any other you can think of.

PART D: Event/community-based surveillance of cholera outbreak

Q1: How successful is the event/community-based surveillance?

Q2: What do you think are the challenges facing effective event/community-based surveillance?

Appendix 5: Kenya Health System



Appendix 6: Questionnaire and Codes

Question Item	Code
PART C: Usefulness of IDSR for Early warning of cholera outbreaks	
1.We often use standard case defintions to detect diseases	C1
2, I am familiar with cholera case definition	C2
3, We notify all cholera suspected cases within 24 hours	C3
4. We register all the cases on the physical registers	C4
Event-based mechanism for case detection is operational (e.g. from the community, media or other informal sources)	C5
6. We Include unusual/abnormal health events in the surveillance system for immediate reporting	C6
7. In your view, majority of the cases are detected on time	C7
8. We submit surveillance reports (immediate, weekly, monthly) to the next higher level on time	C8
9. We report cholera cases using mSOS (mobile phones)	C9
10. Reporting facilities including phones, tablets are available	C10
11. We promptly/timely refer samples to reference labs for rapid confirmation of causative agents	C11
PART D: Relevance of information on cholera cases registered in IDSR	
1. I am fully trained on IDSR	D1
2. I have a problem with filling registers correctly	D2
3. I always validate all data received before registration?	D3
4. All detected cases are registered	D4
5. We confirm all suspected cases through lab tests	D5
6. We report laboratory confirmed cholera cases in IDSR	D6
7. We normally submit our reports regularly even if late	D7
8. Number of cases reported always compare with known number of cases	D8
9. All facilities send their reports as required	D9
PART E: Usage of IDSR information in managing Cholera outbreaks	
1. We have capacity to analyse and interpret reported data	E1
2. The routine laboratory data is analysed and interpreted regularly	E2
3. All data received is analysed, and visualized for intervention and decision-making	E3
4. We visualize the data using maps, charts, tables, graphs	E4
5. We have enough resources to manage cholera epidemics	E5
6. The information generated is useful and adequate for health action	E6
7. The information generated is adequate for case investigation and management	E7
8. The information is useful for timely response	E8
9. We receive bulletin, situation reports, maps, dashboards from the county	E9
10. The information received is very useful	E10
11.The analysed data is very useful	E11
12. The dashboard and the maps generated by the system are helpful	E12
PART F: Event/community-based surveillance of cholera outbreak	
1. Event-based mechanism for case detection is operational (e.g. from the community, media or other informal sources)	F1
2. We Include unusual/abnormal health events in the surveillance system for immediate reporting	F2
3. I have received information on cholera cases from the community in the last 6 months	F3
4. I have received training on community-based surveillance	F4
PART G: Quality of the system	
1. The IDSR system is acceptable	G1
2. The IDSR system is very useful	G2
3. The system is easy to follow	G3
4. The IDSR platform (DHIS2) is user friendly	G4
5. I report through mSOS	G5
6. I report using printed forms	G6
7. Carrying out data analysis is very simple	G7
8. I am satisfied with the system functionalities	G8
9. The IDSR platform (DHIS2) is reliable	G9