SCHOOL OF PUBLIC HEALTH

COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

ELECTRONIC HEALTH RECORDS FOR DISEASES SURVEILLANCE IN PUBLIC HEALTH

BY

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A DISSERTATION REPORT SUBMITTED TO THE SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE AWARD OF DEGREE OF MASTER OF HEALTH INFORMATICS

JULY, 2019
DECLARATION

I hereby declare that this dissertation, except for the references to other people’s work which has duly acknowledge and cited, this work is a product of my efforts as a student of University of Ghana School of Public Health, College of health Sciences. This work is submitted in partial fulfilment of the requirement for the Master of Health Informatics 2018/2019. This work has never been submitted either in part or whole in any other institution for the award of a degree.

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……………………………………  …………………

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(Supervisor)
DEDICATION

This work is dedicated to my teachers and students.

“I can because of you”.
ACKNOWLEDGEMENT

I am grateful to my course mates (Etornam, Yaw, Isaac, Mawusi and Ewoenam) who in one way or the other have helped me in my course of study. My sincere appreciation goes to the faculty members of UG - SPH and the Biostatistics Department in particular for all their efforts in my training.

I am very grateful to my supervisor, Dr. Justice Moses K. Aheto for his time, without which I could not have produce this work. ‘You have put meaning into the work’. Accept my appreciation.

My gratitude to my parents for their love, care understanding and support. ‘Thank you’.

I am most grateful to God for his Love, which has enabled me this far.
ABSTRACT

Introduction of Electronic Health Record (EHR) systems has the potential of improving the quality and accessibility of information and communication for healthcare delivery and also the quality of healthcare services in the healthcare system. Reliable, accessible health information leads to timely health policies planning and interventions, which leads to improvement in the general health status of a country. The key objective of this research is to explore if the electronic health systems being used in some health facilities in Ghana are designed with public health in mind in terms of monitoring communicable and non-communicable diseases.

Method

The study used an exploratory approach to examine the components and design of the electronic systems being used in some health facilities in the country. A cross sectional survey was used to collect data. The population for this study was health facilities using any form of electronic health system for collecting and storing patient data. Data obtained were summarized as frequencies and percentages using Microsoft Excel software.

Results

Most facility systems have all the components of an EHR system. The International Classification of Disease is the most popular standard of classification of disease used by these systems. All systems use an internally generated identification to identify patients. 50% of the facilities are able to generate report on chronic and infectious diseases. 33.3% had a form of decision support system and 16.7% provides reminders to physicians of appointment with patients.
Conclusion

Without a nation-wide-health-specific identification system to identify patients, it would be difficult to tell whether the EHR data is representative of the population. The ICD standard that all the facilities use is to identify the problems or the diseases the patients reported with is mainly for billing purposes, meaning the data captured does not contain enough details for clinical and/or research purposes but can serve as a trigger for investigation for public health purposes. The systems are able to capture residential address which can be used to tell the geographical location of patients. None of the systems have data on immunisations. All the systems lack the ability to produce alerts and reminders of public health interest.
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ABBREVIATIONS

CDC  Centre for Disease Control

CDSS  Clinical Decision Support System

CPT  Current Procedure Terminology

DALY  Disability-Adjusted Life Years

DHIMS  District Health Information Management System

DRG  Diagnosis Related Groups

EHR  Electronic Health Record

Email  Electronic Mail

EMR  Electronic Medical Record

GHS  Ghana Health Service

HAMS  Health Administration Management System

HIMS  Health Information Management systems

HL7  Health Level 7

ICD  International Classification of Disease

ICD  International Classification of Disease

ICT  Information Communication Technology

IT  Information Technology

LOINC  Logical Observation Identifiers, Names and Codes

MOH  Ministry of Health
NGOs  Non-Governmental Organisations

NHIS  National Health Insurance Scheme

NITA  National Information Technology Agency

PDAs  Personal Digital Assistants

PHR  Personal Health Record

RDF  Resource Description Framework

SMS  Short Message Service

SNOMED-CT Systematised Nomenclature of Medicine – Clinical Terms

XML  Extensible Mark-Up Language
CHAPTER ONE

INTRODUCTION

2.0 Background

Data collected from people from a particular community can be a powerful means of improving the health standard of that community. That data contains both the problems and the solutions (Luck, Chang, Brown, & Lumpkin, 2006). Many of the health concerns, causes of death and other health challenges the health sector is facing can in effect be mitigated with effective public health interventions. The investigation of cases of infectious diseases, controlling their spread and education of the population is the role of the public health practitioner. The main aim is to prevent/reduce the occurrences of such diseases. Individuals are able to take measures to prevent illness and improve quality of life, when accurate and credible health information is provided at the point of decision making. The public health professional must also be prepared to deal with disease outbreaks or emergencies such as flu outbreak or a water-borne disease in case of a natural disaster (Canterbury District Health Board, 2019)

How does the health sector generate the necessary information to help educate the population? This is mainly through the ongoing organised investigation, interpretation and sharing of data for use in public health actions to reduce disease and death and to improve general health conditions. This process is called Public Health Surveillance (Provincial Infectious Diseases Advisory Committee, 2012). This involves monitoring infectious disease trends, measure the disease burden, evaluate interventions so as to guide public health actions. Surveillance can also be used to formulate hypotheses for further research.
Public health units primarily depend on clinical and laboratory diagnostic reports for infectious disease surveillance. Most of these reports are incomplete due to missing pages or reported late for any effective action to be taken. Medical records of patients may contain information not necessary for public health (Samoff et al., 2012). Integrating surveillance systems into each of level of health care system is vital for identifying health problems and taking actions to resolve them (Government of Ghana, Ministry of Health, 2002).

Keeping medical records is not a new concept to healthcare. In the fifth century B.C. Hippocrates developed and use the first known medical records with two goals, to “Accurately reflect the course of disease” and “Indicate the probable cause of disease” (The MITRE Corporation, 2006).

Hippocrates’ goals have not changed, but the means of capturing, storing and communicating have. The use of Information Technologies (IT) in healthcare delivery has brought about improvements in the effectiveness and reliability of health information (Yusif & Soar, 2014). Countries that have applied Information Communication Technologies (ICT) appropriately in healthcare delivery are experiencing improved access to healthcare services by those seeking healthcare and improved delivery from healthcare professionals. This translates into a more healthy and productive labour force and increased productivity (Cecchini & Scott, 2003; Oyeyemi & Wynn, 2015). Ministries of Health, NGOs and others involved have seen the relevance of IT in the health sector and are investing in IT infrastructure.

In Ghana, the Ministry of Health in 2010 came out with the “National E-Health Strategy”. This policy seeks to overcome the challenges facing healthcare delivery in the country by finding ways to generate knowledge faster and in an effective way, be
able to share and translate the knowledge generated into operative and cost effective interventions and strategies that will increase the accessibility of healthcare to those who need it most. (Ministry of Health, 2010). The document also stated the need to generate information necessary to formulate *precise* health polices, polices to boost coverage of public health interventions and also empower the citizen in seeking health care and making healthier life choices (Ministry of Health, 2010).

A research conducted in 2014 reported a number of e-health projects involving mobile phones, PDAs, web-based applications being implemented at various stages in the country. This technologies were introduce to aid in information management and communication for improve health care delivery and public health activities (Afarikumah, 2014; IICD, 2014).

EHRs have the potential of improving the worth and consistency of health information and communication and the overall quality of healthcare delivery. Information Systems such as Health Administration Management System (HAMS), District Health Information Management System (DHIMS2), Health Information Management systems (HIMS) are some of the implemented electronic health records system in Ghana (Afarikumah, 2014; IICD, 2014). The DHIS and DHIMS2 are implemented nationwide by the MOH and GHS to generate health information to facilitate health policies and interventions, systems such as HAMS, are implemented in individual health facilities as solution to some challenges with the paper-based records thus to help improve their health records (IICD, 2014).
2.1 Problem Statement

Public health units primarily depend on clinical and laboratory diagnostic reports for infectious disease surveillance. But there are many cases where this information is made available to the public health units late, thus not allowing enough time for effective health interventions.

The District Information Management System version 2 (DHIMS2) by Ghana Health Service, has led to significant improvement in the collection, analysis and reporting of health data in the country. With the system, managers of the health sector (within GHS) has access to health information, monitor the performance of the health sector and the opportunity to respond to any challenges identified. Data is aggregated and entered into the DHIMS2 at the district level.

EHRs on the other hand, are used to capture and store basically the daily activities of a facility, if used appropriately. EHRs has a higher chance of revealing abnormalities in the cases reported at the facilities which can lead to an early detection of an infectious outbreak or any other disease of public health concern.

Since health facilities in the country use some form of information system to capture and store patient data, this study seeks to explore the suitably of the systems for disease surveillance in terms of the design of the systems.

2.2 Purpose of the Study

This study seeks to examine if electronic health records being used at some health facilities in the country are capable of being used in monitoring and detection of diseases and conditions of public health concerns.
The objectives of the study are

- Identify the form of electronic record being used.
- Identify standards and classification systems use in these systems.
- Identify some types of patient data collected.
- Identify and examine the decision support systems being used

2.3 Research Question

The general question this study wants to address is whether information systems being used in the various facilities are designed with public health disease surveillance in mind.

- Is the design of the electronic records suitable for disease monitoring?
- What standards are used to classify diseases and treatment given?
- Does the data captured contain the necessary information for population wide disease monitoring?
- Does the system produce relevant reminders and alerts?

2.4 Significance

This research will provide insight into the use of electronic records in Ghana, since there are very few reports on the use of electronic records in the country.

Software developers and vendors who design electronic records system for health facilities will benefit by getting an understanding of the healthcare delivery system and be able to design systems that will be user friendly and also meet the needs of the facilities and the country at large.
EHRs present a less expensive means of collection of health data that could be used in making public health decisions. With the development of appropriate Clinical Decision Support Systems (CDSS), EHRs could be used as surveillance tools to help in the detection of diseases of public health importance (Amirfar, Taverna, Anane, & Singer, 2011).

Using Electronic Health Records in gathering data of public health concerns has the potential to replace traditional methods of data collection such as chart reviews and the analysis of data collected could also shows the effectiveness of public health programs such environmental exposures, infectious disease surveillance, chronic disease prevalence studies, etc (Amirfar et al., 2011).
CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter looks at the concept of public health and disease surveillance. It also examines the use of electronic records in healthcare delivery.

2.1 The Concept of Public Health

Public health’s main concern is the health of the public or the population as a whole rather than the individual as in the case of medical care. Again, public health is a global issue, as the world continue to encourage the free movement of people. Thus, public health needs transnational solutions to deal with the epidemics of infectious and chronic diseases and factors in the environmental that directly or indirectly affect our health. Public health uses political, economic and social factors to address the health problems at community, national and international levels.

According to the Acheson Report (1988) public health is “the science and art of preventing disease, prolonging life, and promoting health through the organised efforts of society”

CEA Winslow defines public health as “the science and art of preventing disease, prolonging life, and promoting health through the organized efforts and informed choices of society, organizations, public and private communities, and individuals.”

This definitions stresses the fact that public health involves more than an individual effort, but the result of society’s effort. Public health mobilises resources locally,
nationally and internationally to provide conditions suitable for health of the population. It does this through a set of functions.

2.2 Public Health Interventions

Public health professionals have the responsibility to raise and create awareness of public health problems. This should be providing enough information for the public to be willing to take an appropriate recommended actions. The awareness level should not be too little as it will result in poor or no action in the public and should not be too high as it may cause fear and panic which can lead to stigmatisation and isolation of affected persons. Both cases will seriously make implementation of the necessary interventions difficult. Thus, the public health professional have to create the right level of anxiety that results in the necessary actions while reducing inadvertent consequences.

2.3 Public Health Units within GHS

According to the Ghana Health Service’s Guidelines for Public Health Units in Hospitals, Public Health Units (PHU) are institutions with the hospital that manage public health activities within the hospitals and also coordinate with appropriate authorities for responses to be carried out. The public health units are to work with the various units within the hospital to develop hospital guidelines, conduct health assessments and guarantee the health of the hospital staff, patients and the society at large. This will ensure prompt notification of health events of public health importance and elicit timely response from data generated by the public health units.
2.3.1 Objectives and Functions of the PHU

To guide the establishment of public health units within hospitals in Ghana. Some of the objectives of interest are “strengthen surveillance of all health events in hospitals”, “protect health and safety of staff and clients and communities” and “Support hospital research”.

The unit have some of the following as functions “review daily OPD, consulting room, ward, registers for diseases of public health importance and take appropriate action”, “undertake surveillance on epidemic prone diseases and health care associated infections” and “conduct or assist in operational research activities in the Hospital and use the result to inform service quality and development”

For public health unit to be effective in meeting its objectives and carry out its function, the unit needs access to current and complete data. Electronic records can provide this data as soon as they are generated.

2.4 Disease Surveillance

Public health units are always on the outlook for disturbance in the health of the population. Disease surveillance involves a collection of different information systems to be able to identify and report health related outcomes. Disease surveillance provides the data for some vital public health functions such as monitoring and reporting health status of the population, identifying new and emerging health issues, informing the public of potential threats, setting public health priorities for the population and evaluating the effectiveness of intervention programs.
Around 1592, churches in Europe began recording births and deaths. John Graunt later summarized these data and published them. John Snow and Edwin Chadwick explored the data collected for determinants of disease. They looked at how disease rates differed according to factors such as location, gender, social class and occupation (Boston University School of Public Health, 2013).

For disease surveillance to have significant impact on public health functions such as planning, implementation, and evaluation of public health actions, data collected should be analysed in a scientific manner and the results communicated in a clear, effective way to both the health professionals and the community.

GHS/MOH defined disease surveillance as “the process of being watchful and vigilant for health problems and their determinants with the intention to take measure that will control and prevent disease, and thus improve or maintain the health of the population.” (Government of Ghana, Ministry of Health, 2002).

Currently the country uses the integrated disease surveillance system (Government of Ghana, Ministry of Health, 2002). This system relies on receiving accurate and reliable information from all levels of the health system, with an upward flow of information from the community and facilities to the district and the regional and national levels.

This is how it works. When an individual visits the facility, data about the individual is entered into a register manually. Data such as patient’s ID number, date of visit, location, age, diagnosis, treatment given and outcome are collected. Diseases and conditions of public health interest are immediately reported to the designated public health staff in the facility and also at the district level usually through a phone call or fax. Laboratory specimens are obtained and tests conducted to confirm the suspected case. A response action is planned within the facility using the results of the
investigation. Summaries of number of cases and deaths are reported weekly, monthly and quarterly to the district. The district then complies the data monthly for each condition and performs analyses of time, place and characteristics of the patients using age and sex. This report is prepared for both outpatients and inpatients and the sent to the regional and national levels. In addition, the district maintains a log of reported suspected cases by the communities and health facilities. The district monitors any action taken to contain or resolve public health issues and writes a report on the response.

2.5 Limitations of the Current Systems

The system described above faces some challenges. Some of these challenges include timeliness and completeness of reporting, the specificity of coding of data and cost of data collection. Activities such as collecting clinical information from the facilities is still paper-based, thus labour intensive. This results in delays in making critical information for diseases of immediate public health importance available for timelier intervention. Laboratory tests alone are not enough as they do not contain patient’s clinical information and cannot be used for conditions such early Lyme disease, hypertension, and asthma which do not require a laboratory test to confirm diagnosis (Birkhead, Klompas, & Shah, 2015).

2.6 Electronic Health Records

Electronic systems present us with a great opportunity to transform our healthcare system and public health practise in particular. Electronic health records as a computerised system for collecting and documenting patient health data, have great
potential to serve as a facilitator for an effective collaboration between public health units/departments and clinical care providers in maintaining and improving the health of the society. As lifestyles change, health risks to the society are also changing.

In the United States of America, EHRs have been used to monitor disease burden in specific geographic areas (Perlman et al., 2017). The Chicago Health Atlas combines HER data with public health and social service data for infectious diseases such as tuberculosis and chlamydia, chronic diseases such as diabetes, breast cancer and asthma, and birth and deaths using zip code as a common factor ("Chicago Health Atlas," 2019). The Colorado Health Observation Regional Data Service produces a registry for hypertension, obesity and hyperlipidaemia by collecting and integrating data from 10 health care systems ("CHORDS | Denver Public Health," 2019).

Computer-based or electronic records use in the health sector comes in three main forms with differences based mainly on who creates the data and how the data is accessed. These are Electronic Medical Record (EMR), Personal Health Record (PHR) and Electronic Health Record (HER).

Personal health records are created and owned by the individual and are maintained and updated by the individual. The individual decides who to share the contents with, depending on the access privileges, providers can access it. It usually contains data on the individual health and healthcare such as medications, allergies, immunisations, health insurance policy, family’s medical history, etc. PHRs can be internet based or a standalone application that sit on the computer. But the content is easy to download on portable storage devices for portability.

Electronic medical record is created by one health facility or provider and use to record individual patient data. The facility is responsible for maintaining and updating of the
record. The record can only be accessed by the facility or provider that created it and cannot be accessed by facilities outside the creating facility. The electronic medical record is basically a computerised version of the paper folder.

Sanderson in 2009 defined an Electronic Health Record (EHR) as “a computerized lifelong health care record for an individual that incorporates data from all sources that provide treatment for the individual”. This records every encounter of an individual with the health care system. The record contains information such as the individuals complain, medical history, the physician’s assessment, diagnosis, and treatment given. External documents such as laboratory results, X-ray and other scan images, prescribed medications and other medical procedures are also kept. This record serves as a vital business and legal document both to the individual and the facility. It supports clinical decisions and billing purposes.

With the introduction and implementation of the Community-Based Health Planning and Services (CHPS) concepts more people will have access to health services at the community level. This provides the opportunity to collect data about health conditions affecting the community. The CHPS concept combines basic primary care with public health education (MoH & HMN, 2008).

In the United States of America, cities with support from health institutions are implementing electronic health record systems that are meeting the needs of both primary care providers and public health departments. These EHRs do not only enhance the patient care but also improve the health of the society by monitoring chronic disease development and infectious diseases (Calman, Hauser, Lurio, Wu, & Pichardo, 2012).

Reporting capabilities of health facilities can be enhanced through the use of electronic records systems. Since reports can be generated in time and quickly, health professional
will have the opportunity to identify potential outbreaks quickly and measures taken to manage it in a more timely and effective manner. Risk factors for diseases can be identified in the population and preventative measures recommended (Patel, 2017).

2.6.1 Improve Syndromic Surveillance

EHRs can facilitate the monitoring of encounters for symptoms that may characterise an infectious disease and/or other disease of public health interest. Through automated reporting of data to public health units/departments. The system developed by the Institute of Family Health and the New York City monitors these key symptoms; fever, respiratory illness, diarrhoea and vomiting, analyses them and determine when the incidence exceeds the normal or expected levels. The system’s ability to perform this syndromic monitoring in real time has the advantage of informing public health units of the changing needs during outbreaks (Calman et al., 2012; Lurio et al., 2010).

Through well designed clinical decision support systems, health care providers are equipped with a new tools to provide preventive and critical care for those suffering chronic diseases. Disease registries and reports developed from HER data, can be used to identify and contact patients due for visit, test or screening. Patients who require special attention or at the risk of developing certain chronic disease can also be easily identified and measures taken to encourage preventive behaviour in patients (Calman et al., 2012; Lurio et al., 2010).

2.6.2 Effective Responses to Public Health Crises

Natural disasters such as fires, earthquakes, heavy storms, etc have significant impact on the delivery of health care in terms of patient access to care, clinician workflow and
access to health data. Patients displaced by these disasters seek care at new facilities with various conditions some of which need access to patient’s health data to make well informed clinical decision. The Petaluma Health Center, in USA, use its EHR system during the 2017 wildfires to alert patients that it is open. This was not limited to only active patients but almost all patients in their database include visitors. The centre was able to refill and/or replace medications for those patients that had left theirs behind during the evacuations (Monica, 2019).

Through the web-portal of the EHR system, providers were able to view patient health data and deliver accurate care to those in provisional shelters. This helped clinicians eliminate unnecessary procedures, avoid medical errors and reduce confusion (Monica, 2019).

2.6.3 Public Health Policy and Financing

For public health policies to be effective and the financing provided to be utilised accordingly, the policy should be based on accurate and current data. EHRs can contribute greatly to these by providing assessments of disease burden and distribution in the community. This will assist in more accurate planning, targeting, implementation and monitoring (Friedman, Parrish, & Ross, 2013).

2.7 Prerequisites for EHRs in Public Health

To be able to use electronic health records to provide the necessary information for effective use in public health, they need to meet some conditions as discussed in this section.
2.7.1 Patient Identification

EHRs should have the capability of identifying individual patients, even if a patient should visit another facility. This will ensure accurate analysis of information at the population level as no one patient will be counted twice (Calman et al., 2012; Friedman et al., 2013). Currently identification systems commonly accepted as national identifications include the Voter ID card, Driver’s License, Ghanaian Passport and in some cases the National Health Insurance Scheme ID and the Social Security and National Insurance Trust ID. The national Identification Authority is in the progress of registering and issuing the Ghana Card, which is a national identity card that is issued to Ghanaians – both resident and non-resident and legally and permanently resident foreign nationals. The Ghana Card is to serve as proof of identity, citizenship and residence of the holder (NIA, 2019).

EHRs should cover the entire nation/population or a representative sample of nation/population to be able to provide valid and reliable information for making generalisation about the nation/population.

2.7.2 Standards

Using standards in information systems enhances greatly data storage, data security, data integration, sharing and the ability to use such data in research. Standard measures of health conditions such disease and well-being, factors that influence population health should be well defined. Data from multiple providers from different geographical locations can be easily aggregated when standards are well defined and used. Also, reports generated by the EHRs should be standardised. This also enables aggregation of reports from multiple providers in multiple locations.
Standards required can be classify into two, technical and clinical (The MITRE Corporation, 2006) Technical standards such the use of Extensible Mark-Up Language (XML) and Resource Description Framework(RDF), enhances the search capability of large collection of structured data, especially on the web. Clinical standards provide vocabularies used to code data for comparison, exchange and other analysis. Standards such as Current Procedure Terminology (CPT), International Classification of Disease (ICD) and the Diagnosis Related Groups (DRG) are mainly for payment processing and reimbursement. They do not contain enough clinical details for research purposes.

For ordering laboratory test, Logical Observation Identifiers, Names and Codes (LOINC) standards are suitable. And for recording test results Systematised Nomenclature of Medicine – Clinical Terms (SNOMED-CT) is used. Health Level 7 (HL7), this standard is used to enable the different systems within an EHR send and receive structured, encoded data (The MITRE Corporation, 2006)

2.8 Challenges and Limitations

Although electronic health records systems use is gaining ground in the country there are some challenges and opportunities to using electronic health records in general and for public health surveillance. These challenges can be group into technical, legal and regulatory, professional and funding.

The technical challenges mainly consist of lack of requisite technology and standards to operate with. As at 2010 (Ministry of Health, 2010) the country has no standards for data sharing. Most systems are “silos” which produce customised reporting formats, with different data sets. Thus, the one system cannot interface with another. Standards such HL7 and SINOMED are being implemented. The National Health Insurance
Scheme developed its own classification scheme to classify diseases for claims management. Internet service is poor in the rural areas of the country.

The health sector lacks adequate staff with necessary level of IT literacy and the willingness to use computer systems to enhance the delivery of care. But with the introduction of computer and informatics courses at almost all levels of the professional training, Ghana will soon have professionals capable of using computer systems (Dery, Vroom, Godi, Afagbedzi, & Dwomoh, 2016).

The healthcare system lacks needed polices to guide the use of information technologies in handing data. Protocols and procedures in using accessing information are either not there or not followed. This poses a security risk as confidentiality, integrity and availability of patient data cannot be guarantee. Legal and regulatory privacy and confidentiality issues are key in any information system. (Ministry of Health, 2010)
CHAPTER THREE

METHODS

3.0 Introduction

This section presents the approaches, design and processes that are used for collecting necessary data. A brief description of study area, sampling strategy, determination of sample size, data collection instruments, sources of data and data collection procedures for the study. Pretesting, reliability and validity and adherence to ethical considerations are considered during data collection and reviewing of extant literature.

3.1 Research Approach

An exploratory approach is employed. This approach is appropriate since there is the issue under study is not well developed and not much information is available. The research seeks to examine EHRs design and use in monitoring both communicable and non-communicable diseases in public health disease surveillance. The outcome of this study may lead to the advancement of a hypotheses on the issue which may require a different study to test it. (Kothari, 2004)

3.2 Study Design

Since the main purpose of this study is to find out the state of electronic records being used in the country and how well they are designed with public health in mind. A descriptive study is used, so the design of electronic records could be examined and described to determine if they contain the necessary components to be used in monitoring and detecting conditions of public health concerns.
3.3 The Study Setting

The research tried to get responses from almost all part of the country. This is to get enough data to be able to understand the use of electronic records in the country in relation to public health disease surveillance.

3.4 Study Population and Sample Size

Health facilities in the Greater Accra, Bono, Volta and Oti regions that use any form of computer systems to capture, store and use same in retrieving patient data are considered for the study. The electronic record being used, mostly electronic medical record, was the subject of interest in this study. This regions were selected for easy access due to the limited time for the study. Also, it was difficult identifying health facilities that use any form of electronic health record.

3.4.1 Sampling Technique

All health facilities in the four regions selected which have any form of electronic records which they use in place of the paper-based folders were considered for this study.

3.5 Data Collection Instruments

Structured questionnaires were used to collect the necessary data for the study. The items in the questionnaire were divided into four main categories;

- The electronic system,
- Patient identification,
• Data collection and reports
• Decision support tools.

The questions under the *electronic system* are about the components of the system and the standards used. Questions under *patient identification* are about the type of patients covered by the system and how each patient is identified. *Data collection and reports* seeks to find out the information taken from patient like demographic data, medical etc. and the reports the system is able to produce. *Decision support tools* tried to find out alerts and reminders the system is able to produce to inform patients, physicians and others health professionals.

### 3.6 Data Sources

The data used for the study was collected through primary sources. Questionnaires were used to collect the data. The questions were design to elicit the necessary responses.

### 3.7 Questionnaire Administration

The questionnaire was developed using Google Forms. A link was sent directly to the respondent email so he/she could access the questionnaire online and respond. The setting of Google Forms was such that the respondent could review his/her responses and make changes if necessary. Consent was sort from management and the respondents. Pretesting the questionnaire before administration. Some corrections were made to improve the clarity of the questions. The pretesting was done at the Ghana Atomic Energy Commission Clinic, one of the facilities in the Greater Accra Region.
3.8 **Response Rate**

The questionnaire was sent to ten (10) health facilities. Six (6) facilities responded. One from the Oti Region, one from Volta Region, one from Bono Region and three from Greater Accra region. Out of the six, two are quasi-governmental facilities and the rest government facilities.

3.9 **Data Analysis**

The data from the responses was cleaned and coded for analysis. Microsoft Excel was used. The data collected was summarise using descriptive statistics. Microsoft Excel was also used to draw pie charts and bar graphs to give a pictorial view of the responses.
CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents results of the analysis. Data obtained from the questionnaire used in the study has been analysed and presented using tables, pie charts and bar charts with their corresponding percentages and frequencies. This was to give a clear and a more detailed understanding of the study results.

Six health facilities responded to the survey and 33.3% of them are from the same software vendor and another 33.3% also from the same software producer. In all, data was collected from four (4) different systems. As shown in figure 1.

Figure 1 Electronic Medical Record Systems Surveyed
(Source: Field Data, 2019)
4.1 The Electronic System

Electronic health record systems have many components. Some of which are administrative system, computerised order entry system, radiology system, laboratory system, pharmacy system, clinical documentation, clinical decision support system, etc.

The results from the survey showed that the system from most facilities have all of these components. Two (2) does not have radiology component and one does not have administrative component, 33.3 % and 16.7% respectively (Table 4.1).

Table 4.1 System Components (n=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrative System</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Laboratory System</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Radiology System</td>
<td>4</td>
<td>66.7</td>
</tr>
<tr>
<td>Pharmacy System</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Clinical Documentation,</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Computerised Order Entry System</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Clinical Decision Support System</td>
<td>2</td>
<td>33.3</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

All the facilities surveyed use the International Classification of Disease (ICD) standard. Two in addition, use the Current Procedure Terminology (CPT) and one use Logical Observation Identifiers, Names and Codes (LOINC) as coding system to store patient data and classify disease and procedures (Table 4.2).
Table 4.2: Coding Systems (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Procedure Terminology (CPT)</td>
<td>2</td>
<td>33.3</td>
</tr>
<tr>
<td>International Classification of Diseases (ICD)</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Logical Observation Identifiers, names and Codes (LOINC)</td>
<td>1</td>
<td>16.7</td>
</tr>
<tr>
<td>Systematised Nomenclature of Medicine-Clinical Terms (SNOMED-CT)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Health Level 7 (HL7)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

Billing and clinical purposes are the main reasons for all the facilities implementing their electronic record system. Three (3) facilities in addition have research as a reason for implementation (Table 4.3).

Table 4.3: Purpose of Implementation (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Billing</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Clinical</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Research</td>
<td>3</td>
<td>50</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

4.2 Patient Identification

Data was collected on patient identification. Out the three options given in the questionnaire, all the facilities used an internally generated identification to identify patients, three (3) in addition use the NHIS ID to identify patients (Table 4.4).
Table 4.4 Patient Identification Method (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>National ID</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>National Health Insurance ID</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Internally Generated ID</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

All the systems cover inpatients, outpatients and accident and emergency patients (Table 4.5).

Table 4.5 Patient Type (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Outpatient</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Accident &amp; Emergency Patients</td>
<td>6</td>
<td>100</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

Table 4.6 and Table 4.7 both show data collected on patient demographics by the various systems. Table 4.6 shows data collected that are by nature part of the individual, all the system collect patient age and sex that is 100%. 33.3% collects data on ethnicity. Interestingly 33.3% do not store patient height and 16.7% patient weight. For extrinsic demographic, 100% collects marital status, 83.3% stores residential address, 83.3% stores patient religion, 50% store patient employment and 83.3% can tell if a patient has a health insurance plan. Table 4.7 shows extrinsic demographic.
Table 4.6 Patient Demographic Data Collected – Intrinsic (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Sex</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Height</td>
<td>4</td>
<td>66.7</td>
</tr>
<tr>
<td>Weight</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>2</td>
<td>33.3</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

Table 4.7 Patient Demographic Data Collected – Extrinsic (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Address</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Marital Status</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Religion</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Employment</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Health Insurance Plan</td>
<td>5</td>
<td>83.3</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

4.3 Patient Data Collection and Reports

Hundred percent (100%) of the systems are capable of producing patient medical records. 66.7% social history, 50% family history. None of the systems surveyed produces records on patient immunisations. The system used by all the facilities surveyed are able to produce the following reports inpatients report, outpatients report, daily admissions, daily discharge, daily morbidity and mortality reports (Table 4.8).
Table 4.8 Medical Reports (N=6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vital Sign</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Medical History</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Social History</td>
<td>4</td>
<td>66.7</td>
</tr>
<tr>
<td>Family History</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>History of Illness</td>
<td>5</td>
<td>83.3</td>
</tr>
<tr>
<td>Immunisations</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

(Source: Field Data, 2019)

On infectious and chronic diseases, 50% of the facilities’ system had the ability to produce daily infectious disease report. These systems produce reports on tuberculosis, common cold and measles (Figure 2).

![Infectious Disease](image)

**Figure 2** Infectious Disease

(Source: Field Data, 2019)
The same 50% of the facilities are able to produce reports on chronic diseases. These include hypertension, diabetes and dyslipidaemia (Figure 3).

![Chronic Disease Chart]

**Figure 3:** Chronic Disease  
(Source: Field Data, 2019)

### 4.4 Decision Support Tools

About 33.3% of the facilities reported their system have a form of clinical decision support system (Figure 4). Of these, 16.7% produce alerts and reminders, to remind physicians of their appointment with their patients (Figure 5).
Figure 4 EMR with Clinical Decision Support System
(Source: Field Data, 2019)

Figure 5 Alerts and Reminders
(Source: Field Data, 2019)
CHAPTER FIVE

DISCUSSION

5.0 Introduction

In this chapter, the findings from the analysis of data are discussed. The results of the discussions will be used to suggest recommendations for the design of EHR systems with the capability of being used to monitor diseases and conditions of public health importance.

5.1 The Electronic System

Since all the various system have the key components of an electronic health record system, as in Table 4.1, it is assumed that the systems have the capability to collect data needed to provide care to the individual patient. And these data is made accessible to the physician at the point of care delivery.Clinicians should be educated on the importance of filling all the required fields when filling out patients records in the system. For example, details on admitting and discharging of patients should be entered at the time the event is happening and not to be entered at a later date and time.

The laboratory system is very important in an EHR system. This portion handle the tests conducted to confirm physician diagnosis and form the basis for treatment and care given. They provide the information necessary for clinical decision-making. The various systems having this component will decrease turn-around times and improved clinical outcomes by enabling physicians have the results needed in a timely manner.

The computerised physician order entry system is another vital portion that all the facilities have. This component will ensure medical doctors’ medications, tests,
procedures and other orders are standardise, legible and complete to enable those receiving the instructions able to understand and follow them.

All the facilities implemented the system they use for two main reasons; financial and clinical. The systems are used to monitor the use of facility resources especially consumables and facilitates patient billing. It seems the systems were also implemented as a replacement to the manual paper folder system that was being used, to collect and store patient clinical record. The International Classification of Diseases is the common standard system used, all the systems use it. The ICD is limited, as it does not contain enough clinical information about the condition and diseases the patient is suffering from and the procedures the patient received. So is the CPT also. SNOMED-CT and SNOMED-RT are more appropriate to accurately capture the medical records of the patients. But these standards are not used by any of the systems surveyed. The HL7 which is used mainly in messaging across health care applications is also missing in all the systems surveyed (The MITRE Corporation, 2006). But this is not surprising as the various facilities do not share data with others.

5.2 Patient Identification

Patient identification is key, if EHRs are to be used for population surveillance. The ability to identify individual patients would determine whether the data collected in the EHR represents the population in that particular geographic area. The system in the various facilities are able to identify each individual patient. But the system of identification used is limited to the individual facilities since they are all using an internally generated identification for each patient. This means that when a patient should visit another facility, he/she cannot be identified as having visited a previous
facility, unless through question and answer. Thus, difficult to track patients with chronic conditions and be able to tell treatment received or on-going, as well as test conducted and the findings from those tests. Having a national identification will also help those in the habit of doctor shopping. Either just seeking solution to their condition or for substance abuse order reasons.

Without a national identification system, reports submitted by the various facilities for national programs may be inaccurate due to double counting. This affects planning and resources and ultimately makes ineffective the objectives of the intervention programs.

5.3 **Patient Data Collection and Reports**

Immunisations are one effective way of protecting not just the individual but the whole public. Having a reliable source of data on number of the population immunised and the type of immunisations they had will help greatly in planning. The systems do not keep track of immunisations patients received. This is worrying because the EHR data will lack the necessary information to determine how well protected the individual and the population at large is against vaccine preventable diseases such measles, tetanus, smallpox, yellow fever, anthrax, etc. The systems not keeping track of immunisations received by patients will make it difficult to facilitate alerts and reminders to patients due for vaccinations and reduce frequency of missed vaccinations.

With 50% of the facilities collecting and storing patient data on infectious and chronic diseases represents progress in the collection of data. What this study did not do is to find out how the data is analysis and the information disseminated. The study was only to find out if the systems being used are deigned to collect such data.
But the diseases covered by these systems are very few (tuberculosis, measles, and common cold). Data on conditions such as cancer, obesity, cardiovascular disease, smoking, hypertension, HIV, teen pregnancy are not monitored. These conditions can be monitored and a register produced to monitor progress of management of these conditions and also for research purposes.

5.4 Decision Support Tools

One of the most significant contributions of EHRs is their ability to aid physicians in making diagnosis and treatment decisions that will offer patients with safe and effective care through decision-support tools (Sanderson, 2009). Only 33% of the facilities surveyed have a sort of clinical decision support system. And the 16.7% that reported a form of alert, is to remind a physician of an appointment with a patient. None of the systems has the capability to mine data collected to detect a pattern and predict a possible outcome and recommend a course of action. This means the facilities are not benefiting from the full capabilities of computer systems.

Without a well-designed clinical decision support system, the facilities will not be able to perform real-time syndromic monitoring and therefore not able to inform PHUs of changing needs during an outbreak (Calman et al., 2012; Lurio et al., 2010).

Public health units within the facilities cannot take actions quick enough to contain or reduce the spread, locally, will be delayed and may not produce the desired results. Reports submitted by the PHUs will also be late and this could delay planning, resource mobilisation and deployment to the affected area and interventions may not produce the desired results.
With a well-designed clinical decision support system facilities can inform clients of disease outbreaks or patients due for tests, reviews, screening, etc through SMS alerts since they have clients’ contacts. This alerts can be limited to a particular group of people based on ethnicity, work, age, sex, etc. depending on the situation the alert is for (Lurio et al., 2010). The systems surveyed have patients’ demographics but lack the CDSS to send these alerts and reminders.

5.5 Limitation of Study

A search from the MOH, GHS, NHIA and NITA shows no official record on the percentage of health facilities using EHRs in the country. The use of electronic health record systems to monitor diseases of public health importance is a new concept. There are not that many examples to learn from. Standards are not yet well developed to serve as a guide to follow, so it is to measure also.

The study was interested in identifying components of EHRs it considered necessary for public health disease monitoring and therefore did not investigate further how these components are actually being used in the various facilities.

One factor this study did not consider is how long the various facilities have been using their systems. Systems are implemented in stages, knowing how long the facilities have implemented the system could determine the stage at which they are and the components that need improvement.

The study wanted to cover the whole nation but was able to cover only four regions in the country and six facilities. First, identifying facilities that use a form of EHRs in the country was difficult. Time and money were also another limiting factor.
6.0 Conclusion

The systems surveyed have all the necessary components of an EHR, which are capable of capturing relevant data for disease monitoring. But without a nation-wide-health-specific identification system to identify patients, it would be difficult to tell whether the EHR data is representative of the population.

The ICD standard that all the facilities use is to identify the problems or the diseases the patients reported with is mainly for billing purposes, meaning the data captured does not contain enough details for clinical and/or research purposes but can serve as a trigger for investigation for public health purposes.

The systems are able to capture residential address which can be used to tell the geographical location of patients. Some systems also capture ethnicity which can tell, if a condition is affecting part of the population belonging to particular race or ethnic group. With none of the systems having data on immunisation, it would be difficult to use EHRs to tell how protected the population is against vaccine preventable diseases.

All the systems lack the ability to produce alerts and reminders of public health interest.
6.1 Recommendation

The adoption of EHR systems by health facilities presents an opportunity to advance surveillance efforts in the country. Data from EHRs have the potential to increase the timeliness, detail, completeness and larger coverage of public health surveillance and thereby provide better data to guide public health interventions. Also an opportunity to expand the vision and role of current surveillance efforts of the Ghana Health Service and to help link public health practice and clinical practice.

MOH and GHS should work together to identify and produce a register of facilities using an EHR system in the country and also provide a legal framework for the use of EHRs and for public health in particular. This should include standards for documentation, breadth, density, prediction and transmission. Privacy and confidentiality issues should also be addressed including a national unique patient identification.

The list of conditions reported by facilities that monitor infectious and chronic diseases is very small. Foodborne diseases like cholera are ignored. Other conditions such as teenage pregnancy, motor vehicle accidents, substance such as alcohol and tobacco use could be collected. Disease registries and reports developed from EHR data, should be used to identify and contact patients who require special attention or at the risk of developing certain chronic disease. Decision support tools should be developed to contact patients due for visit, test or screening through emails and SMSs.

A further study into the use of EMRs/EHRs in the country will help bring more knowledge on the use of EMRs/EHRs in the country.
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Dery, S., Vroom, F., Godi, A., Afagbedzi, S., & Dwomoh, D. (2016). Knowledge and use of information and communication technology by health sciences students of the University of Ghana Knowledge and use of information and communication technology by health sciences students of the University of Ghana, (September).


APPENDICES

APPENDIX I Questionnaire for using EHRs for disease surveillance in public health

This study seeks to find out if electronic medical records being used now can be used in early detection of diseases and conditions of public health concerns.

Please respond to the items sincerely and truthfully. In most of the sections, you will find statements followed by several possible options. Indicate the answer(s) that best fits your response. Most of the questions may require YES or NO. There is no right or wrong answer. The information you provide will be handled confidentially. You are also assured of anonymity of the reports that will come out of this study.

NAME OF FACILITY: _________________________________________________

NAME OF ELECTRONIC SYSTEM _________________________________________

NAME OF RESPONDENT _______________________________________________

POSITION OF RESPONDENT ____________________________________________
Section A: The Electronic System

(Components of the system, purpose for implementation and coding system used)

1. Does the electronic record have the following components?

   Check all that apply.

   A. Administrative System

   B. Laboratory System

   C. Radiology System

   D. Pharmacy System

   E. Computerised Physician Order Entry

   F. Clinical documentation

2. Does the system transform patient record into structured data for

   Check all that apply.

   A. Billing purpose?

   B. Clinical purpose?

   C. Research purpose?

3. Does the facility use any of the coding systems below?

   Check all that apply.

   A. Current Procedure Terminology (CPT)

   B. International Classification of Diseases (ICD)
C. Logical Observation Identifiers, Names and Codes (LOINC)  

D. Systematized Nomenclature of Medicine—Clinical Terms (SNOMED-CT)  

E. Health Level 7 (HL7)  

4. Does the facility use any other coding systems not listed above  

*Mark only one.*  

Yes  

No  

5. If yes to the above, please can name it(them)  

_____________________________________________________________________
_____________________________________________________________________

Section B: Patient Identification  

*(How the patient is identified and types of patients covered by the system.)*  

6. Are medical records currently kept on the following types of patients  

*Check all that apply.*  

A. Inpatients  

B. Outpatients  

C. Accidents and emergency patients
7. Are all admissions, outpatient notes and accident and emergency records filed under one number in the one medical record?

Check all that apply.

A. Inpatients

B. Outpatients

C. Accidents and emergency patients

8. How is the patient identified?

Check all that apply.

A. National Identification Number

B. National Health Insurance ID

C. Internally Generated Number

9. If the facility uses another form of patient identification not listed above, please can indicate it below?

_____________________________________________________________________
_____________________________________________________________________

10. Does the facility have a patient master index (PMI)? (PMI is an index of all patients who have attended the hospital as an patient)

Mark only one.

Yes

No
11. Are all admissions, outpatient notes and accident and emergency records filed under one number in the one medical record?

Mark only one.

Yes ☐

No ☐

12. Are each admissions for a patient tracked?

Mark only one.

Yes ☐

No ☐

13. Are Intensive Care Units (ICU) stays tracked for a patient?

Mark only one.

Yes ☐

No ☐

Section C: Data Collection and Reports

(Data collected from patients and reports produced)

14. Does the system keep the following demographic data? (Intrinsic physiological)

Check all that apply.

I. Age ☐

II. Sex ☐

III. Height ☐

IV. Weight ☐

V. Ethnicity ☐
15. Does the system keep the following demographic data? 
(Extrinsic physiological)

Check all that apply.

I. Residential Address
II. Marital Status
III. Religion
IV. Employment
V. Health Insurance Plan

16. Does the system keep the following

Check all that apply.

A. Medical History?
B. Social History?
C. Family History?
D. History of Illness?
E. Vital Signs?

17. Does the system keep track of immunisations received by patients?

Mark only one.

Yes
No
18. If yes to the above question, please kindly name the immunisations

_____________________________________________________________________
_____________________________________________________________________

19. Is the system able to produce inpatients reports?

*Mark only one*

Yes ☐
No ☐

20. Is the system able to produce out-patients reports?

*Mark only one*

Yes ☐
No ☐

21. Is the system able to produce daily admissions reports?

*Mark only one*

Yes ☐
No ☐

22. Is the system able to produce daily discharge reports?

*Mark only one*

Yes ☐
No ☐
23. Is the system able to produce daily morbidity (illness) reports?

*Mark only one.*

Yes [ ]

No [ ]

24. Is the system able to produce daily mortality (death) reports?

*Mark only one.*

Yes [ ]

No [ ]

25. Is the system able to produce daily infectious disease reports?

*Mark only one.*

Yes [ ]

No [ ]

26. If infectious disease report is generated, kindly name the diseases

_____________________________________________________________________
_____________________________________________________________________

27. Is the system able to produce daily chronic disease reports?

*Mark only one.*

Yes [ ]

No [ ]
28. If chronic disease report is generated, kindly name the diseases.

Section D: Decision Support Tools

(Decision support systems built into the system and any alert/reminder the system produces)

29. Does the system have clinical decision support system (CDSS)?

Mark only one.

Yes   

No    

30. Does the System provides alerts and reminders?

Mark only one.

Yes   

No    

31. If yes, kindly name the alerts and reminders

_____________________________________________________________________

_____________________________________________________________________