ELECTRONIC MEDICAL RECORDS: THE EFFECT OF INFORMATION, COMMUNICATION AND TECHNOLOGY ON THE QUALITY OF MEDICAL RECORDS, IN AFRICAN AIR RESCUE CLINICS, KENYA.

BY:

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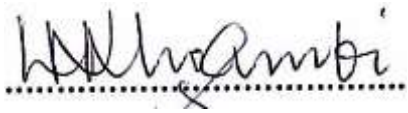
Declarations

This is my original research and thesis and has not been presented elsewhere;

Signed 

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This thesis has been submitted to Moi University with our approval

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DEDICATION

This thesis is dedicated to the entire medical fraternity towards the uptake of new technology not only towards provision of routine clinical care but especially in telemedicine and e-health, towards increased access of medical care to the common ‘mwananchi’ who may not necessarily reside within easy reach of a well-equipped health facility.

ABSTRACT

Introduction: In busy health facilities, substantial medical records are generated daily, posing a problem for timely retrieval, prompt decision-making, and the possibility of medical errors. ICT promises to help resolve most of these issues but little research exists to demonstrate its efficacy. This study goes to demonstrate the effect of ICT on the quality of Electronic Medical Records

Broad objectives: To determine the effect of ICT on the quality of medical records in African Air Rescue (AAR) Clinics, in Nairobi Kenya.

Methodology: This is a cross sectional study, assessing the effect of ICT on the quality of Medical Records. A sample of all electronic medical records within AAR was evaluated against the set standards governing quality of medical records. A sample of all HCWs handling these records was also assessed to ascertain whether their knowledge, attitudes and practices affect the quality of these records. Statistical analysis of both the quantitative and qualitative data was performed using SPSS.

Results: The EMR in use was able to support administrative tasks such and clinical management functions. There was 100% ability of the system to make lab orders, prescriptions and schedule appointments electronically. 88% of HCWs reported retrieval of records in less than 1 minute, and 73% of HCWs reported that lab results retrieval in less than 5 minutes. Some human factors such as employment status, increased age and previous EMR use of the Health Care Workers had statistical significance on the quality of EMRs.

Conclusion: This study showed that computerization of medical records does improve their quality by meeting most of the set standards that EMRs must meet to ensure quality of such records, however some human factors do affect the quality of such records.

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LIST OF ABBREVIATIONS

- **AAR** Africa Air Rescue
- **EMR** Electronic Medical Records
- **HCW** Health Care Workers
- **HMO** Health Maintenance Organization
- **ICT** Information and Communication Technology
- **ICD** Institutional Classification of Diseases
- **IREC** Institutional Research and Ethics Committee
- **IRB** Institutional Review Board
- **IT** Information Technology
- **PIN** Personal Identification Number
- **PDA** Personal Digital Assistant
- **WHO** World Health Organization.
- **PCA** Principal Component Analysis

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To you all,

God bless.

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CHAPTER ONE:

INTRODUCTION

1.1 Background

Information and Communication Technology (ICT), is defined as 'technologies that facilitate the communication, processing and transmission of information by electronic means' (Marker et al, 2002) and has been wildly advocated for in different sectors, including in the Health Sector. Even though by late 2003 Kenya did not have a policy on ICT use in health care, the uptake of ICTs in health service delivery in a few developing countries like Ghana, Bangladesh, Namibia, Indonesia and the Philippines, has led to an ICT revolution, so to speak, in some of the private hospitals, Health Maintenance Organizations (HMOs), as well as in medical insurance companies in Kenya.

The National Information and Communications Technology Policy of 2006 states that 'the goal of Information Technologies in Health Services will be to improve equity and quality of life by utilizing IT in health delivery systems'. Its main target was Public health facilities, to train medical staff, as well as setting standards in IT in health care systems as well towards developing legislation for governing of telemedicine. An assessment of the use of ICT systems in Kenyan Hospitals before the Kenya ICT Healthcare conference of 2003 held in Nairobi, estimated that only 10% of the public hospitals were already using some form of ICT in their health systems. Since then Kenya has come a long way in the use of ICT in Health Service delivery, specifically in the financial and administrative systems, and in some private health institutions, it is now primarily used for clinical record keeping and claims processing, especially among insurance companies.

Though many health facilities in Kenya have in the last few years begun adopting IT for administrative purposes such as internal and external communications between departments and patient billing, the use of IT in private health facilities in Nairobi specifically has widened to include its role in patient medical record-keeping by the use of Electronic Medical Records (EMRs). Health facilities such as Gertrude's Hospital, Nairobi Hospital, Aga Khan Hospital and AAR's network of health facilities have all embraced the use of IT in patient management, including patient identification verification, patient billing, patient scheduling and more importantly, the use of Electronic Medical Records (EMR).

On the other hand, medical record keeping in Public health facilities is still done manually, a state that is complicated by the number of patients seen in these institutions, these being the health facilities that are easily accessible as well as affordable to the majority of Kenyans. Kenyatta National Hospital as a representation of public health institutions is the oldest referral and teaching hospital in Kenya. It has a bed capacity of 1800 beds, with over 6000 staff members, an average annual outpatient visit of 600,000, and an average annual in-patient attendance of 89,000 patients. Suffice it to say, the number of records required to be maintained is enormous and requires a Medical Records department with a work force of 227, consisting of Medical Records officers, Medical Records Assistants and Clerical Officers. (http://knh.or.ke/index.php)

Following the assessment made on ICT in Healthcare by the Kenya Private Sector Alliance / AITEC at The Kenya ICT in Healthcare Conference, Nairobi (2003), there were several challenges found in healthcare that could be addressed by ICT:-

Kenya does not have a properly functioning referral system. This has led to the excessive burden on the main national referral hospitals, namely the Kenyatta National Hospital, and Moi Teaching and Referral Hospital. A streamlined ICT based referral system would go a long way to decongest these two hospitals and this may be through introduction of e-health solutions through tele-consultations, such as is currently being practiced in Bangladesh. The backbone of these solutions will however require the standardization of medical records through their computerization.

There were significant losses incurred in the public healthcare system due to inefficient management and logistics. This is especially felt with inefficient management of patient records, which are the back bone of report generation, and eventual decision making regarding administration of these facilities. There is need for improved and better integrated Health Management Information Systems to cater for and improve the uptake of administrative functions of ICT such as in patient identification, as well as in use of standardized coding for medical diagnoses, drugs, tests and to eventually improve the use of referral systems by Kenyans.

Though there is a lot being done by the private sector especially such as AAR Healthcare, there are plenty of opportunities that can be taken up by all players within the health sector. This includes the need to set up regulatory bodies on ICT use in healthcare regarding such issues as standardization of patient records for future retrieval towards improving the quality of these records for timely clinical decision making.

1.2 Problem Statement

In busy health facilities, substantial medical records are generated daily, a state that if not handled properly can result in misfiling, loss and untimely retrieval of records

resulting in inability of these records to trigger or prompt decision making, in addition to medical errors resulting from illegibility of clinical notes. ICT promises to help resolve most of these issues but little research exists to demonstrate its efficacy.

1.3 Justification

To date, there has been some improvement in the delivery of health care, resulting from the use of ICT in increasing the access that healthcare workers have to administrative data and patient medical records. In spite of this, not many studies have been done to assess the effect, if any, of ICT in health care management, and specifically on medical records especially in the private health institutions that have fully embraced ICT. This study therefore goes to ascertain any positive effects of ICT on EMRs, especially in improving the quality of medical data. This might go a long way in assisting those in the public and private sectors to embrace ICT in the use of Health Information Management Systems, as well as to complement the Private sector in issues related to regulation of the same. Other beneficiaries of this study will include; researchers requiring organized medical data studying disease prevalence, government policy makers, as well as the Ministry of Health, towards eventual standardization of EMRs. In addition health care providers and facilities with intentions to adopt ICT will have an idea of the requirements that most standard systems must have in order to ensure that data meets the criteria for quality of medical records.

CHAPTER TWO:

LITERATURE REVIEW

2.1 Use of ICT in healthcare globally

Denmark is the world's leading country in the use of this technology in healthcare. Approximately 98% of primary care physicians use electronic medical records, and with this technology they are able to send and receive patients' clinical data, to and from specialists, to the pharmacy, hospital, as well as to send patients reminders electronically. (Pretty and Johansen, 2010). From this case study, the critical success factors in the Danish model that can be emulated by developing countries such as Kenya in their future approach towards scaling up ICT in health care included; The development of a national policy that supports the development of a National Health Information Technology policy which enhances quality, efficiency and patient centeredness, as well as the requirement for all primary care physicians to use Electronic Medical Records by 2004. There was also the requirement to use email technology to communicate with patients. Closer home, communication between patients and clinicians can be addressed via email even without an EMR system in Kenya, whereby patients' laboratory reports and medical reports could be emailed to reduce back and forth movement between patients and providers.

In Denmark, a non-governmental body- MedCom coordinated and supported the health information technology development and in Kenya, this would begin with a government policy to support the use of EMRs, such as the standards and guidelines developed for EMR systems developed by the Ministry of Health in 2010.

The presence of every Danish citizen having a national Person Identification Number has enabled the patient's entire medical history to be accessible to providers, and

every Kenyan who is within the system can be given a unique PIN number for the purpose of using EMRs. This number could be attached to medical files, including patient allergies, previous hospitalizations, and other such pertinent medical issues, that could be accessed from any inter-related EMRs, or Electronic Health Records.

Following the United Nations Conference in Bangkok (Thailand) on the 9th to 10th December 2009, on 'ICT Applications in e-health: Improving Community Healthcare Services towards achieving the MDGs', a paper was presented on the present situation of ICT use in Indonesia. Indonesia has a population of 230 million, 60% of who live in the rural set up. The use of ICT in this fast developing country that is very similar to Kenya has been mainly used to improve and streamline the referral system while improving health service delivery to all people in its 33 provinces. The main objectives in this study were mainly to evaluate the competence of healthcare providers, as well as to assess ICT applications in community level recording and reporting, outbreak management system, telemedicine referral systems, use of paperless prescriptions, as well as the use of Local Area Network (LAN) to support the transfer of medical information. The main lesson learnt from this study was the importance of capacity building and competence of healthcare providers in the use of ICTs, the presence of some cultural barriers, the need for more funding towards technology and operational costs, and the widespread availability of telecommunication infrastructure. Conclusions from the study advocated for the promising outcomes of ICT use in healthcare despite the challenges faced, the need for the involvement by the community, institutions, private and public sector to achieve sustainability.

Bangladesh's national ICT policy was for ICT to be used in Medical records, the referral system through the use of telemedicine especially for rural patient management, as well as in distant medical and health education. This technology was to be used further in the development of mass awareness for prevention of diseases in the management of disease outbreaks. The above were to be implemented after all public hospitals and medical research centers were linked by computer networks (Bangladesh National ICT Policy – 2008).

2.2 Use of ICT in Africa

Egypt alongside several other African countries has not been left behind in the establishment and refinement of their National ICT policies which have significantly affected their health care sectors. Just like Bangladesh, Philippines and Indonesia, these have been well articulated and currently being implemented in the areas of Telemedicine.

A satellite Personal Digital Assistant (PDA) (handheld computers or palm tops) project conducted in Kenya and Uganda in 2000, was excellent in showing the use of these gadgets in the rural set up for not only gathering information but also in increasing accessibility to necessary practical medical information for healthcare providers.(Hook and Werner, 2003).

In this satellite project the PDAs were given to 6^{th} year Medical students from Makerere and Moi Universities, having been loaded with reference medical material. These included Medical textbooks like Harrison's textbook of medicine, Harriet Lane, Griffith's 5 minute clinical consult, 5 minute pediatric consult, HIV/AIDS, TB, and Malaria guidelines specific to Kenya and Uganda, a medical calculator with over 40

formulae, World Health Organization (WHO) Essential Drug List as well as an Essential Drug List specific to Kenya and Uganda.

The writer of this thesis being one of the beneficiaries of these handheld computers (PDAs) in her year of internship after medical school, felt very well equipped with this kind of technology at a time when computers were not common place, and reference to medical textbooks was cumbersome during clinical consultations and rotations.

2.3 ICT in Kenya

The effect that ICT has made in the Health Sector in Kenya has not been clearly established. The uptake of ICT use is still quite low, compared to some select developing countries like Bangladesh. There is also a big discrepancy between the use of ICT in the public and private health institutions. The private sector has therefore been in the fore front to embrace the use of ICT, by not limiting its use to administrative purposes only but also in basic clinical medical practice, specifically in Electronic Medical Records.

As mentioned earlier, Kenya does not have a fully functional referral system. This has led to the excessive burden on the main national referral hospitals, namely the Kenyatta National Hospital, and Moi Teaching and Referral Hospital. This is further worsened by the many Kenyans who travel long distances to access these two referral hospitals for specialized care. A stream lined ICT based referral system would go a long way to decongest these two hospitals. This may be done by introducing telemedicine. This involves use of patient electronic medical records being sent electronically, via email to consultants, most of who might be in Nairobi, and other urban centers, to review these medical records, along with electronic imaging, e.g.

electronic x-ray and CT scans, digital photos, if need be in order for reviews and tele-consultations to be made with prompt responses mitigating the need for patients to be transferred from rural areas, and thus cutting on transport cost for specialized care. This might further involve the setting up of tele-centers in the major district and sub district hospitals from where such services can be carried out, and from where resources from the government may be pooled in order to facilitate these activities. In addition, there would be need for sufficiently trained technicians to operate such technology to assist the medical personnel involved in the electronic referral process.

ICT use in health care may be used widely, and the effect it may have on record keeping is likely to be significant, if not immediate, in not only streamlining record keeping but also reducing space needed for keeping these records, manpower needed for retrieval, and its effect on referral of patients in the rural set up towards providing better, specialized care for those too far from specialists to consult them.

African Air Rescue (AAR) began its operations in 1984 as a company dealing with evacuation of medical and accident casualties both by road and air. As its membership increased, the requirements of its clientele expanded. The evacuation service became only one of the many innovative and quality health care services offered to members and was no longer the core business of the company. AAR operates fifteen health centers in four countries namely; Kenya, Uganda, Tanzania and Rwanda, providing preventive and curative health care to clients in all income brackets, as well as offering rescue and evacuation services to its members from anywhere in the world. In Kenya, AAR has 10 health facilities located in Nairobi, Thika, Kisumu, Mombasa, Nakuru, Eldoret and Kabarak. Within these health facilities, there are 161 HCWs who are in direct contact with patient records.

AAR Health care, began using Electronic Medical Records in 2005, and has since then expanded its use to both primary and secondary uses of Electronic Medical Records such as recording of clinical progress notes, laboratory and pharmacy interconnectivity in order to make ordering of lab tests and prescriptions easier and paperless, patient management, and using the EMR diaries to schedule patients. In addition AAR's EMR system has been used for financial purposes such as billing of claims, management of patient billing records and keeping abreast of the use and depletion of insurance cover and benefits. In addition this system has been used to provide clinical guidelines and standard operating procedures within the system to make them easily accessible even in the process of attending to patients.

2.4 Methodology of studies used in the past

From a survey of this novel entity of ICT in health care and its effect in Kenya, several case studies and case reports have been conducted in other countries, where the use of ICT in healthcare has been going on for a few years. Being a qualitative study, and 'as many have found, evaluation of the application of information technology in health is complex…" (Protti et al, 2008), it is also clear that the use of ICT in Kenya, just as in other developed countries like Denmark and Spain, will be dependent on economic, cultural and social factors. (Protti et al, 2008).There have been studies carried out to determine whether a physician's attitude and experience with the use of ICT Vis a Vis computers, determines the uptake of the same, and this is an interesting variable in this writer's study.

In this research study carried out at the AAR health facilities in Nairobi, Kenya, it was interesting to measure a few variables such as the Healthcare providers' knowledge, exposure and training on Information Technology (IT) and their response and

subsequent use of ICT in Health care, and specifically in feeding in clinical notes into an IT system, the employment status, whether they were employed on permanent or locum basis, their duration of employment, time taken to retrieve records, and the use of ICT in patient identification and patient scheduling.

Of note, was the use of a novel scoring system in the methodology of two studies conducted to compare the degree of automation in primary care physicians, between Denmark and Spain, and between Denmark and New Zealand. (Protti et al 2008).This scoring system was used to evaluate the adoption of Electronic Medical Records and with it the present variables including; doctors who record patient appointments in a computer in their offices, those who book appointments with specialists and clinics from a computer in their office, those who print prescriptions, those who receive alerts or prompts, those who record the majority of clinical notes in their computer in the office, those who place orders like lab requests, procedures and receive most of the patient lab results on their computers, those who receive specialist, radiologist, and cardiologists' reports into a computer in their offices and those who receive hospital discharge summaries in their offices.

Based on the above variables, it was interesting to see the response to the same, as well as how applicable and measurable these same variables are in the Kenyan set up. A review of the literature that is currently present in this area of interest is minimal in Kenya. What is present however is a good layout of what exactly is currently taking place in the developed countries, and the different terminologies used like Electronic Medical Records (EMR)s versus Electronic Patient Records (EPR)s, that have been used during this study. A review too, of the current policies in different countries'

national ICT policies tell us what to expect in the future should ICT in healthcare be aggressively taken up by Kenya and other developing countries in Africa.

The study gap that is clear here is that not many specific studies have been carried out in Kenya, if any at all, and these are more of case reports. This writer has thus used a cross sectional study to assess the effect of ICT on Electronic Medical Records in a private healthcare institution that has completely adopted ICT, not only in administrative tasks but in the clinical sector as well. This therefore has been fundamental in testing the main variables present with the use of ICT and therefore can provide solid recommendations which can later be used to implement policy, should public health institutions such as Kenyatta National Hospital want to adopt the same.

2.5 Definition of quality in medical records

The Kenyan government in 2010, through the Ministries of Health published the Standards and Guidelines for Electronic Medical Systems, which were developed from WHO guidelines on the best practices for EMR installation in Kenya and similar settings. These guidelines may be used as the baseline for defining the quality of medical records. The Ministry of Health further outlines the minimum EMR functional requirements which must address the above international standards, and are summarized in the following 6 key functional areas:

i. Basic Demographic and Clinical Health Information
ii. Clinical Decision Support
iii. Order Entry and Prescribing
iv. Health Information and Reporting
v. Security and Confidentiality

vi. Exchange of Electronic Information (MOMS and MOPHS, 2010):

Tang, 2003, further expounds on these guidelines further that all EMRs must provide;

1. Immediate access to key information - such as patients' diagnoses, allergies, lab test results, and prior medications in order to improve caregivers' ability to make sound clinical decisions in a timely manner.
2. Access to new and past test results in order to increase patient safety and the effectiveness of care.
3. The ability to enter and store orders for prescriptions, tests, and other services in a computer-based system to enhance legibility, reduce duplication, and improve the speed with which orders are executed.
4. Reminders, prompts, and alerts, computerized decision-support systems to improve compliance with best clinical practices, ensure regular screenings and other preventive practices, identify possible drug interactions, and facilitate diagnoses and treatment
5. Electronic communication and connectivity; efficient, secure and readily accessible communication among providers and patients to improve continuity of care, increase the timeliness of diagnoses and treatments and reduce the frequency of adverse events.
6. Patients support, using tools to give patients access to their health records, to provide interactive patient education especially for chronic illnesses, such as diabetes.
7. The ability to use computerized administrative tools, such as scheduling systems, that would greatly improve hospitals' and clinics' efficiency and provide more timely service to patients.

8. Reporting; where electronic data storage employs uniform data standards to enable health care organizations to respond faster to reporting requirements especially as concerns disease surveillance.

Using the above two modes of defining the quality of medical records, this study therefore investigates the effect if any, that ICT has had on improving the quality of medical records, and if answered positively, this might go a long way in aiding those in the private and public sectors to fully embrace ICT in streamlining medical records, after which the government can be tasked to regulate the use of Health Management Information Systems, to complement the private sector, and eventually improve health service delivery as a whole.

2.6 Research Question

To what extent does computerization of medical records improve the quality of medical records in AAR Clinics in Nairobi?

2.7 Hypothesis

The computerization of medical records does not improve their quality.

2.8 Objectives

2.8.1 Broad Objective

To determine the effect of ICT on the quality of medical records in AAR Clinics, Kenya.

2.8.2 Specific Objectives

1. To determine the use of ICT in administrative tasks, and in clinical record management.

2. To ascertain the turnaround time of record retrieval, placing orders such as lab requests, procedures and that of receiving the same results through computers.
3. To determine whether human factors such as age, status of employment, length of employment and duration of ICT system use, determine the quality of clinical records.
4. To determine whether the measures of quality assessed at AAR are in keeping with the benchmark (Tang, 2003) and (MOMS and MOPHS, 2010).

CHAPTER THREE:

METHODOLOGY OF STUDY

Computerization of medical records was fully completed in AAR clinics in 2005, after members of staff were trained in computer literacy and Compu Care- the EMR system currently in use. The Compu Care system is connected widely among all the AAR health facilities in Kenya, rendering health records accessible to AAR health care workers all over the country. It therefore becomes very easy for a physician who is in Nairobi to access health records captured in the Nakuru, Kabarak, Kisumu, Eldoret and Mombasa clinics. In total there were approximately 60,000 AAR members by January 2011 and a similar number of EMRs in the Compu Care system. Applications within the AAR Compu Care electronic medical records include keying in of patient medical histories by doctors or medical practitioners, ordering laboratory tests and investigations electronically, receiving the same results electronically as part of a patient's records, accessing treatment guidelines, coding of diagnoses according to the International Classification of Diseases (ICD) 10, and use of paperless prescriptions.

These are some of the basic applications generally used with EMRs, both at AAR health facilities as well as internationally.

3.1 Study Area

The study ares therefore is AAR's George Williamson House Health Center, located on 4th Ngong Avenue, Nairobi, which houses the server from which all health records in Kenya, can be accessed. In addition, AAR's National network of 10 health facilities provided a sample of all Kenyan Health Care Workers (HCW) s.

3.2 Study Population

These were two;

A cohort of patient EMRs utilized during the study period out of the total 60,000 records EMRs that are accessible at the central data base at George Williamson House Clinic within the study period, and the 161 health care workers working for AAR Kenya who are responsible for record keeping at any stage of care, within the study period. This includes doctors, nurses, lab technicians, front office and pharmacy staff.

3.3 Study Design

This is a cross sectional study, examining a sample of all electronic medical records, against the determinants of quality as per the MoH, standards and guidelines of 2010 and Tang, 2003 and an evaluation of the knowledge, attitudes and practices of Health Care Workers using the above mentioned records, by the use of Self-Administered Questionnaires.

3.4 Eligibility Criteria

3.4.1 Inclusion criteria

All Electronic Medical Records that have been in use within the study period and have been keyed into by at least 4 of the different types of health care workers namely; front office staff, nurses, doctors, lab technicians, and pharmacists.

Health Care workers who come into contact with patient medical records routinely, as part of their work, and who have signed the consent form.

3.4.2 Exclusion criteria

All Electronic Medical records not meeting either one or both of the above inclusion criteria. Health Care Workers who do not routinely handle patient records, or have not given consent to participating in this study.

3.5 Sample Size Determination

3.5.1 Sample size of Health Care Workers:-

Using the Cochran's 1977 formula for sample size determination for categorical data:-

$$\mathbf{n} = \frac{\mathbf{Z^2 \times p\,(1-p)}}{\mathbf{d^2}}$$

Where **n** = required sample size

z = is the confidence level at 95%, giving a standard value of 1.96 (the level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error.)

P (1-p) = estimate of variance, using p as the proportion of HCWs that use computers in the country

d = acceptable margin of error at 5% (0.05 error researcher is willing to accept).

If we assume the proportion p of Health care workers that 'keyboard' in Kenya for both administrative and clinical purposes is 50% (Hook and Werner 2003), we can then allow an error margin of 5%, or confidence interval which gives us a z-value of 1.96.

Using the above formula then, the sample size is as follows:-

$\mathbf{n} = (1.96)^2 \times 0.5(1-0.5)/ (0.05)^2$

n=384.16.

The calculated sample size is 385. Since the total number of AAR Health Care Workers is approximately 161, and the calculated n value is more than 5% the total population, Cochran (1977) suggests a correction formula to reduce the final sample size thus:-

n1 = n/ {1 + (n / Population)}

The correction formula therefore gives us a new sample size of:

385/ {1+ (385/161)}

N1=113.

This figure being more than 5% of the total HCW sample population required further correction thus:-

N2 = n1/ {1 + (n1 / Population)}

113/ {1+113/161)}

n2=66

This figure, which is still more than 5% the total population can be used as it can be useful to account for any non-respondents.

3.5.2 Determination of EMR Sample size:-

Using the above formula for determining sample size:-

$$n = \frac{Z^2 \times p\,(1-p)}{d^2}$$

Where n = required sample size

z = is the confidence level at 95%, giving a standard value of 1.96. (The level of risk the researcher is willing to take that true margin of error may exceed the acceptable margin of error.)

P (1-p) = estimate of variance, using p as the proportion of medical records in Kenya that are computerized.

d = acceptable margin of error at 5% (0.05 error researcher is willing to accept).

Assuming that the proportion p of medical records that are computerized in Kenya, are only 50%, (no studies confirm the actual number of medical records that are

computerized in Kenya) and both the level of risk and the acceptable margin of error are 5%, then the sample size of medical records will be as follows:-

n= $(1.96)^2$ x 0.5(1-0.5)/ $(0.05)^2$

n=384.16

The calculated sample size n is therefore **385.**

3.6 Sampling technique

Simple random sampling of all electronic medical records utilized within the study period was carried out (15,000). A list of all medical records with allocated numbers was availed, from which random sampling was carried out, using a table of random numbers. This was carried out up to the sample size required and meeting the inclusion criteria.

Stratified sampling of all health workers in contact with patient medical records during this period was also carried out from the different health facilities in Kenya. To begin with, a list of all health care workers from the different clinics as well as their designations was made. Proportions of the different strata represented, such as locum and permanent health workers from each facility, was then determined. Knowing the sample size required was 66, and out of an average of 161 health workers in total, the nth worker was then randomly picked from each list of the different groups of workers, up to the proportion required from each group in order to get representative samples not only from the different health facilities but from the different cadres of HCWs.

3.7 Data collection tools

Self-administered questionnaires were administered via e-mail to the sampled HCWs, towards determination of knowledge, attitudes, and practices in the use of EMRs by

these members of staff. The HCWs were able to respond to the questionnaires, append their signatures and send the scanned copies back via email.

A standards checklist against which each medical record was assessed compared each EMR to the set MoH standards governing EMRs, in order to determine the quality of each medical record. The standards checklist included the evidence of each EMR to provide immediate access to key patient information such as patients' diagnoses, allergies, lab test results, and prior medications to improve caregivers' ability to make sound clinical decisions in a timely manner, quick access to new and past test results to increase patient safety and the effectiveness of care, the ability to enter and store orders for prescriptions, tests, and other services in a computer-based system to enhance legibility, and improve the speed with which orders are executed, the use of reminders, prompts, and alerts, and other computerized decision-support systems to improve compliance with best clinical practices, electronic communication and connectivity among providers and patients to improve continuity of care, allowing patients access to their health records to provide interactive patient education, the ability to use computerized administrative tools, such as scheduling systems, and availability of reporting mechanisms of electronic data to enable health care organizations meet reporting requirements as concerns disease surveillance.

3.8 Variables

3.8.1 Dependent variables

Quality of medical records; the quality of medical records was measured using a standards checklist, from which all records assessed were measured against. This form contained all the specific parameters that pertain to the quality of medical records.

3.8.2 Independent variables

These independent variables are those directly affecting the dependent variable and were arising from the assessment as determinants of the dependent variable. These included completeness of record, entering the ICD 10 code, flow of clinical notes, legibility, electronic communication and connectivity, ability to schedule appointments using the system. In addition other variables assessed included HCW job designation, age, length of employment, time taken for formal employment, time taken to be conversant with the system, time taken to access a patient file, time taken to access lab results, difficulties encountered during EMR use, and ability to order lab and other procedures using the system.

3.9 Data analysis

Statistical analysis of both the quantitative and qualitative data was performed using SPSS 15.0 for Windows. Proportions of the total number of medical records adhering to the set standards by Tang, 2003, were determined quantitatively. Frequencies, and descriptive ratio statistics were extracted and statistical output was exported to text on Microsoft Word, in the form of pie charts, tables and graphs. The qualitative data derived from the views of Health Care workers at the AAR's network of health facilities was also analyzed to ascertain the factors determining the proper use of EMRs. Responses were first coded, and then summarized to ease in data entry and analysis. These results have also been represented in the form pie charts, tables and graphs.

Lastly, Principal component analysis (PCA) a statistical technique for data reduction was run to reduce the number of variables in this analysis in order to select EMR

variables with the highest variance. Variables with the greatest variability would be best for determining quality of EMR, while those with no variability were dropped.

3.10 Study limitations

Though the AAR network of health facilities, is interlinked and includes health centers in Kenya, Uganda, Tanzania and Rwanda, due to financial and time constraints, the study was limited to the Kenyan health facilities for an evaluation of the knowledge, attitude and practices of health care workers and how this affects medical record keeping, while the medical records were pulled from all Kenyan health facilities, but accessed from the George Williamson House Health facility. These records were accessed from the central data base at GWH health center. An assumption made was that that the factors pertaining to the quality of medical records in Kenya are similar to those in the region.

3.11 Ethical considerations

The study was commenced after approval from the IREC and IRB boards, in June 2011. Medical records whether manual or electronic are confidential and their contents cannot be disseminated to any persons other than health care providers of the institution that the patient has intentionally sought to consult. This was practiced throughout the course of this study. Medical records used were not personified, and thus informed consent was not sought from patients, since the extracted data did not present any risk to the patient. HCWs participating were however required to fill in consent forms prior to giving their views. Lastly, all information obtained in the course of this research shall be kept in confidence, only to be used towards improving patient care, and not for disciplinary purposes towards staff who either due to ignorance or choice do not adhere to AAR's use of EMRs.

3.12 Time frame

This study ran the course of one year, during which time pre-testing of study instruments, collection of data, analysis, and thesis writing has taken place. Data collection however, occurred over two months.

CHAPTER FOUR:

DATA PRESENTATION, ANALYSIS

AND INTERPRETATION

4. 1 Data Presentation-Descriptive Data

4.1.1 EMR support for administrative and clinical management functions

Below is a summary of EMR ability to perform admin' tasks and medical record management based on objective one. A random sample of 385 out of all EMRs accessed and utilized between January 2011 and June 2011 was assessed.

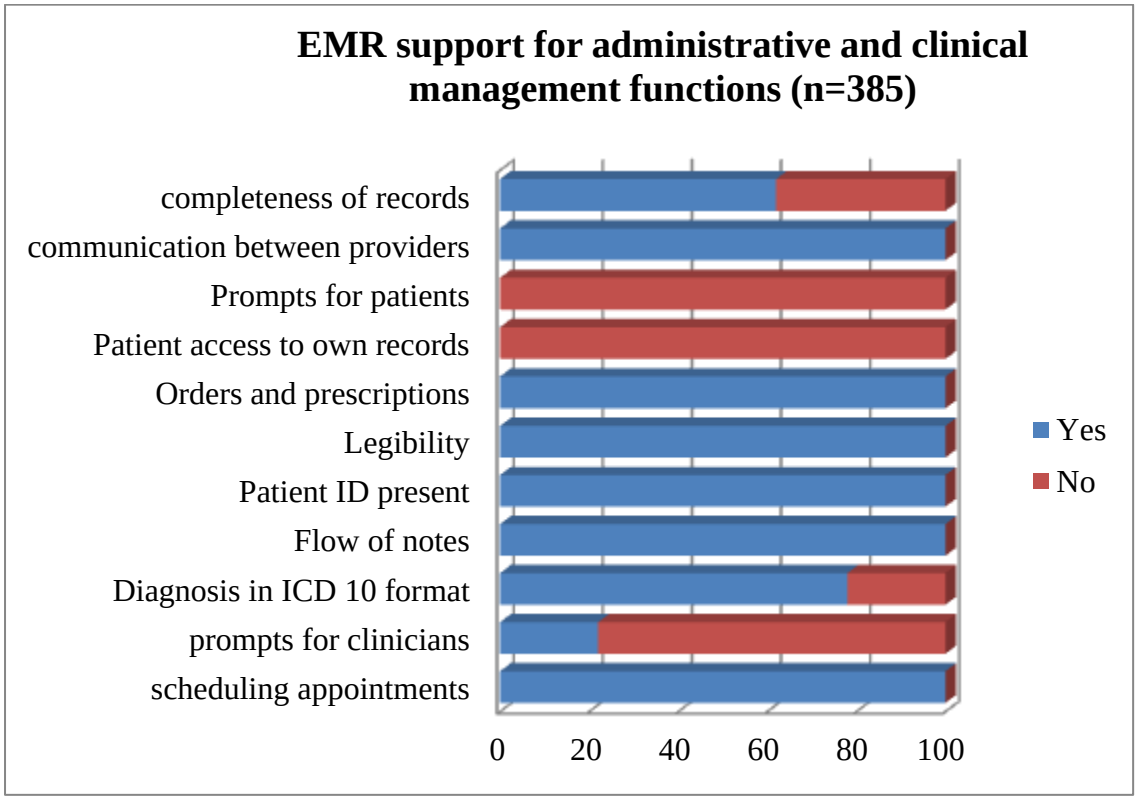

Figure 4. 1: Bar graph showing percentage of percentage of administrative and clinical management functions that the Compu Care EMR system is able to support.

4.1.2 HCW knowledge and perception of the current EMR system

Below is a summary of HCW responses to ascertain their perception regarding the turnaround time of record retrieval, placing orders and retrieval of the same results through computers in response to objective number 2.

Table 4. 1: HCW responses on EMR characteristics

1	**Time in minutes to access a patient's file**	**n = 66**	**%**
	> 1 minute	**58**	**88.8**
	1 to 5 minutes	**6**	**8.8**
	5 to 10 minutes	**1**	**1.3**
	>10 minutes	**1**	**1.3**
2	**Use of the system to schedule patients**		
	Yes	**38**	**62.5**
	No	**28**	**37.5**
3	**Ability to access patient past visits using system**		
	Yes	**63**	**95.0**
	No	**3**	**5.0**
4	**Ability to order labs and make prescriptions using system**		
	Non applicable	7	**11.3**
	Yes	**47**	**71.3**
	No	**12**	**17.5**
5	**Time taken in minutes to access lab results**		
	Non applicable	**11**	**17.5**
	less than 5 minutes	**49**	**73.8**
	5 to 10 minutes	**5**	**7.5**
	10 to 30 minutes	**1**	**1.3**
6	**Legibility of clinical notes**		
	Not at all	**4**	**5.0**
	Sometimes legible	**15**	**23.8**
	Always legible	**47**	**71.3**

4.1.3 HCW characteristics and the effect of these characteristics on the quality of EMRs.

Below is a summary of the HCW analyzed and their characteristics.

Table 4. 2: HCW characteristics

Table 1(HCW characteristics) **Job designation**	**n**= 66	%
Doctor	19	28.7
Nurse	21	31.3
Pharmaceutical technologist	12	17.5
Laboratory technologist	10	16.3
Front office	4	6.3
Job status		
Permanent	54	82.5
Locum	12	17.5
Previous use of EMRs before joining AAR		
Yes	24	36.3
No	42	63.7
Age in years [mean (SD)]	31.1	(6.6)
Job length in months [median (range)]	27	(4-180)
Orientation time in days [median (range)]	7	(1-180)
Grasp time in days [median (range)]	14	(1-150)
Hours worked per month [median (range)]	176	(30-186)

Table 4. 3: HCW attitude towards the EMR system

Difficulty using the systems for whatever functions	n = 66	%
Never	12	17.5
Once a day	34	51.2
Thrice a day	12	17.5
Almost always	8	13.8
Common difficulties with the system		
System speed	23	35
Network failure	33	50
Stock related	4	6.3
Access to patient benefits	2	2.5
Others	4	6.3
Usefulness of Compu Care EMR vs. a manual records system		
Half the time	3	5
Most of the time	18	27.5
Always useful	45	67.5
Changes desired to render the system better		
Increase system speed	17	26.3
Stabilize network	23	35
Automatic stock updates	7	7.5
CCA interconnectivity to increase access to patient benefits	10	16.3
Others	9	15

4.1.5 EMR characteristics against the set standards

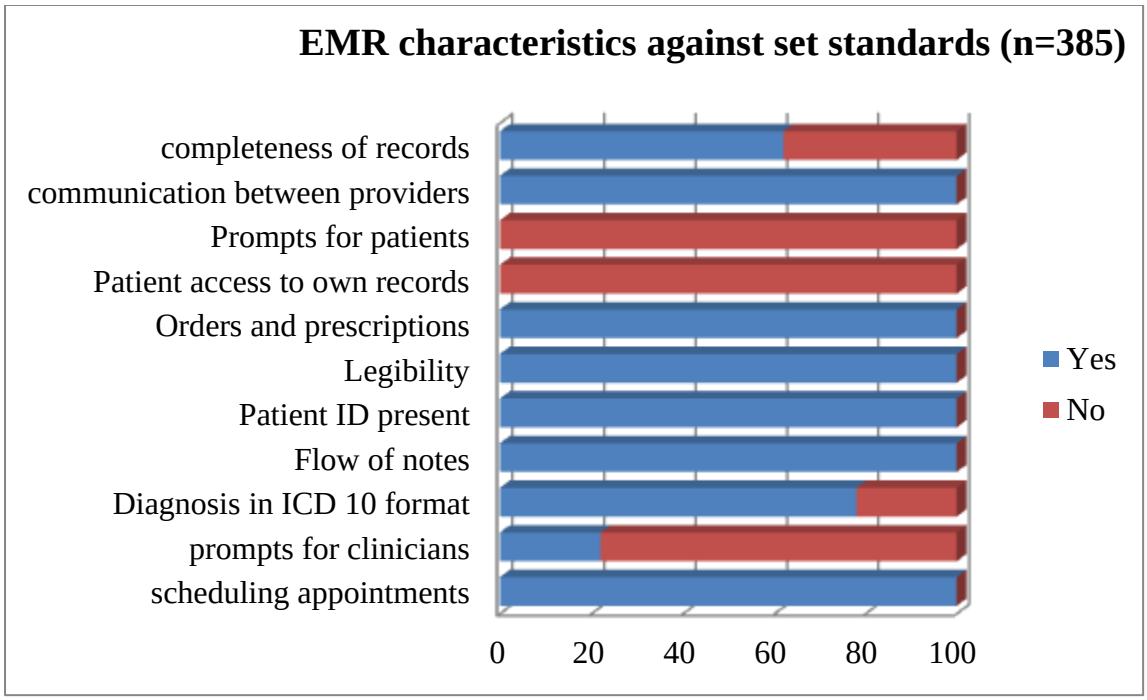

Figure 4. 2: EMR characteristics against the set standards.

4.2 Data analysis

4.2.1 Review of quality of EMR data

Principal component analysis (PCA) is a statistical technique for data reduction that helped reduce the number of variables in this analysis by describing a series of uncorrelated linear combinations of the variables that contain most of the variance.

In this analysis, PCA was used to select EMR variables with the highest variance. Variables with the greatest variance were used to disaggregate between performances of health care workers when completing EMRs. In a PCA, each component represented the proportion of the total variability within the data explained by the variable in question. The mean, standard deviation and the range (minimum and maximum) for each variable have been presented in table 3 below.

Table 4. 4: Principle components analysis

Variable name	Component 1	Component 2	Component 3	Mean	Std. Dev.	Min	Max
Record completion	0.65	0.22	-0.01	1.38	0.49	1	2
Part incomplete	0.66	0.24	0.06	1.23	1.82	0	5
ICD 10 diagnosis	0.31	-0.43	0.23	1.23	0.45	1	5
Patient prompts & alerts	-0.15	0.78	-0.28	2.00	0.07	1	2
Clinician prompts & alerts	-0.16	0.32	0.93	1.76	0.43	1	2

Principle components analysis (PCA) was used to determine key factors among the set of twelve (12) EMR characteristics that had the greatest variability. In this study variables with the greatest variability would be best for determining quality of EMR. When a PCA was run, several variables were dropped from the model due to lack of variability (always present or never present). These included; presence of a unique identifier for each record, ability to carry out orders and prescriptions, flow of clinical records from the first to the last, legibility of notes (because they are typed), presence of interconnectivity between providers, patient access to their own records, presence of alerts and prompts to patients and ability to schedule appointments using the system. Those variables with the greatest loadings and variability include; record completion, part of record incomplete, whether the record had an ICD 10 diagnosis or

not, presence of patient prompts and alerts and presence of clinician prompts and alerts.

4.2.2 Uni-variable and multivariable regression of HCW characteristics affecting quality of EMR

Regression analysis was also used to determine the univariable and multivariable relationship between EMR quality and clinician characteristics. First, each of the five variables identified from the PCA model above was modeled against clinician's characteristics. When individual and multiple regression was performed between record completion, part of record incomplete, whether a record had an ICD 10 diagnosis, presence of patient prompts and alerts and presence of clinician prompts and alerts and clinician characteristics, there was no statistically significant relationship.

Secondly a summary variable was created by converting EMR characteristics into a binary variable (0 and 1) and then adding up the modified EMR variables to give a quality score where 0 was the worst quality and 5 the best quality of EMR.
Three linear regression models were applied;

1. Simple Univariable linear regression of the summary variable against each of the clinician variables.
2. Multivariable linear regression between the summary variable and all the health care worker characteristics.
3. A fixed effects multilevel regression was run between the summary variable and the clinician characteristics, to account for the hierarchical nature of the data where patient records were nested within clinicians

The results of the regression are presented in tables 5a, 5b and5c below for the univariable linear regression, multivariable linear regression and for the multilevel regression respectively.

Table 4. 5: Univariate Linear analysis

	Univariable linear analysis		
	Coef.	P-Value	[95% Conf.
Age	0.035	< 0.001*	[0.022, 0.048]
Job length (months)	0.006	< 0.001*	[0.003, 0.009]
Orientation time (days)	-0.002	0.059	[-0.005, 0.000]
Time taken to be conversant with	0.002	0.543	[-0.005, 0.009]
Average hours worked/ month	0.007	< 0.001*	[0.006, 0.009]
Job designation	0.031	0.792	[-0.198, 0.260]
Job status (locum/ permanent)	0.866	< 0.001*	[0.663, 1.068]
Previous use	0.251	0.002*	[0.406, 0.096]

Table 4. 6: Multivariate linear analysis

	Multivariable linear analysis		
	Coef.	P-Value	[95% Conf.
Age	0.015	0.244	[-0.010, 0.039]
Job length (months)	0.005	0.070	[0.000, 0.010]
Orientation time (days)	-0.002	0.196	[-0.004, 0.001]
Time taken to be conversant with	0.001	0.882	[-0.007, 0.006]
Average hours worked/ month	0.006	0.001*	[0.002, 0.010]
Job designation	-0.259	0.081	[-0.549, 0.032]
Job status (locum/ permanent)	0.225	0.379	[-0.277, 0.726]
Previous use	0.351	< 0.001*	[0.516, 0.186]
Mean	2.465	3.489	[0.044, 0.000]

Table 4. 7: Multivariate multilevel analysis

	Multivariable multilevel analysis		
	Coef.	P>z	[95% Conf.
Age	0.003	0.937	[-0.064, 0.069]
Job length (months)	0.004	0.529	[-0.009, 0.018]
Orientation time (days)	-0.002	0.525	[-0.009, 0.005]
Time taken to be conversant with	0.004	0.592	[-0.011, 0.019]
Average hours worked/ month	0.005	0.100	[-0.001, 0.011]
Job designation	-0.247	0.446	[-0.883, 0.389]
Job status (locum/ permanent)	0.198	0.659	[-0.683, 1.079]
Previous use	0.263	0.217	[-0.680, 0.154]
Mean	3.670		[2.869, 4.471]
Level I variance	- 0.600	< 0.001*	[-0.670, -0.530]
Level 2 variance (clinician)	0.377	< 0.001*	[0.242, 0.512]

The results of the above regression analysis were as follows; There was statistically significant uni-variable relationship between; age, job length, average hours worked per month, being in permanent employment and previous use of an EMR. Being a permanent employee increased EMR quality by 0.87 points (out of 5) 95 % CI [0.663, 1.068] while previous use increased EMR quality by 0.25 points, 95 % CI [0.406, 0.096]. There was an increase of EMR quality of 0.035 for each record when a clinician was older. Job length and average hours worked per month only marginally increased the EMR quality. In the simple multivariable analysis, average hours worked per month and previous use had statistically significant relationship with the quality of EMR. Previous use increased EMR quality by 0.35 points, 95 % CI [0.516, 0.186], while average hours worked increased EMR quality by 0.006 points, 95 % CI [0.002, 0.010].

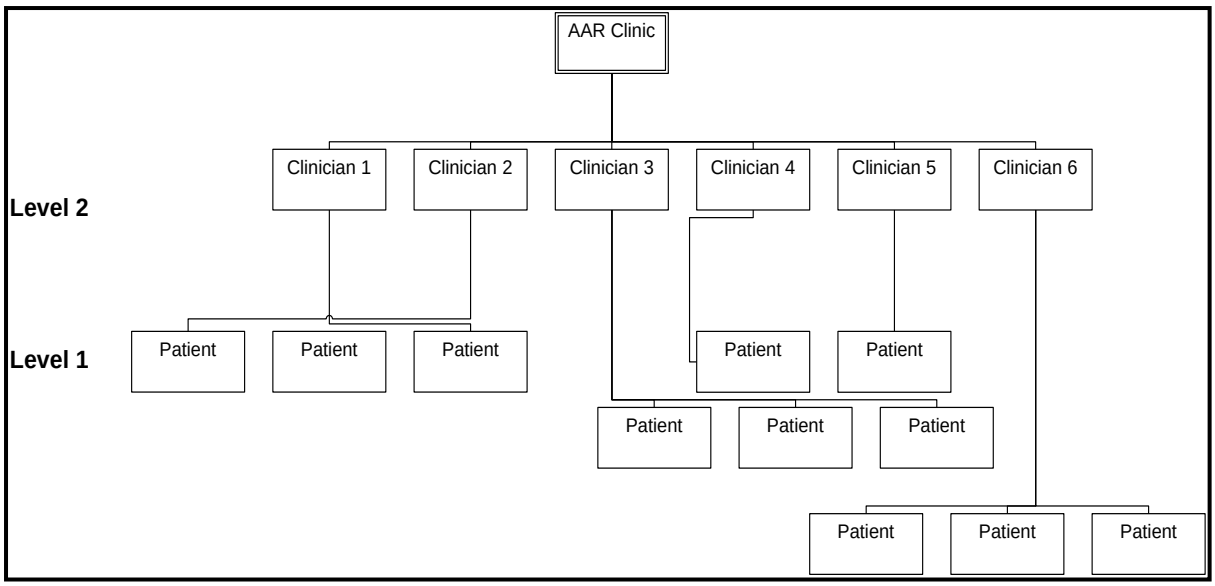

Figure 4. 3: Showing the multilevel nature of EMR data at an AAR clinic

In the multilevel multivariable (hierarchical) analysis as represented above, there was no statistically significant relationship between individual clinician characteristics. The between clinician variability and within clinician variability were, however statistically significant. The between clinician variance was -0.6 points, 95 % CI [-0.670, -0.530], whereas the within clinician variability was 0.377, 95 % CI [0.242, 0.512]. The variability between and within clinicians is presented in the figure below.

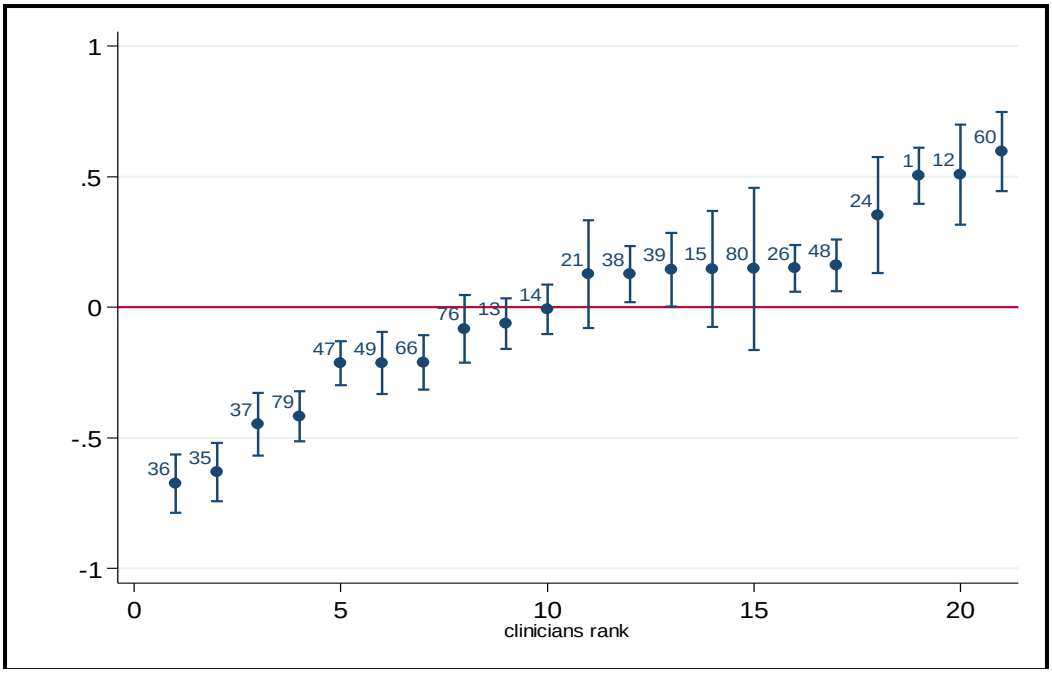

Figure 4. 4: Showing the ranking of HCWs based on the magnitude of difference from mean performance

4.2.2.1 Summary of the effect of HCW characteristics on the quality of EMRs

Table 4. 8: HCW characteristics affecting EMR quality

HCW factors affecting quality of EMR	Increase in EMR Quality	Analysis demonstrating effect
Permanent employment	↑ by 0.87 points 95 % CI [0.663, 1.068]	Uni-variate Linear analysis
Increased age	↑ by 0.035 points 95% CI (0.022,0.048)	Uni-variate analysis
Previous EMR use	↑by 0.25 points, 95 % CI [0.406, 0.096]. ↑ by 0.35 points, 95 % CI [0.516, 0.186]	Uni-variate linear analysis Multivariable analysis
Average hours worked/month**	↑ by 0.007 points, 95 % CI [0.006, 0.009].	Multivariable analysis
Job length in months**	↑ by 0.006 points, 95% CI (0.02,0.010)	Uni-variate analysis

CHAPTER FIVE

DISCUSSIONS

5. 1 Comparison of research findings and objectives

The main objective of this study was to determine the effect of ICT on the quality of medical records in AAR Clinics, in Kenya.

Among the specific objectives outlined, these were the findings against each set objective;

1. To determine the use of ICT in administrative tasks, such as patient ID verification, and scheduling of appointments as well as the use of computers in keying in progress and clinical notes.

   All EMRs assessed had a unique identifier. The EMR system supported the scheduling of patient appointments, but out of the HCWs sampled, only 62.5 % of them used the system to schedule appointments. All clinical notes were typed by clinicians into the system under a specific patient's clinical notes.

2. To ascertain the turnaround time of record retrieval, placing orders such as lab requests, procedures and that of receiving the same results through computers.

   Once the HCWs were evaluated, 88.8% of them stated that it took less than 1 minute to access a patient's file, while a further 8% could do so between 1 and 5 minutes. The remaining 2.6% could still do so within 10 minutes. 95% of these HCWs also reported that they could access a patient's past visits using the system, while 5% only could not.

3. To determine if human factors such as age, status of employment, whether on locum or permanent, length of employment and duration of ICT system use, determine the completeness and accuracy of clinical records.

From the above analysis this study was able to ascertain that certain factors such as; age, job length, average hours worked per month, being in permanent employment, previous use of an EMR, had statistical significance in determining the quality of medical records and thus the completeness of these records. It is not immediately clear why the above factors affect the practices of the HCWs however these have been speculated upon in the discussion section below.

4. To determine if the measures of quality assessed at AAR are in keeping with the benchmark (Tang, 2003) and (MOMS and MOPHS, 2010).

   As discussed above, and as shown in figure 2, there are certain benchmarks that the AAR Compu Care system supports 100% of the time such as; presence of a unique identifier for each record, ability to carry out orders and prescriptions, a flow of clinical records from the first visit to the last, legibility of notes and presence of interconnectivity between providers

   There are a few characteristics that the Compu Care system does not have or is not able to support at all namely patient access to records and availability of prompts for patients.

   There are other benchmarks that the system has supported, but is utilized based on clinician practices. These include; completeness of each record, the parts of the record that are incomplete and whether the record had an ICD 10 diagnosis or not.

Compared to previous studies as Protti et al, (2008) found, ‘evaluation of information technology in health is complex’ and this is dependent on economic and social factors. Similar to Protti et al’s (2008) study it is clear that a clinician’s attitude and previous experience with ICT determines not only their uptake but the quality of data as well.

5.2 Discussions and Interpretation of results

From the above analysis of both HCWs and EMRs it was noted that;

The AAR network of health facilities, is mainly run by a 'young' HCW population (median age 31.1 years), with a high turn over, most employed for approximately 27 months(2 years, 3months). This is probably because these facilities are run by Primary Care physicians and caregivers, unlike referral facilities or specialist establishments in the country, which might have a higher population of 'older' specialists. In addition, 82.5% of all AAR staff are permanently employed, a factor that is necessary to ensure streamlined services. Locum members of staff are few (17.5%) and work sporadically to occasionally fill in when there are staffing shortfalls such as those due to sickness, annual leaves and maternity leaves. It is necessary therefore that the bulk of staff remains permanent to ensure continuity of care.

Having only 36.3% of staff having had exposure to EMRs in the past, orientation to the system is necessary and has been allocated for all new staff, and it is noted that this takes approximately 7 days, resulting in most HCWs grasping the contents of the system within 14 days on average, of their commencing employment. Looking at the benchmarks against which the EMR sytem is being measured, the current Compu Care system is able to achieve 100% of a few of the set benchmarks, mainly; presence of a unique identifier for each record, ability to carry out orders and prescriptions, flow of clinical records from the first to the last, legibility of notes (because they are typed) and presence of interconnectivity between providers. The EMR system does not have any patient support system meaning patients cannot log onto the system, cannot directly access medical records or even lab results and reports directly.

Generally speaking, Kenya has not reached the point where patients are allowed complete and total access to their medical records. In many institutions, only some select aspects of their records are willingly submitted to patients, and these include lab results, and a summary of pertinent medical records, through summarized Medical Reports. The Current Compu Care system was not designed with the possibility of a patient directly accessing their medical records, unless a section of it is summarized and printed off the system by a clinician. This is probably the reason why there are no prompts for clients within the records, rather they are there for clinicians pertaining to patients, such as drug allergies, need for repeat or serial blood pressure readings, etc.

Other benchmarks with variable utility and that are solely dependent on clinician knowledge, attitude and practice include; entering of the ICD10 diagnosis- 78.3% of the time, and completeness of a medical record- 62% of the time. The parts of the record that are usually incomplete include the following; presenting complaint-4.5%, exam findings- 54.5%, and more than one part of the record incomplete- 40.9%. The above aspects of each medical record depend on a clinician's attitute, whereby this might be quite subjective and can only be speculated upon. Such reasoning includes time constraints, whereby a clinician may feel time is wasted by clicking or moving a step away from the main clinical notes to select a diagnosis.

A further review of the doctors' clinical notes where they were incomplete, there was a tendency to enter the visit's diagnosis in the clinical notes without necessarily typing in the patient's presenting complaints, and exam findings. This was more so for such diagnoses such as upper respiratory tract infections (flu), and gastroenteritis. Some of the reasons given for this practice was time constraints.

It was necessary to evaluate a further 400 medical records that were accessed and utilized by all doctors filling in the Self Administered Questionnaires (SAQ)s, because doctors are generally the custodians of patient clinical notes and thus affect such a patient's clinical notes. This was also necessary to ascertain the practice of this sample of doctors, in line with their data having been collected from the HCW SAQs. The results have been described and laid out in figure 11 along with their rankings. Of note however are the following; Being a permanent employee improved EMR quality, as well as having had previous experience with the use of EMRs. This relationship is probably as a result of increased time spent on the system, and thus the ability of a HCW to be more conversant with all the functionalities of the system. Additionally, being older seems to improve EMR quality. This might be because the older clinicans have also worked for AAR longer and may be more conversant with the system than those newly employed. The older clinicians have also had time to progress with the system, and adapt to new changes of the system.

Lastly, though the EMR system currently available has a wide spectrum of functions, not all staff utilize these functionalities maximally, a factor that may be improved with more time allocated to individual staff orientation to ensure HCWs not only know what to do, but why they must do so as well. It must be emphasized that with EMRs, clinical reports are easier to retrieve from the system, such as those on prescription patterns, common illnesses encountered in a facility, stocks-more so drugs, as well as patients seen per practitioner per hour, as a means of evaluating staff efficiency. All these reports are only as accurate as the users who feed in this information into the system.

Of note is that though the system has some good qualities, there are some difficulties that the HCWs have been experiencing with the Compu Care system as outlined in figures 20 to 22.

These include; network failure-50%, system speed(system slowness) -35%, stock related issues -6.25% and difficulty accessing patient benefits 2.5%. The desired system changes are thus geared towards resolving the above problems, and all sorround stabilizing the network connection. Despite the above issues, 95% of all HCWs interviewed found the system useful compared to manual record systems.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The study has gone a long way in ascertaining what the definition of quality as pertains to EMRs is, and the standard qualities that any Electronic Medical Record must have in place and that are incorporated into AAR's Compu Care system. It has however also clearly demonstrated that in addition to system factors, human factors must also be considered as determinants of quality of records within an EMR system.

It can be concluded from this study that computer based EMR systems, such as AAR's Compu Care system are very useful in improving the quality of medical records, so long as the majority of the set standards by both Tang 2003, and the Ministry of Health are met. This study has also fully met the set objectives in determining the effect of ICT on the quality of medical records in AAR Clinics, in Nairobi Kenya, by determining the use of ICT in both administrative and clinical tasks.

6.2 Recommendations

For, AAR as one of the pioneer health providers in this country to embrace EMRs and use them fully, it is clear that the Compu Care system currently in use has the majority of specifications required by any standard EMR system. The current system however can be upgraded to support some of the specifications that it does not support, such as; patient support systems to offer patients prompts and reminders for refill of medication and review of lab tests and remote patient access to their own medical records, or at the very least, some parts of their medical records, such as lab results, vital signs, past prescriptions and so forth. Further training for staff is

necessary to sensitize them on areas of the system that they may not be using or updating sufficiently. This includes, completing medical records as well as entering the ICD10 diagnosis for each patient seen to ensure records retrieved there after are not only complete but accurate.

The underlying system issues that members of the medical staff noted would require to be addressed comprehensively. Network stabilization is necessary to ensure minimal interruptions during utilization of these EMRs. These network fluctuations not only affect the system speed and thus staff speed, but may also be the underlying factor behind other issues arising such as difficulty accessing patient benefits and stock related issues. EMRs may be used to solve the problem created by the numerous numbers of medical records generated by different health facilities, as they grow. The space required to store the ever increasing number of records for larger institutions can be minimized with a fully EMR systems integrated to other systems such as Radiology Information Systems that are able to store radiological images electronically.

The turnaround time of record retrieval can be greatly reduced by computerizing records to ensure medical records are retrieved in a timely manner to ensure faster clinician decision. This has been clearly evidenced by the sentiments collected by AAR HCWs concerning the turnaround time of accessing patient records, accessing lab results as well as making orders and prescriptions. Loss of records, as well as manipulation of medical records are problems unlikely to occur with EMRs since most systems have electronic signatures and cannot be edited once saved. This is the case with the Compu Care system, whereby once saved, records cannot be edited in the future. This must be a consideration of all future EMRs to ensure accuracy,

unlikelihood of record loss and manipulation and the reliability of such records for medico legal purposes.

EMRs are the backbone of telemedicine where electronic medical data may be transmitted to other medical practitioners or specialists via email remotely. This would go a long way in easing the congestion in referral facilities such as Kenyatta National Hospital, where patients occasionally wait months in order to see a specialist. These patients could easily be attended to from their rural homes after consulting a specialist remotely on phone or via video conference or even better after sending electronic medical notes or images such as x-rays done electronically, for the consultant to review and advice accordingly. This set up would require the government's support in funding start up equipment, including setting up medical ICT hubs within each district or provincial hospital to ensure all referral cases are sorted in this manner. This would not only decongest the referral facilities, but also improve rural patient management without the transport costs that referrals result in.

For AAR this is a worthy cause and a natural development for the current system to interlink the upcountry health facilities with Nairobi specialists, to avoid sending such patients to Nairobi just for referrals to see specialists. The converse would be creating one telemedicine hub within one of its Nairobi facilities, from where consultants might be consulted on specific pre-booked patients. Each facility could have one day a week where also referral type patients would be booked to consult specialists remotely. This would go a long way to serve as a model for the public institutions that would need to do the same in the future.

Public health facilities are many times accused of being run inefficiently. Electronic medical records would aid in generating accurate reports based on the electronically based records that are usually easier and faster to compile and thus help in making evidence based clinical and managerial decisions. This also affects such reports as those pertaining to notifiable diseases in facilities of all levels. Additional reports that may be useful for managers specifically in running their institutions more effectively would include reports relating to staff efficiency, whereby the system is able to ascertain how many patients a clinician has seen each hour, and administrative tasks such as booking patients to efficiently manage them.

Researchers requiring organized medical data especially on studies such as disease prevalence of certain diseases would benefit from this sort of data due to the ease with which it can be retrieved, as well as the format required, such as based on ICD 10 classification, based on age groups, based on weight and other demographic factors.

From the study, it is clear that the transition from manual records to electronic records for any health facility would require adequate training for all staff likely to handle these records to ensure maximum utilization of all functions of such a system. The completeness of the records would solely depend on the HCWs in the facility. In addition this study has demystified the components of any such EMRs, highlighting on some of the specifications that any health facility manager would require to ensure the EMR in use is robust and up to date.

In addition to the different specifications that have been outlined by Tang,(2003) and MOMS and MOMPHS, (2010), a few areas that would require to be emphasized on would include installing patient reminders and prompts to ensure patients too play a

major role in their follow up, by getting system generated reminders sent on their phones on matters such as, refill of chronic medications, review of lab results, recheck of certain parameters such as blood pressure and blood sugar for hypertension and diabetes respectively. These would encourage health promotion in prevention of disease and reduction of disease complications.

The government can play a major role in ensuring regulations are put in place to ensure all EMRs adhere to the standards and guidelines set by the ministries of health according to their 2010 publication on the same. Matters such as confidentiality of records would require special attention to ensure that web based EMRs are protected to ensure patient confidentiality is always maintained.

In addition to regulation, the Ministries of Health in conjunction with other sectors can work together to ensure unique citizen identifiers such as PIN numbers and national identification numbers can be linked to electronic medical data bases to ensure retrieval and provider access regardless of where a patient may be, even far away from their primary physician. This will ensure that any patient connected to this network of EMRs can be treated anywhere in the country.

Lastly, all future medical records must be modeled to improve medical care. The EMR systems will thus enhance the definition of these EMRs thus, ‘records in digital format that are capable of being shared across different health care settings, by being embedded in network-connected enterprise-wide information systems. Such records should include a whole range of data in comprehensive form, including medical history, medication and allergies, immunization status, laboratory test results, radiology images, and billing information’ (Gunter, et al, 2005), to improve the medical care of all patients!

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APPENDICES

APPENDIX I Data Collection Instruments

APPENDIX IA: Informed Consent Form

Dr. Mugambi-Nyaboga is carrying out a study whose purpose is to investigate the knowledge, attitudes and practices that determine the quality of Electronic Medical Records (EMR)s.

You are invited to participate in this study by giving your sentiments on a voluntary basis. The research is anticipated to take place for one year, but your views will be taken once by the use of a Self-Administered Questionnaire (SAQ) that you will receive via e-mail, within one month.

Besides this consent form, The SAQ will not carry your names but rather a unique identifier to maintain confidentiality, as well as to completely obliterate the risk of any other persons other than the primary researcher named above from accessing this information.

Although you will not benefit directly from this study, views taken on your knowledge, attitude and practice in the use of EMRs will be used to ascertain factors determining the quality of the same.

Your signature on this form means that you understand the purpose of this study, and that you are willing to voluntarily participate in this study. Be advised that you may withdraw from this study at any time without any adverse repercussions.

Signature of participant

Contact information for Dr. Mugambi-Nyaboga

Email: lmugambi@aar.co.ke

Phone:020 2895054

APPENDIX IB: Self-Administered Questionnaire for HCWs

1) Participant's unique identifying number_____
2) Job designation_____
3) Job status permanent_____ locum_____
4) Age_____
5) Length of employment_____
6) Had you previously worked with Electronic Medical Records before joining AAR? Yes__ No __
7) How long was your formal orientation period upon joining AAR? _____
8) How long did it take you to be comfortable with the system? - _____
9) How many hours do you work per month? _____
10) How long does it take you to access a patient's file? 1min___5min___10min____30min____
11) Do you use the system to schedule patients for visits routinely?_ Yes_____ No_____
12) Can you access a patient's past visits from the system? Yes_____ No_____
13) Are you able to order labs and procedures using the system? Yes_____ No____
14) How long does it take you to access lab results using the system?5min___10min____30min_____
15) How legible are clinical notes in the system? Not at all_____ sometimes____ always legible____
16) How often do you have difficulty using the system for whatever function? Never____ Once a day____ thrice a day_____ almost always_____
17) What difficulties do you commonly encounter with the system? _____
18) In your past experience and opinion, how useful is the is the Compu Care system in carrying out your day to day activities, as compared to manual systems(manual filing systems) Not at all_____ rarely useful_____ useful half the time_____ useful most of the time _____always_____
19) What changes to the system do you think would help improve your work as pertains to the system? _____

APPENDIX IC: Standards checklist for measuring EMR performance against set standards

1) Does the medical record have a unique identifier for a particular patient? Yes____ No_____
2) Are the clinical records complete, i.e. with presenting complaints, diagnosis, plan of action Yes___ No__
3) If not, which bit is not complete?

   _____
4) Is the diagnosis entered according the International Classification of Disease (ICD) Yes___ No__
5) Is there a flow of clinical notes from the first visit to the last Yes___ No___
6) Does the record demonstrate entering and storage of orders, as well as creation of prescriptions? Yes_____ No_____
7) Are they legible? Yes_____ No_____
8) Are there any prompts, reminders, or alerts to assist patients with compliance to the best clinical practice? Yes_____ No_____
9) Are there any prompts, reminders, or alerts to assist clinicians with compliance to the best clinical practice? Yes_____ No_____
10) Is there any electronic communication and connectivity among providers using the record system? Yes ____No_____
11) Is the patient supported through access to their records? Yes_____ No____
12) Is it possible to schedule patients for subsequent appointments using the system? Yes____ No___

APPENDIX ID: Research Activity Schedule (Gantt chart)

	Jan '11	Feb '11	Mar '11	Apr '11	May '11	Jun '11	Jul '11	Aug '11	Sep '11	Oct '11	Nov '11
Submission of research proposal to IREC		↔									
Approval from IREC						↔					
Pre testing of data collection tools							↔				
Sampling of medical records for evaluation							↔				
Sampling and identification of HCWs for interviewing								↔			
Analysis of medical records									↔		
Interviewing of HCW s using SAQs									↔		
Data entry, coding and analysis										↔	
Compilation of reports and thesis											↔
Submission of thesis											↔

APPENDIX II: Figures and Tables

Figure 1: ***HCW age in years***

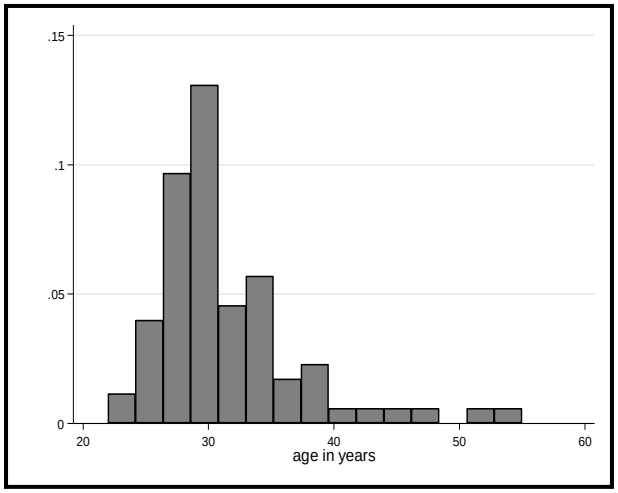

Figure 2: ***Average hours worked per month***

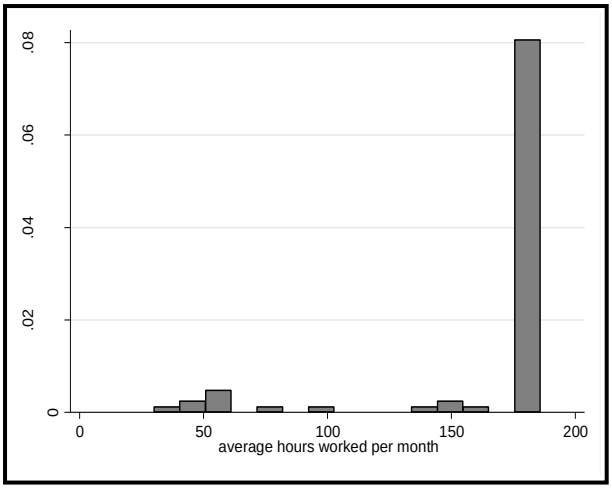

Figure 3: ***Job length in months***

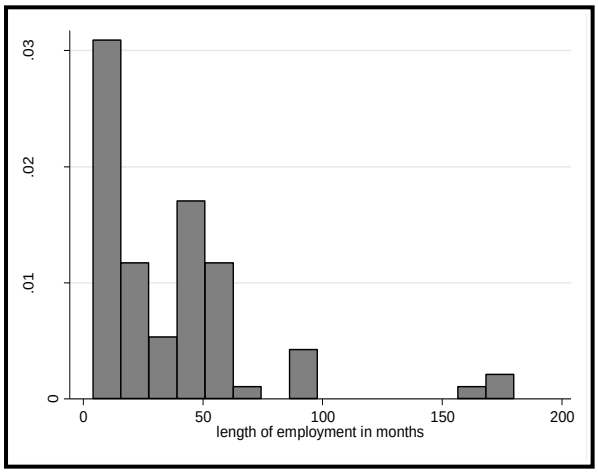

Figure 7. 4: ***Length of formal orientation in day)***

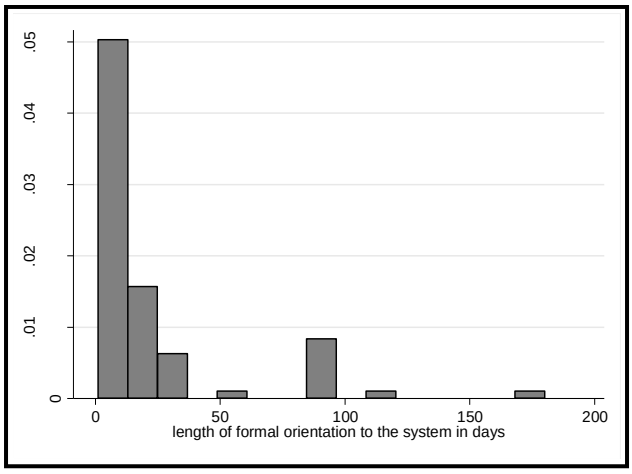

Figure 7. 5: Time taken in days to be conversant with system

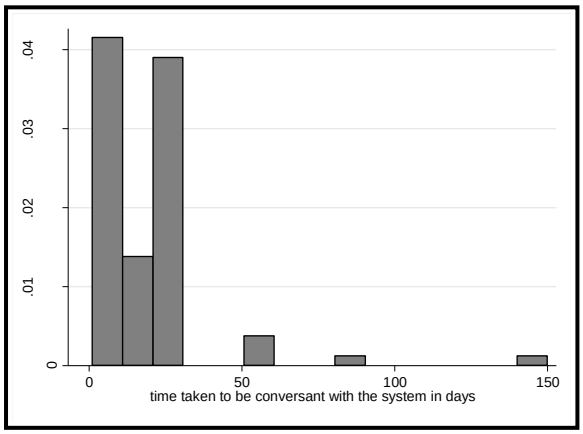

Figure. 6: pie chart showing time taken to access patient files

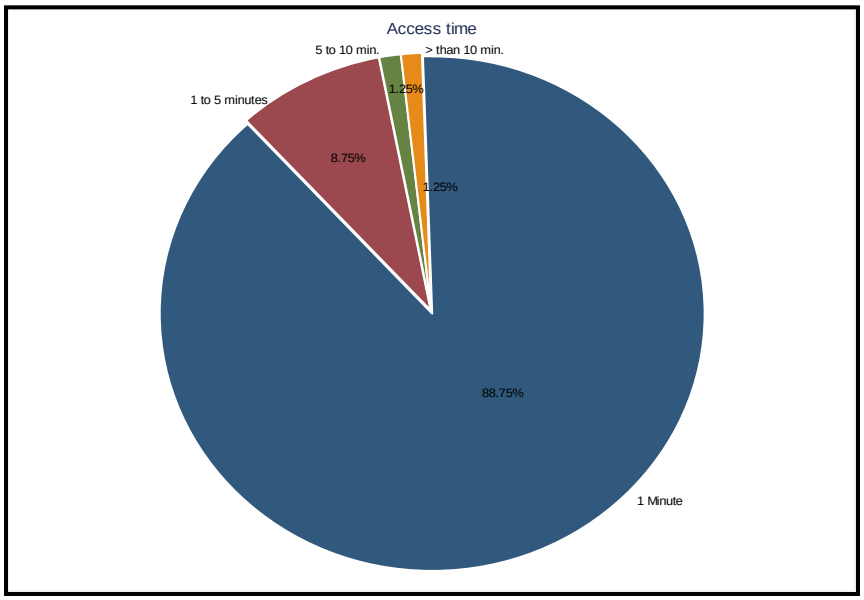

Figure 7: EMR system usefulness

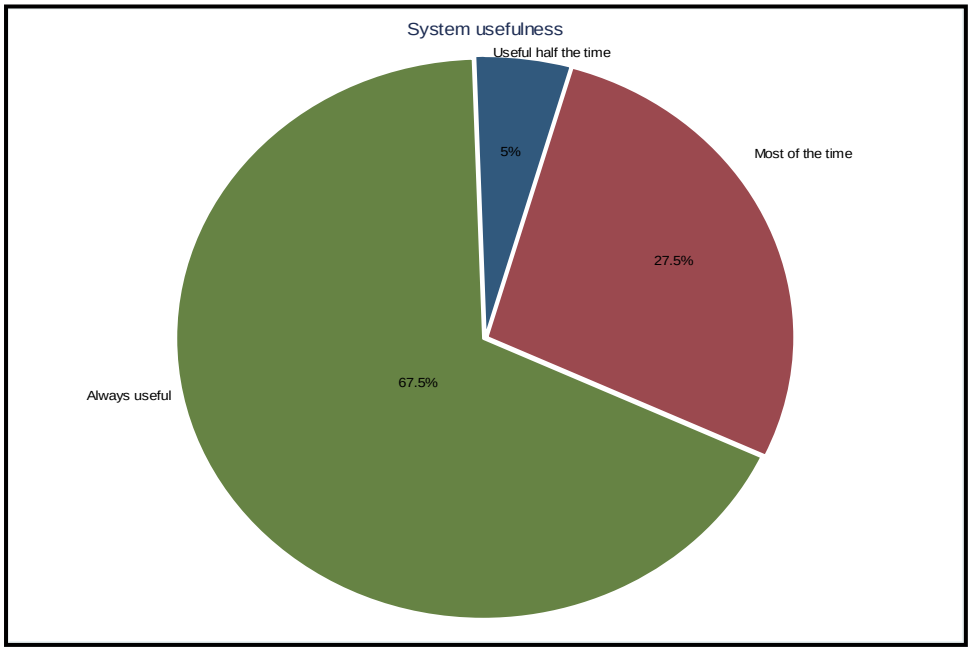

Figure 7. 8: HCWs and their job designations

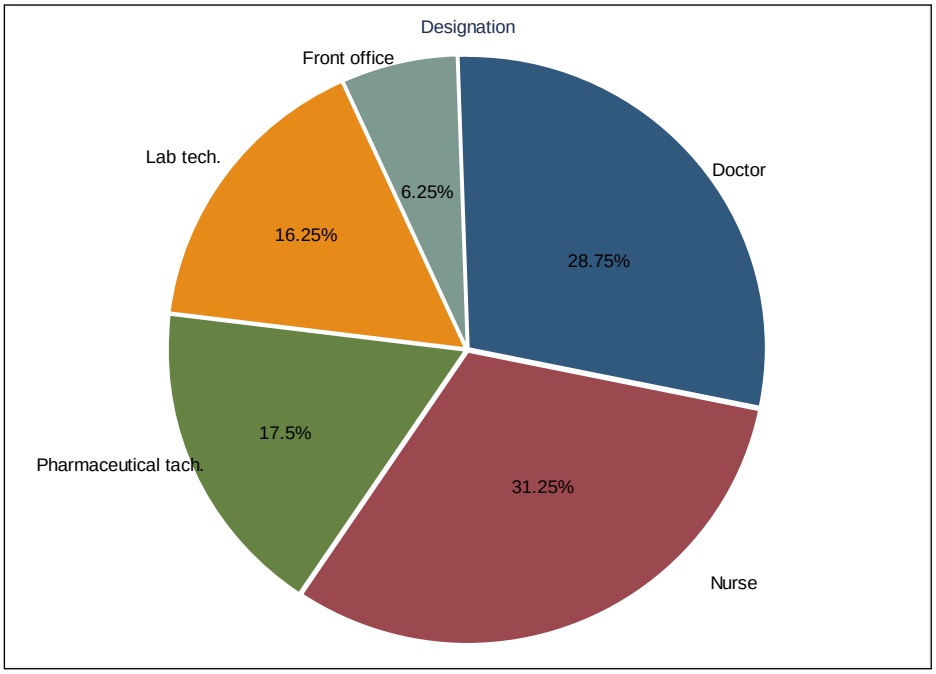

Figure 9: HCW employment status

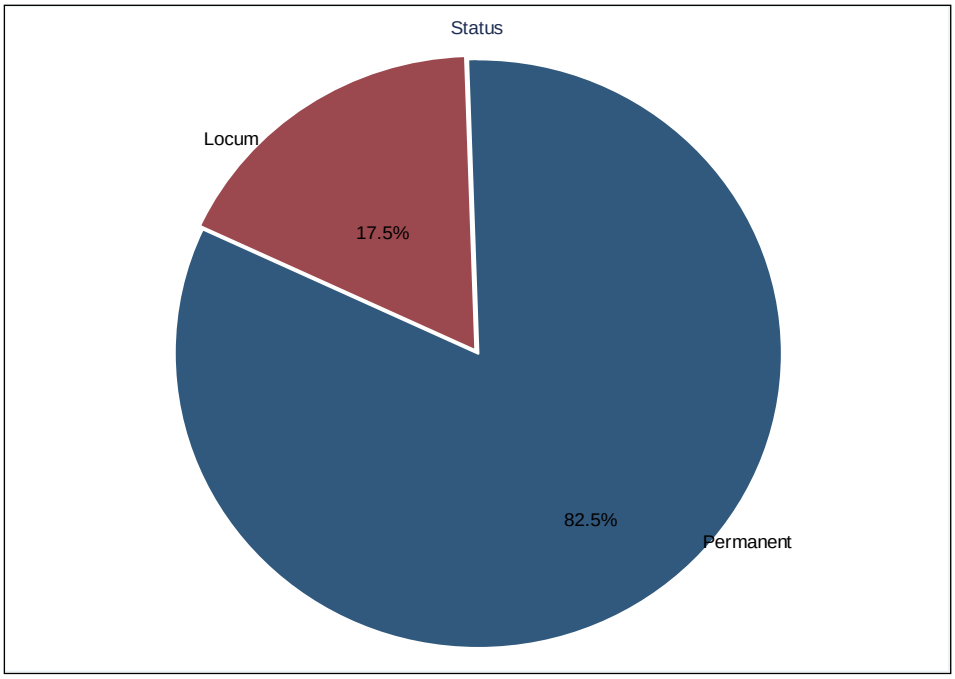

Figure 7. 10: HCWs and previous use of EMRs

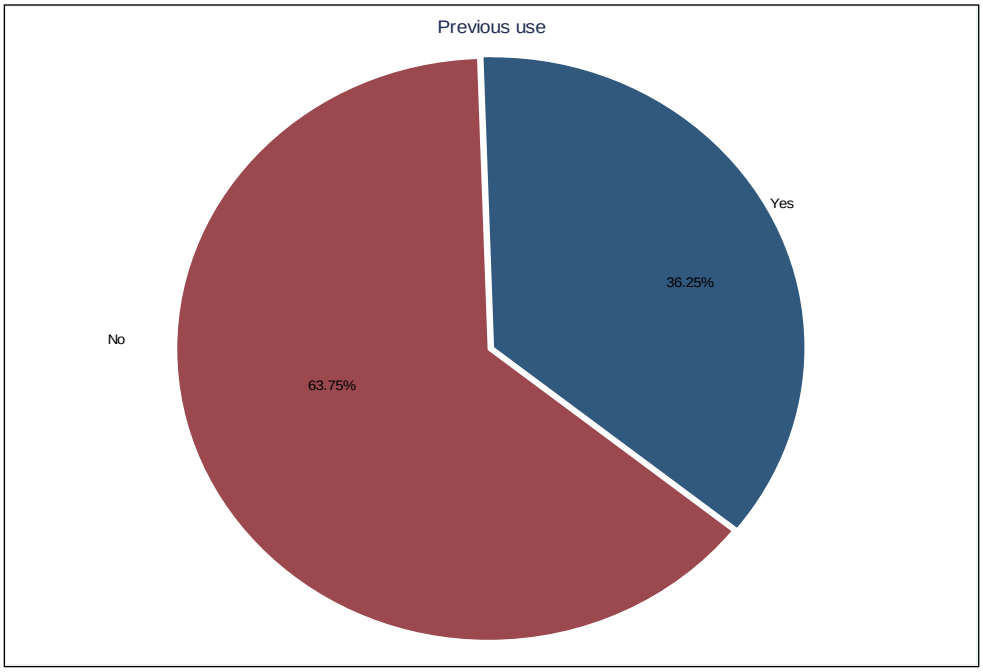

Figure 7. 11: HCWs and scheduling of patients using the EMR system

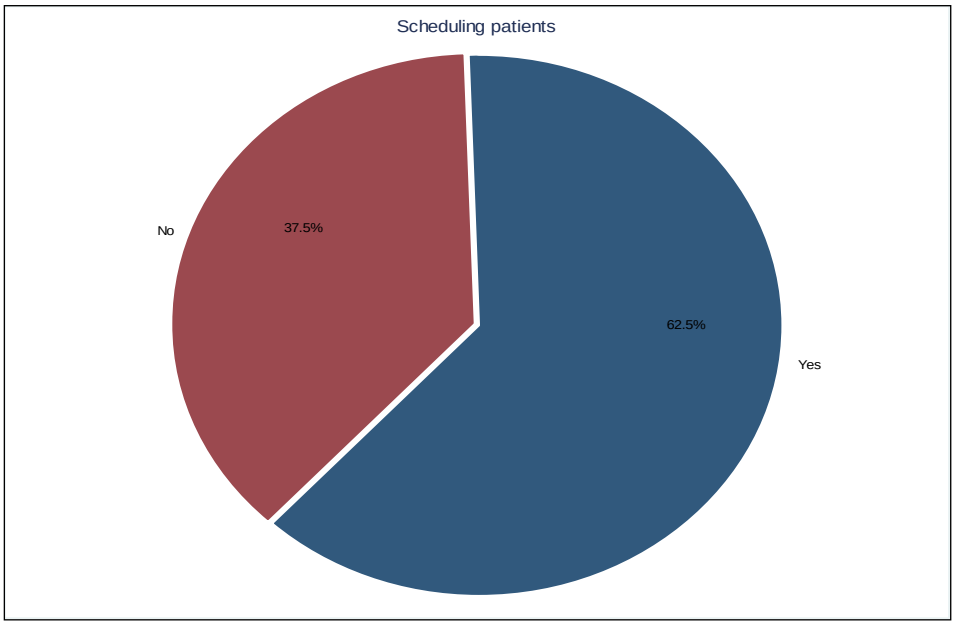

Figure 12: HCWs and ability to access patient visits

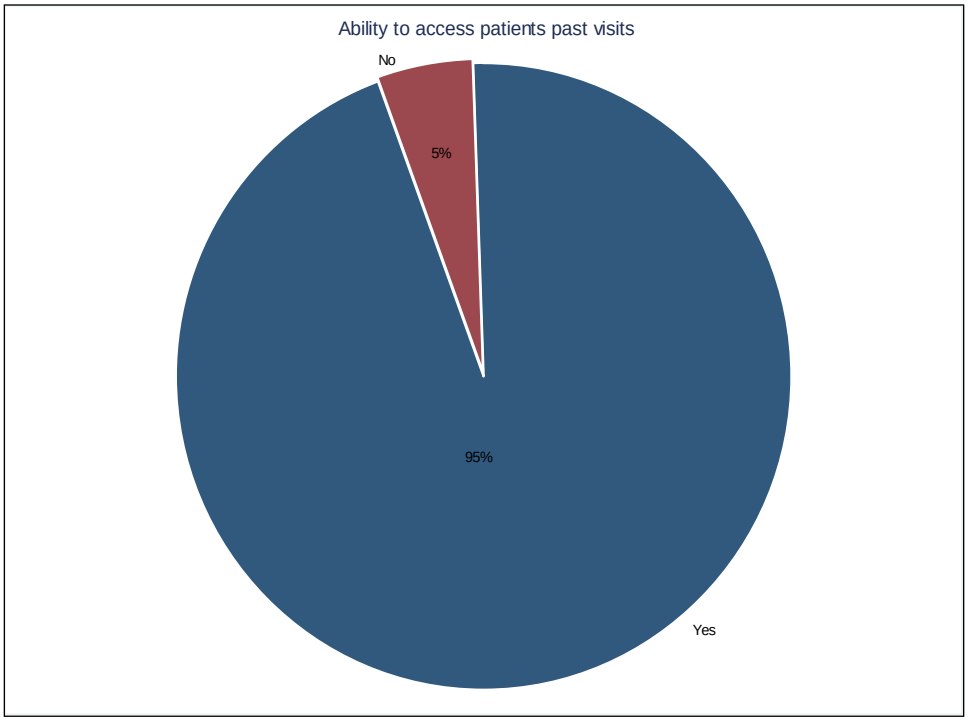

Figure 13: HCWs and ability to make lab requests and write prescriptions

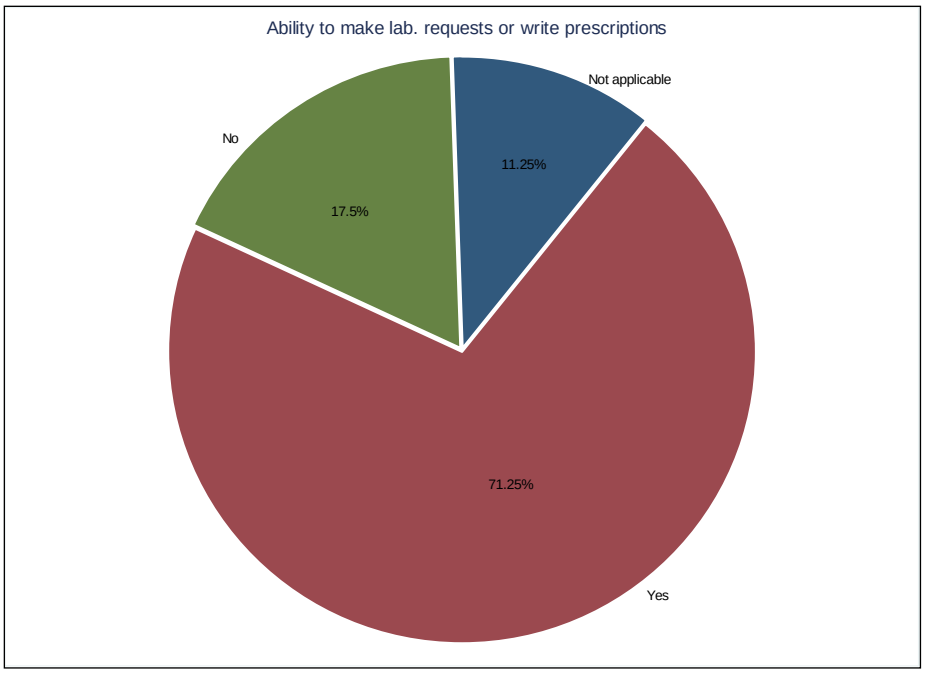

Figure 14: HCWs and their turn around time in accessing lab results

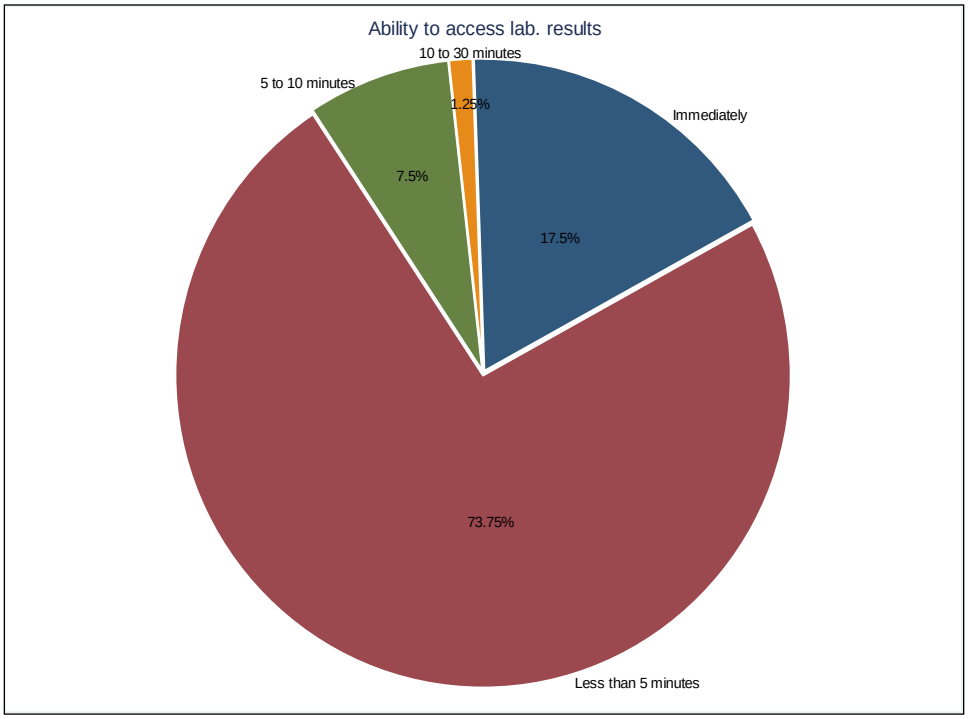

Figure 15: HCWs and how legible they find the system

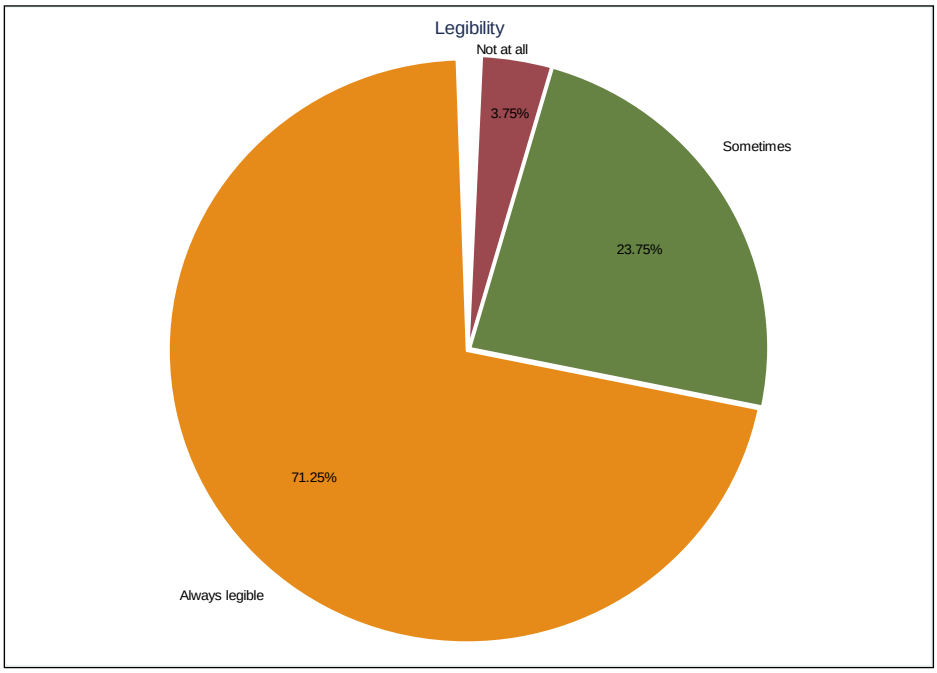

Figure 16: ***HCWs and likelihood of encountering system difficulties***

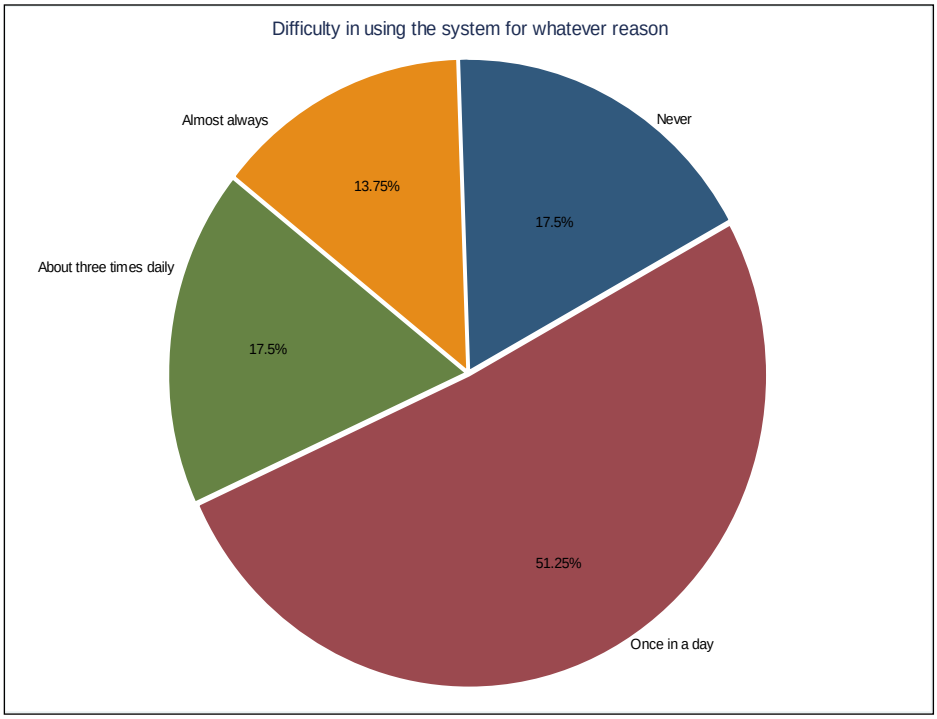

Figure 17: ***HCWs and the common difficulties encountered***

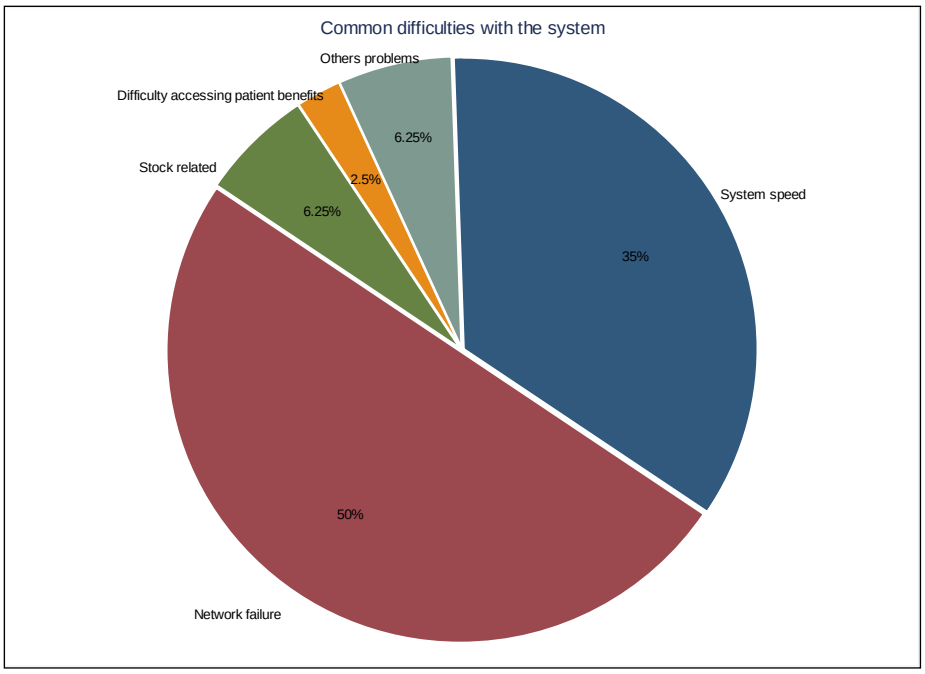

Figure 18: ***HCWs and the desired system changes***

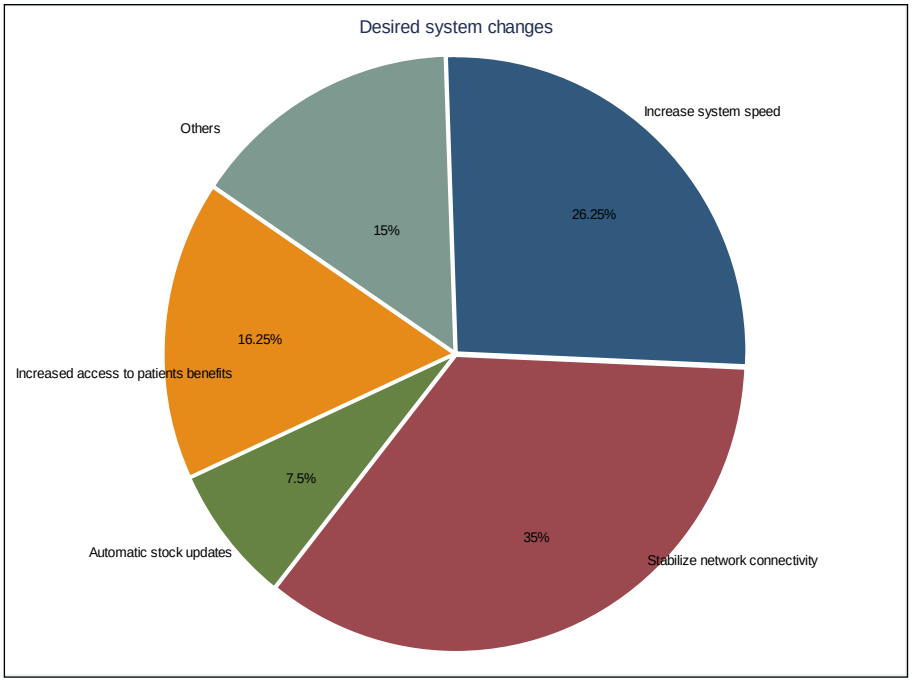

Figure 19: HCWs Age vs job designation

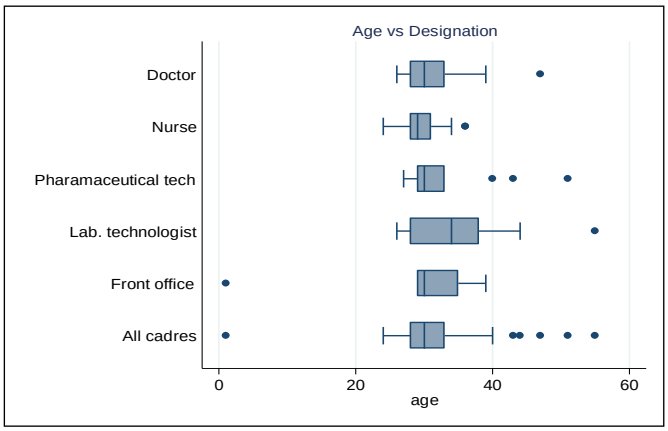

Figure 20: HCWs ages previous EMR use

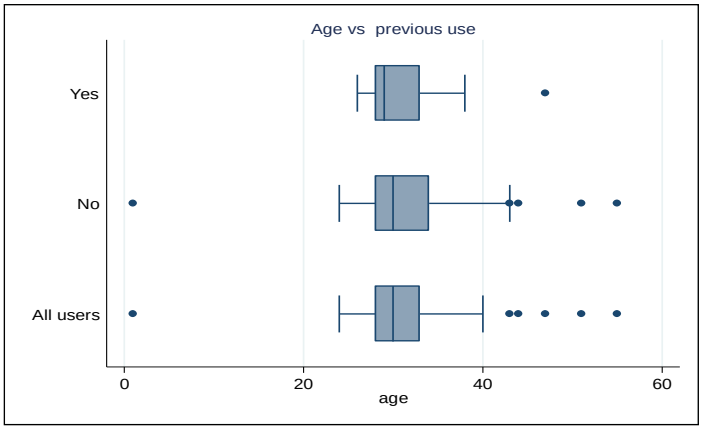

Figure 7. 21: HCWs age vs job status

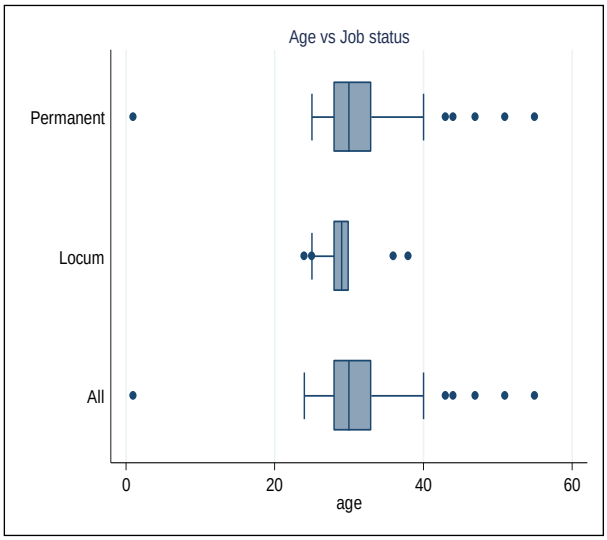

Figure 22: HCWs time taken to grasp system vsjob status

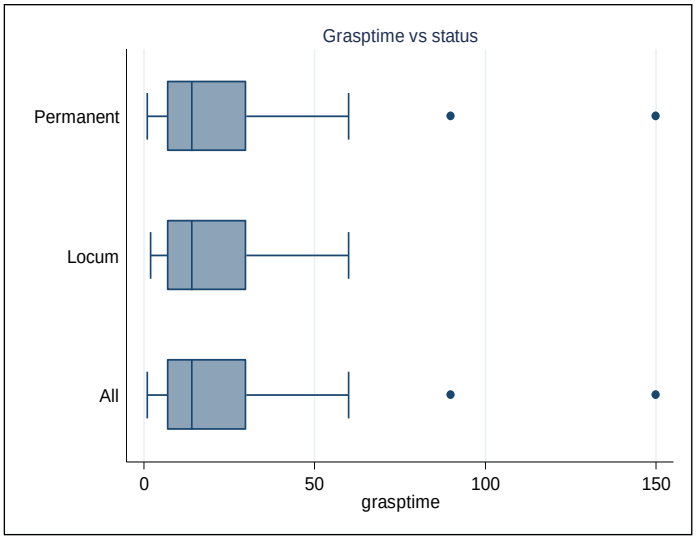

Figure 23: HCWs Time taken to grasp system vs previous use

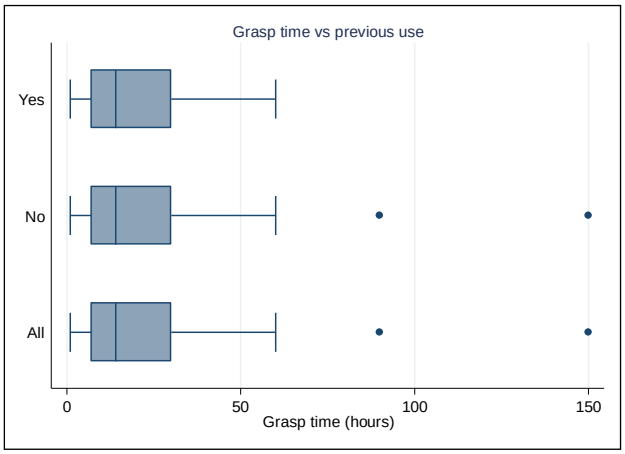

Figure 24: HCWs hours worked vs job designations

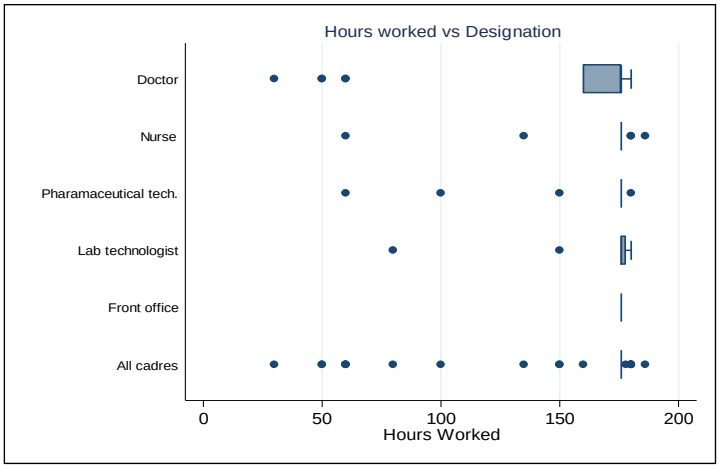

Figure. 25: ***HCWs hours worked vs previous EMR use***

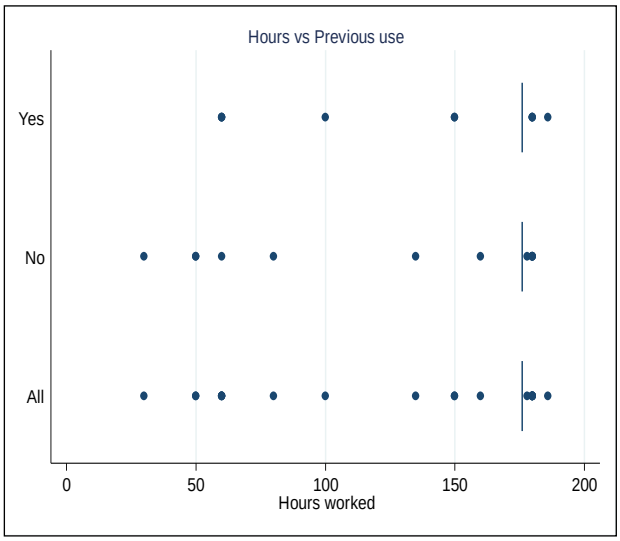

Figure 26: HCWs hours vs job status

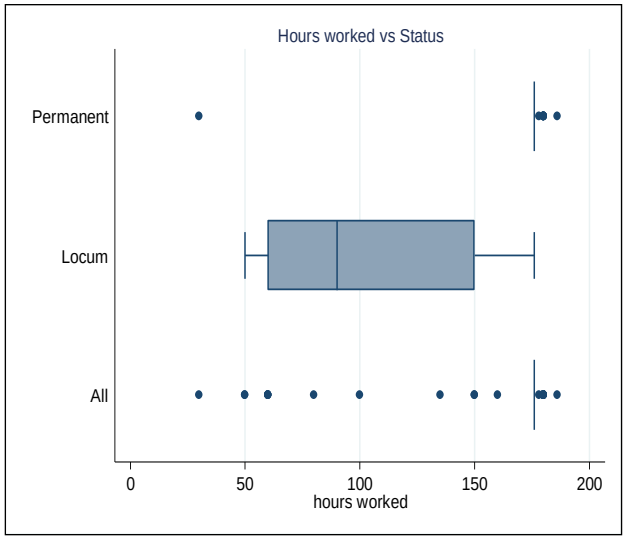

Figure 27: HCWs employment length vs job designations

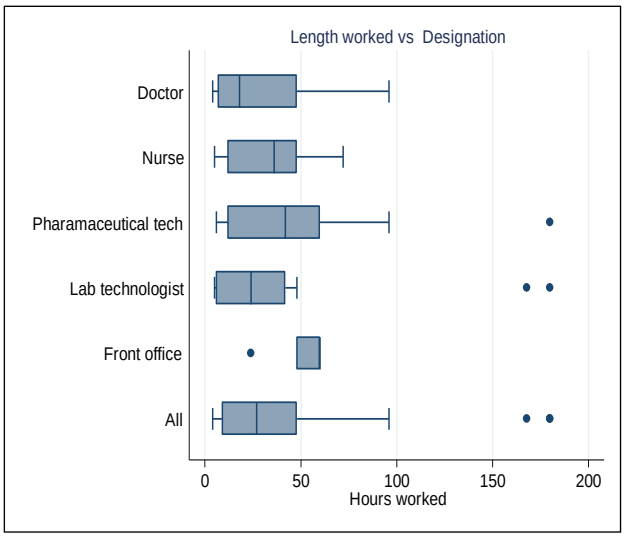

Figure 28: HCWs job length vs previous use

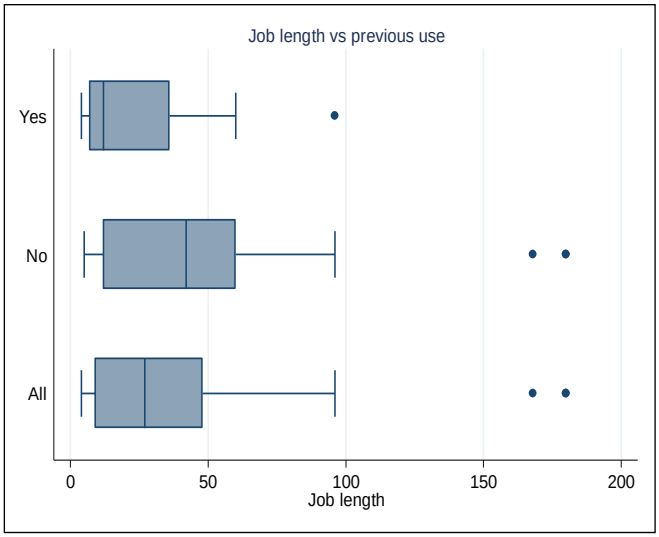

Figure 29: HCWs orientation vs designation

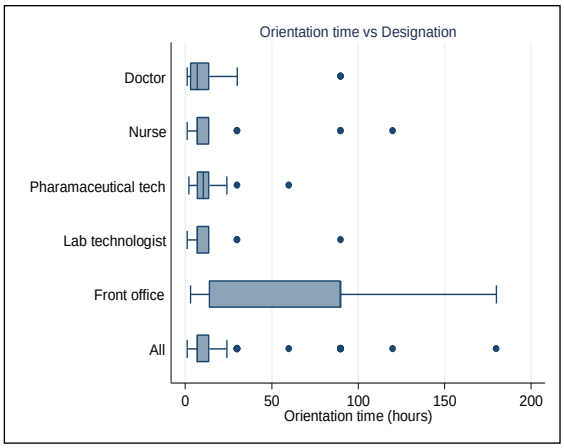

Figure 30: HCWs orientation time vs job status