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FACTORS AFFECTING THE AVAILABILITY OF DIAGNOSTIC IMAGING EQUIPMENT: A CASE OF MURANGA COUNTY

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ABSTRACT

Purpose: Medical imaging is a key component in the doctor's daily requirement to diagnose various diseases and prescribe effective treatment. Increased cases of terminal illnesses within Murang'a County have been on the rise in recent years requiring comprehensive screening and management. However, the imaging equipment remains inadequate due to the cost of availing the equipment with only one CT Scan available at the Murang'a Level 5 Hospital. The study's main objective was to determine the factors influencing availability of modern medical imaging equipment that impact on the health delivery in the Kenyan healthcare systems.

Methodology: The methodology utilised by the researcher involved a descriptive research design incorporating a qualitative and quantitative survey. Purposive sampling of both public and private health facilities in Muranga County was done to acquire a representative sample. A sample of 30 health facilities involving 15 public and 15 private ones with a bed capacity of 50, having laboratory services for diagnostic services were sampled for study purposes. Information was gathered using questionnaires, as well as Key In-depth interviews and the response rate was 67%. Data analysis involved descriptive statistics, and presented in form of frequency tables, graphs, charts, mean and percentages.

Results: From the findings, 72% of the respondents 68% and 59% indicated financing, proper legislations and policies, and effective collaborations with health stakeholders respectively as the major factors affecting the availability of diagnostic imaging equipment in Murang'a County. Further, capacity building of workers and its financing, maintenance of the equipment and acquiring of spare parts were listed as affecting sustainable availability of the equipment. The study concluded that the government should employ resource mobilisation strategies with healthcare stakeholders to acquire medical diagnostic equipment. Further, continued capacity building of staff is crucial to ensure increased skills acquisition, as well as maintenance of equipment.

Unique Contribution to Theory, Practice and Policy: The study recommends that the National and County governments allocate more resources, buy more equipment, train more technologists and ease the procurement procedures.

Key Words: *Availability, Equipment, Medical imaging, diagnostic screening, financing, capacity building, maintenance.*

INTRODUCTION

The World Health Organisation (WHO, 2007) defines health systems as consisting of all organizations, people and actions whose *primary intent* is to promote, restore or maintain health. A health system is made up of six building blocks namely; service delivery; health workforce information and research; medical products, vaccines and technologies; financing; leadership and governance (stewardship) (WHO, 2010). The building blocks need to be good or well-functioning if the health system has to produce the expected health outcomes.

Diagnostic imaging is one of the pillars of medical diagnostic that is critical in ensuring quality health access through effective treatment (WHO, 2010). Further, a diagnosis process is crucial in the determination of a patient's history and subsequent determination of an ailment. The developing world has experienced challenges in respect to medical diagnostic technologies access. In 2016, Asia formed the largest region in the Diagnostic equipment market taking over 38% of the market share, followed by Americas at 31% and Europe third at 24% (Diagnostic Equipment 2017). Acquisition of diagnostic equipment is expected to be on the rise with increasing need for accurate and effective diagnosis in the world. However, the sub-Saharan Africa bears the greatest burden of poor diagnostic imaging access due to lack of equipment.

The Sub-Saharan Africa accounts for 11% of the World's population although its carries an average of 24% of the total world disease burden (Elsa, 2016). Only a few nations in the Sub-Saharan Africa provides minimum healthcare as per the WHO definition within the range of $34-40 per person in spite of increased financial aid from the international community. At the beginning of the 21st century, the World Health Organisation (WHO) estimated that up to 70% of medical technology lies idle from failures in the acquisition process, ineffective training and lack necessary technical support (WHO, 2000).

The past two decades have seen increased demands of diagnostic equipment for timely, accurate and reliable diagnosis to improve treatment procedures. Alemnji et al. (2014) indicates that there has been a neglect of some national health laboratories which inhibit the ability to effectively screen patients and diagnosis ailments to introduce necessary treatment processes. Further, Hu (2011) states that majority of the diagnostic images are of poor quality and of no diagnostic use affecting the screening process which hampers the realisation of quality treatment processes. In some areas, imaging facilities are simply not available or not functioning at all. For example, the Magnetic Resonance Imaging (MRI) is only available in selected few hospitals in Kenya within major towns (Mutia, Kihiu and Maranga, 2012).

In Muranga County, a population of 1.1 Million relies on 3 County Hospitals and 2 Sub-County hospitals (Murang'a County, 2015), as well as 5 major private hospitals with only one CT-Scan machine available for use. The CT-Scan is only available at the Muranga Level 5 Hospital and access to services costs an average of Ksh 20,000 per patient. Individuals unable to afford the costs are likely to lack the correct diagnosis, resulting to mortalities that could have been mitigated (Ministry of Health, 2014). Further, the cost of acquiring the medical diagnostic equipment is very high with lowest level CT-Scan; Quad slice CT scanner going for between 7-10 million Kenya shillings while the MRI going for 20 to 40 million shillings. Consequently, majority of medical personnel have no technical knowhow to handle the equipment, as well as how to maintain the machines to enhance efficiency. In this regard,

determining how to overcome these challenges affecting effective acquisition and operationalization of medical diagnostic equipment in Kenya is inevitable.

The main objective of the study was to determine the factors affecting the availability of modern diagnostic medical imaging equipment in Murang'a County. The study sought to;

i. To determine the relationship between financing and the availability of modern diagnostic medical equipment in Murang'a County hospitals.
ii. To determine the effect of capacity building on the availability of modern diagnostic imaging equipment.
iii. To evaluate the influence of maintenance on the availability of modern diagnostic imaging equipment in hospitals.

THEORETICAL AND CONCEPTUAL FRAMEWORK

Systems Theory

Systems theory applies in the context that this theory will assess the interaction of different parts of political systems affecting health policy (Homer & Hirsch, 2006). Through application of systems theory, the researcher clearly and concisely understood health care structures, processes and outcomes processes and their interactions within a health care system. According to Bielecki and Stocki (2010), system theory can effectively be used as a framework to describe the components of systems and the relationships between these components, the boundaries of the system, the goals of the system, and system's ability to change and adapt in response to internal and external forces (Von Bertalanffy, 1962).

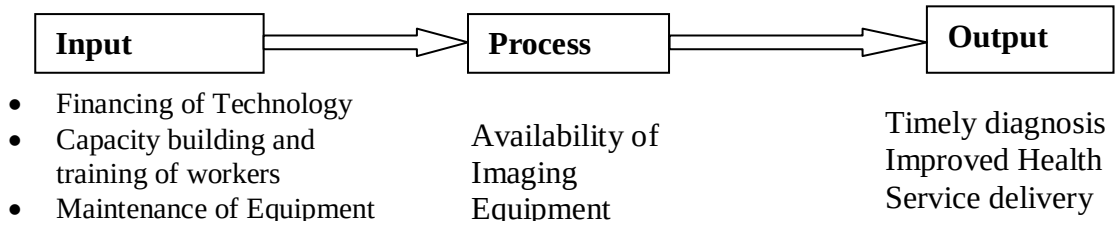
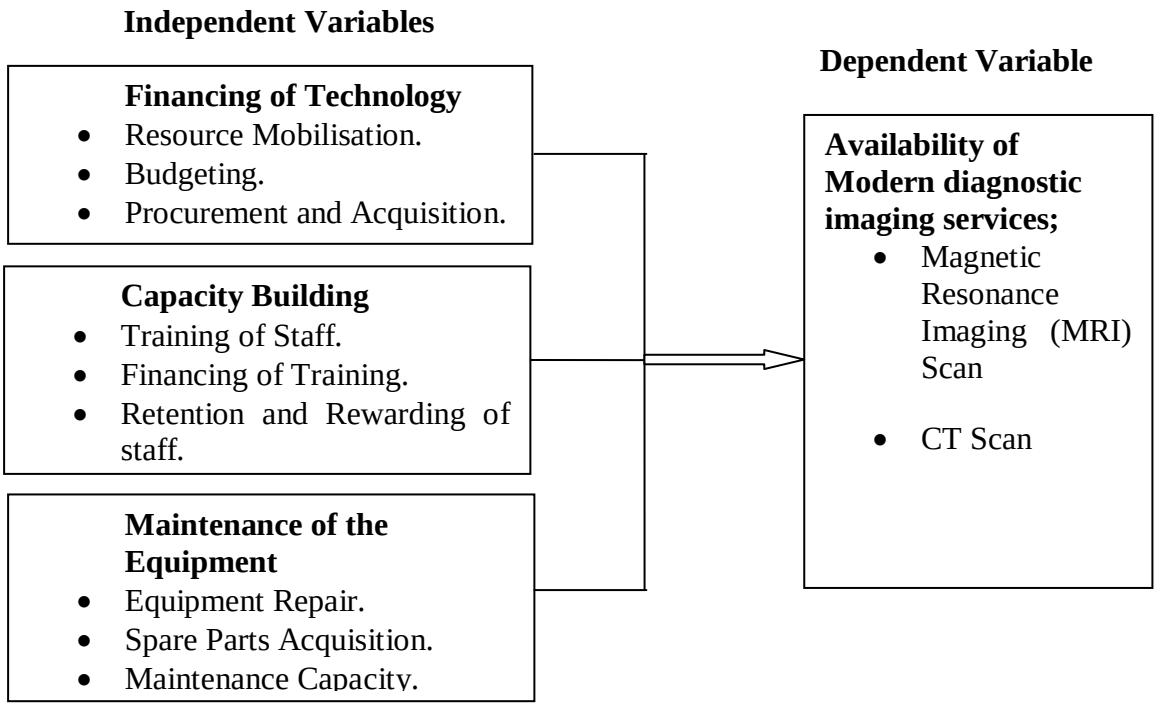


Figure 2.1: How a Systems Theory works (Source: Von Bertalanffy, 1962)

The conceptual framework outlines the various research variables affecting the availability of modern diagnostic imaging in Murang'a County.

Conceptual Framework



RESEARCH METHODOLOGY

The researcher utilised descriptive research design involving a mixed survey to determine the various objectives to the research study. The target population incorporated sampled administrators from both the public and private health sectors. 75 respondents were sampled from the 30 facilities for questionnaire survey. Ten key informants for in-depth interviews were sampled using purposive sampling and involved County health secretary, members of the County Health Board. Secondary data was outsourced through document analysis from journals, publications, as well as non-published materials pertaining to study objectives and yielded qualitative data. Data analysis was carried out via the use of statistical techniques for data analysis through SPSS Version 21.0 to come up with representative data on graphs, charts and tables that clearly clarify numerical data and present relationships among variables.

The researcher ensured the research study was approved by Kenya Methodist University Research and Ethics Review Committee for purposes of ensuring compliance to ethical standards. Approvals were also outsourced from National Commission for Science, Technology and Innovation (NACOSTI) and the Murang'a county Health Research Board to undertake the research. Subsequently, the study was guided by the principle of informed consent.

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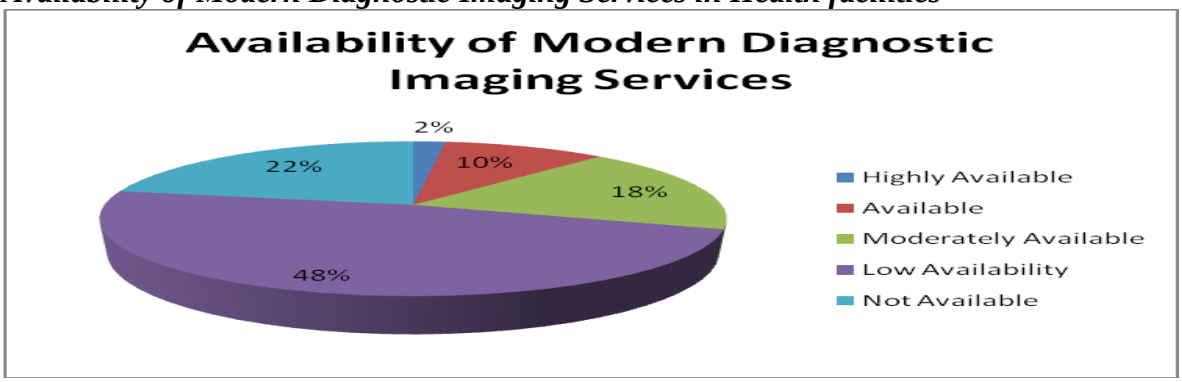
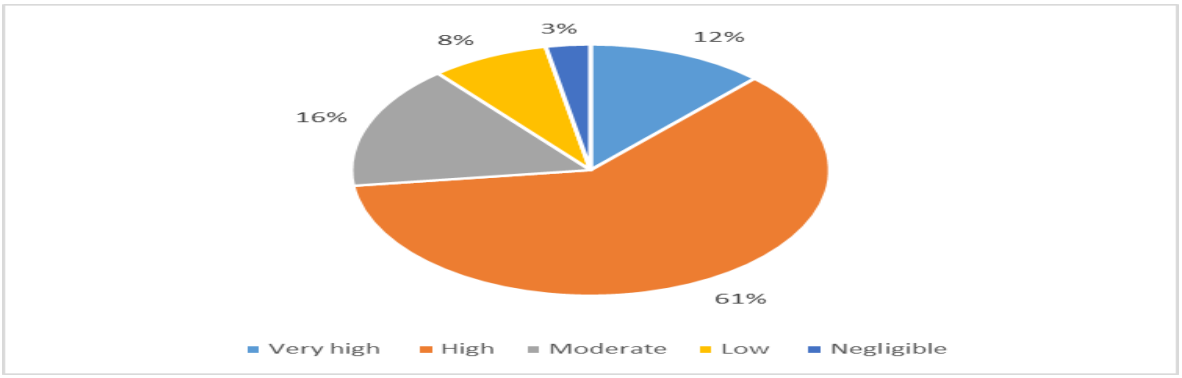
RESULTS AND DISCUSSION

The study targeted a sample of 75 respondents for the questionnaire survey and 50 responded giving a 67% response rate. For the Key In-depth Interviews, only 8 out of 10 targeted were found giving a response rate of 80%.

Availability of Modern Diagnostic Imaging Services in Health facilities



From the findings, it is apparent that there is low availability or no availability at all of modern diagnostic imaging services in the health facilities sampled. 24 (48%) of the respondents indicated low availability, 11 (22%) not available, 9 (18%) moderately available, 5 (10%) available and 1 (2%) highly available.



Level of Requirement of Diagnostic Imaging

The respondents were also required to rate the level of requirement of diagnostic imaging in their health facilities and findings represented in the pie chart.

The X-Ray was cited as the most importance by the respondents at a Mean 4.1000, followed by CT scan (Mean 3.6200), Magnetic Resonance Imaging (MRI) (3.5600), Positron Emission Tomography (PET) (3.4400), Endoscopy (3.3000), Thermography (2.7600), Elastography (2.6800), and Tactile Imaging (2.6000) and Medical Photography (2.5600).

Financing of Medical Diagnostic Imaging Equipment

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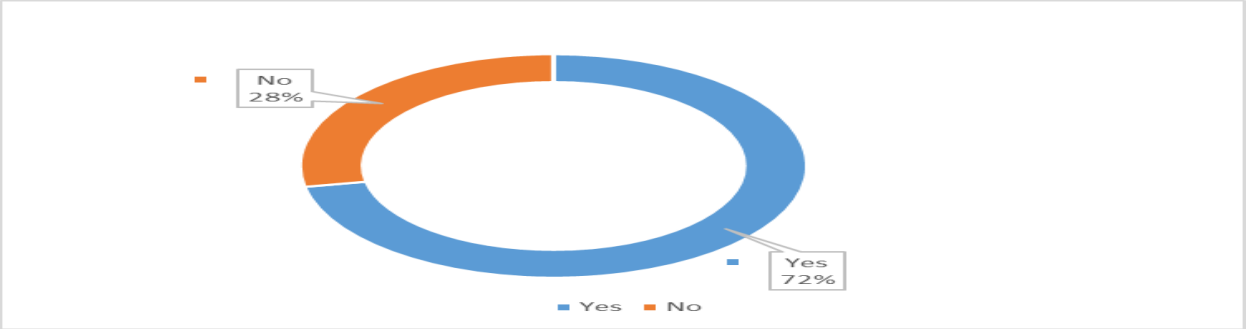
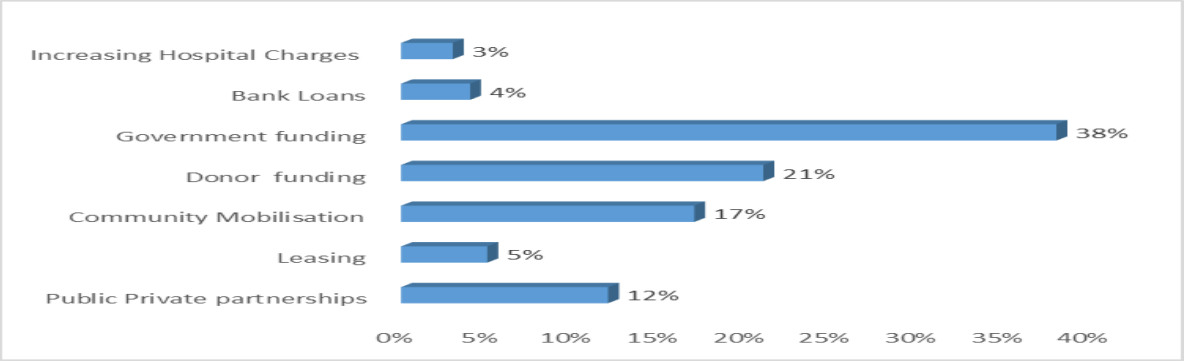


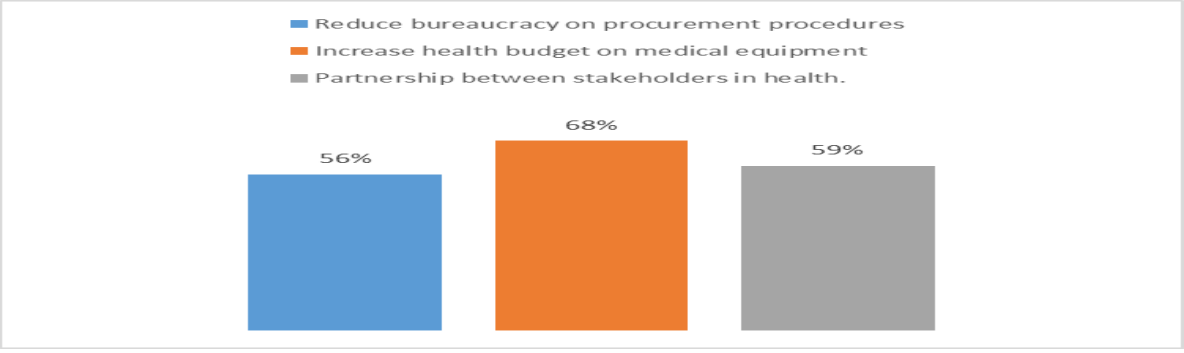
Acquisition of Diagnostic Imaging Equipment

The study found out that majority of the respondents; 36 (72%) indicated that lack of enough funds affected effective acquisition of diagnostic imaging equipment in their health facilities, while 14 (28%) indicated that lack of enough funds did not affect effective acquisition of diagnostic imaging equipment. Further, those who indicated that lack of funds affected effective acquisition of diagnostic imaging equipment in their health facilities cited the following to be the most efficient ways through which the health facility would access resources to acquire the equipment.

The findings were as shown below.



Accessing Resources to Acquire Equipment



Proper Acquisition of Resources

Proper acquisition of resources for acquiring medical diagnostic equipment for the health facilities in the County was indicated as follows;

The study found out that the respondents indicated that the various ways that can ensure proper acquisition of resources to acquire medical diagnostic equipment for the health facilities in the County included increasing health budget on medical equipment (68%), partnership between stakeholders in health (59%) and reducing bureaucracy on procurement procedures (56%). This implied that the three major ways that can ensure proper acquisition of resources to acquire medical diagnostic equipment for the health facilities in the County included increasing health budget on medical equipment, partnership between stakeholders in health and reducing bureaucracy on procurement procedures respectively. This agrees with (Mutia, Kihiu & Maranga, (2012) in respect to the Kenyan National and County governments having the sole responsibility of financing the health care infrastructure. Thus, the two levels of government have a bigger role to play in ensuring efficient and sufficient funding of healthcare systems. Nevertheless, the access to quality healthcare directly relates to the level of financing from the government, non-governmental organisations and the private sector (Malkin & Keane, 2010). In this regard, a multi-sector corroboration and the effort between these agencies would enhance the sufficiency of financing to improve access to medical diagnostic equipment.

Resource Mobilization

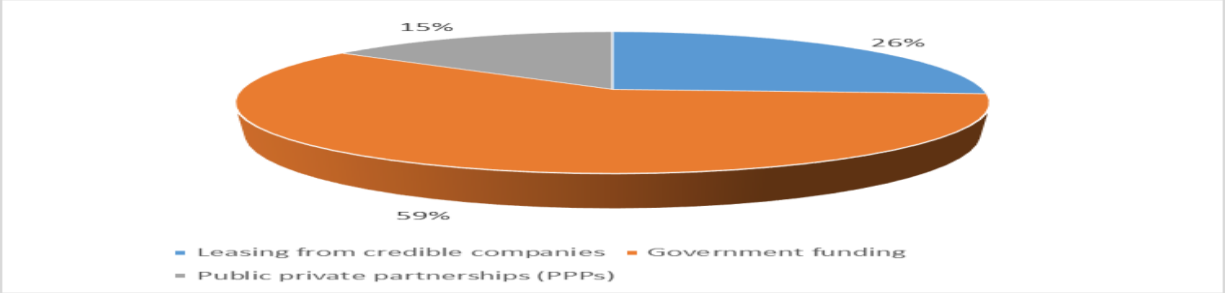
The study found out that the respondents were in agreement that in terms of resource mobilization as indicated below.

Resource Mobilization

Statement	Mean	Std. Dev.
There are sufficient finances to avail medical diagnostic service in both County and National levels.	3.7200	1.01096
Proper utilisation of funds by the governments can ensure acquisition of the basic diagnostic equipment in major hospitals	3.6200	.83029
The initial cost of installation may be high but the later cost of health sustenance would go down	3.5600	1.23156
Collaboration of the health sector with other stakeholders and private sector can ensure realisation of enough resources for equipment	3.0000	1.62882
Leasing of medical diagnostic equipment can be a greater opportunity towards availing efficiency of services in health facilities	2.9400	1.25210

Ruud, et al. (2012) support the finding by stating that it is evident financing approaches are critical for any health system in the world to realise universal and equitable coverage of quality care. In the same line, majority of developing countries including Kenya have made considerations to introduce critical reforms in their health financing systems in a way that enhances equity and efficiency through infrastructure and equipment acquisition. The financing also targets training of staff in the handling of equipment introduced in the laboratories and maintenance of the equipment to ensure continuous functioning.
Further, the study found that the factors which would enhance the acquisition of medical diagnostic imaging equipment involve;

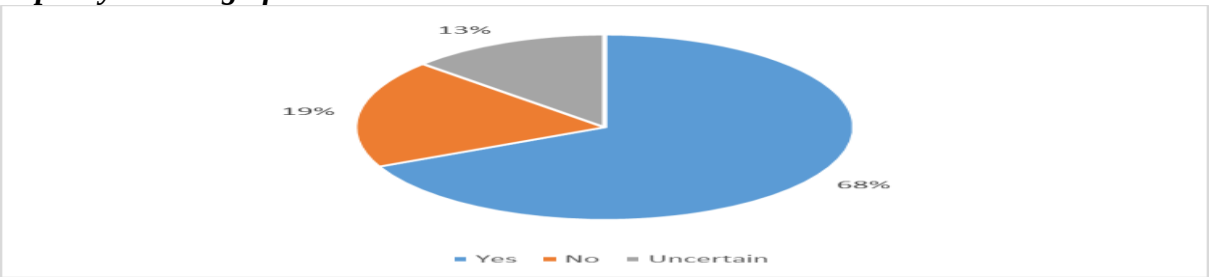
Factors of enhancing acquisition of medical diagnostic imaging equipment	Mean	Std. Dev.
Government funding	4.0800	.98644
Leasing from credible companies	3.7600	1.11685
Public private partnerships (PPPs)	3.4600	1.09190
Community resource mobilisation	3.1600	1.23487
Donor funding	2.8600	1.70246
Bank loans to facilitate equipment acquisition	2.3600	1.41075
Increasing hospital charges	2.1200	1.64924



Availability and Affordability of Diagnostic Imaging Services

Further the health professionals were requested to suggest ways which could be utilised to ensure availability and affordability of diagnostic imaging services to all people as indicated below.

Capacity Building of Workers

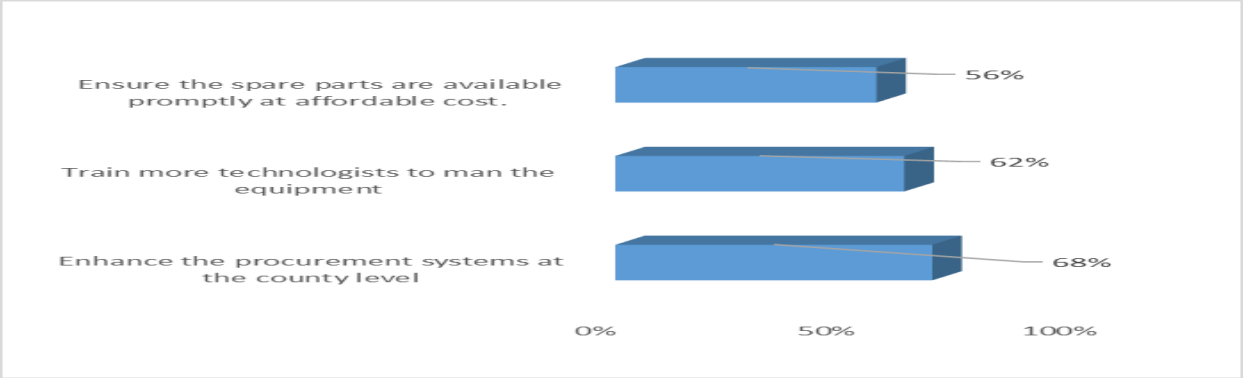


Capacity Building and Training

The study found out that majority of the respondents; 34 (68%) indicated that they believed that capacity building and training of professionals was necessary to enhance availability of medical imaging in laboratories, 10 (19%) said No, while 6 (13%) indicated that they were not certain that capacity building and training was necessary to enhance medical imaging in laboratories. This implied that the medical officers recognized the importance of training and capacity building in enhancing medical imaging in laboratories.

This is supported by Matovu et al. (2013) who observed that capacity building within an organisational context involves developing and strengthening skills and abilities among employees, as well as enhances resources that organisations require to survive and thrive in the increasingly changing world. In this era of globalisation, change is inevitable in every sector of human development and health care sector is no exception. Through knowledge

mobilisation, healthcare organisations often ensure capacity building in form of training of employees through relatively short projects that directly depends on limited funding (Ruud et al., 2012).



Ensuring Availability and Affordability of Diagnostic Imaging Services

The study found out continuous availability and affordability of diagnostic imaging services to all people included enhancing the procurement system at the County level (68%); training more technicians to man the equipment (62%) and ensuring spare parts are available promptly and at an affordable cost (56%). This implied that the various ways of ensuring continuous availability and affordability of diagnostic imaging services to all included procurement system at the County level, training more technicians and ensuring spare parts are available.

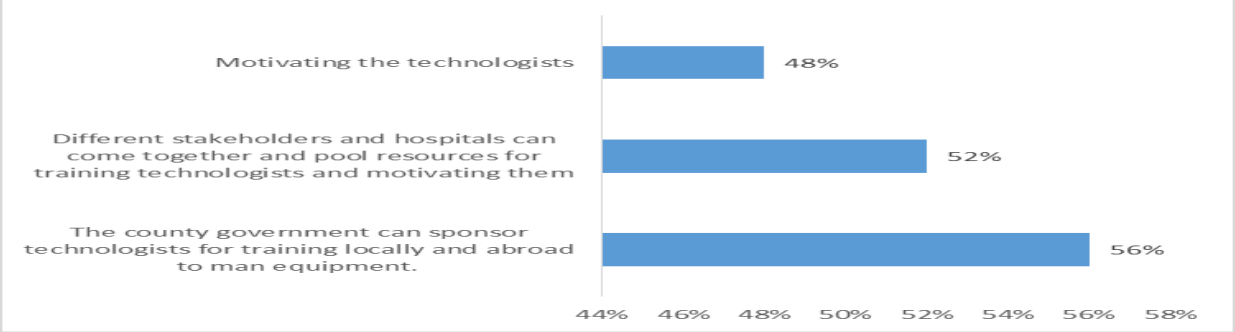
Further, the extent effective training of technologists affects effective diagnosis and screening of diseases as indicated below.

Training of Technologists and Diagnosis of Diseases

Extent	Frequency	Percentage
Very great extent	26	52%
Great extent	14	28%
Moderate extent	5	10%
Less extent	3	6%
Not at all	2	4%
Total	**50**	**100%**

This is supported by Kislove et al. (2014); that the discussion pertaining to effective capacity building and training of staff is structured around the following three themes. First it involves the definition and classification of capacity building for knowledge mobilization; secondly, it involves mechanisms of capability development in organizational context; and thirdly individual, group and organizational levels of capability development (Kislove et al., 2014).

Ways of Promoting Training of Technicians and Health Professionals



Ways of Promoting Training

Kislove et al. (2014) supports the finding by stating that the process of capacity building can be supported by external knowledge mobilisation initiatives that can be represented by professional associations, collaborative research partnerships, as well as implementation networks. This ensures standardised processes of capacity building that not only promotes quality of service delivery, but also adheres to the competency standards of the medical professionals. According to World Health Organisation Health Promoting Hospitals (HPHs) initiative boosts health facilities to enhance health quality of their stakeholders through development of organisational capacity (WHO, 2009). The performance of managers at the local health services level is critical in ensuring that health services are of good quality and cater to the health need of the population within the given area.

Technologists Training

The study found out that majority of the respondents; 36 (72%) indicated that continuous training and effective financing of the training programs promoted availability, 8 (16%) indicated continuous training and effective financing of the training programs did not, while 6 (12%) indicated that they were uncertain that continuous training and effective financing of the training programs ensured availability of diagnostic imaging services. Capacity building is presented as a practice-based process of developing multiple skills, or capabilities, belonging to different knowledge domains and levels of complexity. It requires an integration of acquisitive learning, through which healthcare organisations acquire knowledge and skills from knowledge mobilisation experts, and experience-based learning, through which healthcare organisations adapt, absorb and modify their knowledge and capabilities through repeated practice (Matovu et al., 2013).

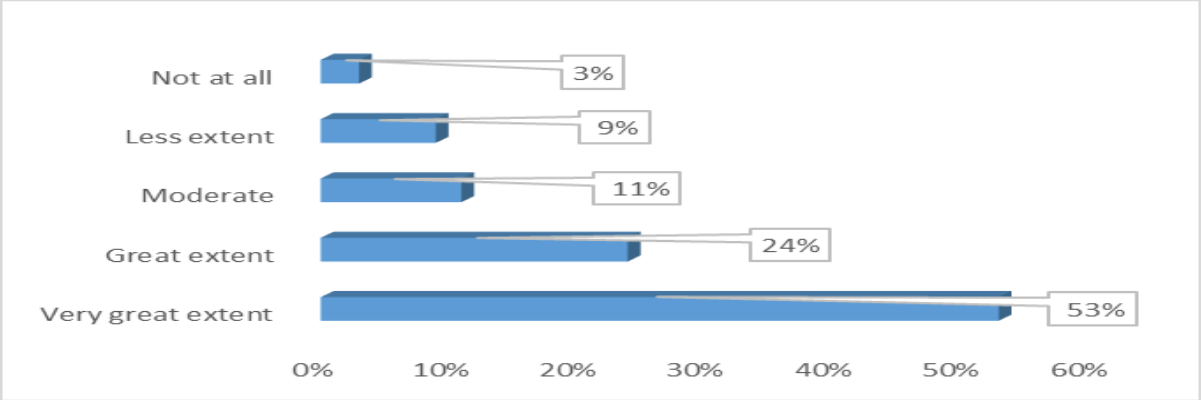
Maintenance of the Equipment and Acquiring of Spare Parts

The study found out that majority of the respondents; 38 (76%) indicated that maintenance ensures continued availability, 8 (16%) indicated that maintenance did not, while 4 (8%) were not sure. Further those who indicated yes were required to indicate how maintenance enhanced equipment efficiency in diagnosis to ensure continued availability of diagnostic and imaging services. 34 (68%) were in support of the fact that maintenance have a greater impact on the continuous availability of diagnostic imaging services as breakdowns are minimal. Further, the reliability of the readings is also enhanced with 31 (61%) of the respondents being in support. This implied that there were two factors through which maintenance enhanced equipment efficiency in diagnosis namely; the equipment operates

throughout with minimal breakdowns and the reliability of the readings is also enhanced respectively.

Efficiency in Maintenance Services

The study sought to find out to what extent maintenance of equipment enhanced service delivery efficiency in healthcare systems.



Efficiency in Maintenance Services

This is supported by Khalaf et al. (2013) who argues that three critical factors are enhanced by maintenance of medical equipment within healthcare facilities and they involve efficiency, cost saving and safety. Efficiency occurs with the reality of wear and tear of biomedical equipment that results to decreased efficiency.

CONCLUSION AND RECOMMENDATIONS

Sufficient financing of modern diagnostic imaging equipment affects the availability. Both County and National governments should avail sufficient resources or alternative financing strategies like leasing to ensure availability of modern diagnostic imaging equipment.

Capacity building is necessary to ensure continued availability of diagnostic imaging services in Murang'a health facilities. Health technologists have to be put on continuous training and refresher courses on modern diagnostic imaging services to ensure continued capacity building and expertise acquisition.

Maintenance of diagnostic imaging equipment is critical for availability of diagnostic imaging services. Factors affecting maintenance involve budgeting adequate finances for maintenance and spare parts acquisition, removing rigid procedures in procurement, availing spare parts and maintenance services locally, as well as manufacturers to give follow up maintenance service to the equipment users.

The researcher recommends the National assembly and the Senate to come up with legislation on leasing and acquisition of modern diagnostic imaging equipment. This involves easing the procurement and tendering procedures to enhance the standards of health systems. Further, the Ministry of Health should collaborate with stakeholders through PPPs and acquire sufficient resources to avail modern diagnostic imaging equipment in health facilities. Finally, leasing of equipment should be prioritised in order to ensure acquisition of modern diagnostic imaging equipment and subsequent management and maintenance.

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