

**FACTORS AFFECTING DELIVERY OF INTERVENTIONAL  
RADIOLOGY SERVICES AT KENYATTA NATIONAL HOSPITAL**

**PRINCIPAL INVESTIGATOR:  
DR. IRERI NJAGE M'BARUTHI  
H58/35735/2019  
DEPARTMENT OF DIAGNOSTIC IMAGING AND RADIATION MEDICINE,**

**A RESEARCH DISSERTATION SUBMITTED IN PARTIAL  
FULLFILMENT OF THE REQUIREMENTS OF THE DEGREE OF  
MASTEROFMEDICINE, DEPARTMENTOF DIAGNOSTIC IMAGING AND  
RADIATION MEDICINE, FACULTY OF HEALTH SCIENCES, UNIVERSITY OF  
NAIROBI.**

**©2023**

## **DECLARATION**

I, **Dr. Njage Ileri M'baruthi**, do hereby declare that this dissertation is my original work and has not been submitted to any other university for an academic award.

**Dr. Njage Ileri M'baruthi**

**Signature:**

.....

**Date:** 21<sup>st</sup> September, 2023

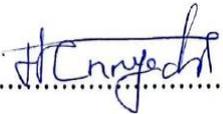
## SUPERVISORS' APPROVAL

This project has been submitted with our approval as the appointed University supervisors.

**Dr. Callen Onyambu**

*(M.B.Ch.B. (UON), M.Med RAD (UON), PGDRM (UON))*

Project Supervisor (UON)

Sign:  ..... Date: 21/03/2022 .....

**Dr. Mugambi M'ariithi**

*M.B.Ch.B (UON), M.Med RAD (UON) FELLOW I.R (Iran)*

Project Supervisor (KNH)

Sign:  ..... Date: 21/03/2022 .....

**DR KIBAYA**

*M.B.Ch.B (UON), M.Med RAD (UON) FELLOW I.R (Singapore)*

Project supervisor (KNH)

Sign:  ..... Date: 22/03/2022 .....

## TABLE OF CONTENTS

STUDENT’S DECLARATION .....	ii
SUPERVISORS’ APPROVAL .....	iii
TABLE OF CONTENTS.....	iv
LIST OF FIGURES .....	vii
LIST OF TABLES .....	viii
LIST OF ABBREVIATIONS.....	ix
ABSTRACT.....	<b>Error! Bookmark not defined.</b>
1.0 CHAPTER ONE: INTRODUCTION:.....	<b>Error! Bookmark not defined.</b>
1.1 Background of the Study .....	<b>Error! Bookmark not defined.</b>
2.0 CHAPTER TWO: LITERATURE REVIEW .....	<b>Error! Bookmark not defined.</b>
2.1 Training and Qualification of Service Providers .....	<b>Error! Bookmark not defined.</b>
2.2 Physical Infrastructure .....	<b>Error! Bookmark not defined.</b>
2.3 Referral System.....	<b>Error! Bookmark not defined.</b>
2.4 Total Radiology Waiting Time .....	<b>Error! Bookmark not defined.</b>
2.5 Cost of IR service.....	<b>Error! Bookmark not defined.</b>
2.6 Conceptual Framework.....	<b>Error! Bookmark not defined.</b>
2.7 Justification of the Study .....	<b>Error! Bookmark not defined.</b>
2.8 Questions of the Study .....	<b>Error! Bookmark not defined.</b>
2.9 Objectives of the Study.....	<b>Error! Bookmark not defined.</b>
2.9.1 Broad Objective .....	<b>Error! Bookmark not defined.</b>
2.9.2 Specific Objectives .....	<b>Error! Bookmark not defined.</b>
3.0 CHAPTER THREE: RESEARCH METHODOLOGY: ...	<b>Error! Bookmark not defined.</b>
3.1 Research Design.....	<b>Error! Bookmark not defined.</b>
3.2 Study Area Description.....	<b>Error! Bookmark not defined.</b>

3.3 Target Population.....	<b>Error! Bookmark not defined.</b>
3.4 Inclusion/Exclusion Criteria .....	<b>Error! Bookmark not defined.</b>
3.5 Sample Size and Sampling Method .....	<b>Error! Bookmark not defined.</b>
3.6 Data Collection Instrument and Method.....	<b>Error! Bookmark not defined.</b>
3.7 Ethical Considerations .....	<b>Error! Bookmark not defined.</b>
3.8 Quality assurance .....	<b>Error! Bookmark not defined.</b>
3.9 Validity and Reliability.....	<b>Error! Bookmark not defined.</b>
3.10 Data Analysis and Presentation Plan .....	<b>Error! Bookmark not defined.</b>
3.13 Data Dissemination Plan.....	<b>Error! Bookmark not defined.</b>
4.0 CHAPTER FOUR: STUDY RESULTS .....	<b>Error! Bookmark not defined.</b>
4.1 Study Demographics .....	<b>Error! Bookmark not defined.</b>
4.2 Training and Qualification of IR staff .....	<b>Error! Bookmark not defined.</b>
4.3 Infrastructure.....	<b>Error! Bookmark not defined.</b>
4.4 Referral System.....	<b>Error! Bookmark not defined.</b>
4.5 Total Radiology Turnaround Time .....	<b>Error! Bookmark not defined.</b>
4.5 Cost of IR services .....	<b>Error! Bookmark not defined.</b>
5.0 CHAPTER FIVE: DISCUSSION, CONCLUSION AND RECOMMENDATIONS ....	24
5.1 Discussion.....	<b>Error! Bookmark not defined.</b>
5.1.1 Training and Qualification of IR Staff.....	24
5.1.2 Physical Infrastructure .....	24
5.1.3 Referral System.....	25
5.1.4 Total Radiology Turnaround Time .....	26
5.1.5 Cost of IR Services .....	26
5.2 Conclusion .....	27
5.3 Recommendations.....	28
REFERENCES .....	<b>Error! Bookmark not defined.</b>
APPENDICES .....	<b>Error! Bookmark not defined.</b>

Appendix A – Consent Form ..... **Error! Bookmark not defined.**  
Appendix B-Questionnaire ..... **Error! Bookmark not defined.**  
Appendix C: KNH/UoN-ERC Letter of Approval ..... **Error! Bookmark not defined.**

## LIST OF FIGURES

Figure 1:Conceptual Framework .....	<b>Error! Bookmark not defined.</b>
Figure 4. 1:Gender distribution.....	11
Figure 4. 2:Staff cadre.....	12
Figure 4. 3:Registered by professional body. ....	12
Figure 4. 4:Number of staffs Requiring additional professional training.....	13
Figure 4. 5:Hospital sponsored additional trainings .....	14
Figure 4. 6:Perceived benefit from additional training.....	15
Figure 4. 7:Adequacy of department’s equipment.....	16
Figure 4. 8:Effects of machine downtime on service delivery .....	17
Figure 4. 9:Adequacy of consumables supply .....	18
Figure 4. 10:Effects of materials stock out on service delivery.....	19
Figure 4. 11:Other identifiable infrastructure gaps.....	19
Figure 4. 12:Current referral system encourages multi-disciplinary consultation.....	20
Figure 4. 13:Referral system encourages backward feedback.....	21
Figure 4. 14:Identifiable gaps in referral system .....	21
Figure 4. 15:Factors contributing to TRWT .....	22
Figure 4. 16:Perception of the current IR service charges.....	22
Figure 4. 17:Components of service cost.....	23
Figure 4. 18:ways of enhancing accessibility to IR services .....	23

## LIST OF TABLES

Table4. 1:Age distribution .....	11
Table4. 2:Frequency of continuous professional development audit .....	13
Table4. 3:Last professional training attended.....	13
Table4. 4:Specific area of demanded professional training.....	14
Table4. 5:Machine down time is a challenge.....	16
Table4. 6:Materials stock out is a challenge.....	18
Table4. 7:Average TRWT .....	21
Table 4. 8:Effect of current prices on service accessibility .....	23

## **LIST OF ABBREVIATIONS**

<b>CT</b>	Computed Tomography
<b>DICOM</b>	Digital Imaging and Communications in Medicine
<b>GOK</b>	Government of Kenya
<b>IR</b>	Interventional Radiology
<b>KNH</b>	Kenyatta National Hospital
<b>MOH</b>	Ministry of Health
<b>NHIF</b>	National Hospital Insurance Fund
<b>UON</b>	University of Nairobi
<b>SPSS</b>	Statistical Package for the Social Sciences
<b>TRWT</b>	Total Radiology Waiting Time

# MANUSCRIPT

## FACTORS AFFECTING DELIVERY OF INTERVENTIONAL RADIOLOGY SERVICES AT KENYATTA NATIONAL HOSPITAL

<sup>1</sup>Njage Ileri Geoffrey M'baruthi, <sup>2</sup>Onyambu Kwamboka Callen, <sup>3</sup>M'ariithi Mugambi Lawrence, <sup>4</sup>Kibaya Daniel

1. **MBChB. (UON), (EMBA. (JKUAT));** Masters student department of Diagnostic Imaging and Radiation medicine, School of Medicine, College of Health Sciences, University of Nairobi. Principal investigator and corresponding author.
2. **MBChB. (UON), M. Med (UON), PGDRM (UON);** Consultant Radiologist and Senior Lecturer, Department of Diagnostic Imaging and Radiation Medicine, School of Medicine, College of Health Sciences, University of Nairobi.
3. **MBChB. (UON), M. Med (UON), IR Fellowship (IRAN);** Consultant Radiologist, and interventionist, Kenyatta National Hospital, Radiology department.
4. **MBChB. (UON), M. Med (UON), IR Fellowship (SINGAPORE);** Consultant Radiologist, and interventionist, Kenyatta National Hospital, Radiology department.

**Corresponding author email: [balozigen@gmail.com](mailto:balozigen@gmail.com)**

## **ABSTRACT**

### **Background**

The provision of radiological services needs to be examined from the point of customer-oriented delivery. This, in the business sense, would put into consideration various factors among them being customer satisfaction, quality and efficiency of service. To reach high reputation standards of a service the provider must have well equipped and laid out radiology department set up. This is particularly important for interventional radiological services given that they are highly specialized and require sophisticated and often high capital tools as well as minimal suite standards. Additionally, interventional radiology services require highly specialized, continuously trained and motivated staff that are able to operate in a multidisciplinary setting.

### **Objective**

To determine factors affecting the practice of Interventional Radiology at Kenyatta national hospital.

### **Materials and methods**

This cross-sectional study employed the purposive sampling approach where all employees working at the KNH IR department, including UON IR fellows as well as the heads of technical unit and head of finance were targeted. Between 2<sup>nd</sup> May 2022 to 17<sup>th</sup> June 2022 the respondents were administered with a closed and open-ended questionnaire.

### **Results**

Of the 27 targeted interviewees, 19 responses were returned (70% response rate). The data obtained was analyzed using excel quantitative computer analytics tool. One nurse (..%), and one interventionist (50%) were on annual leave during the study period. There are more female staff (52.63%) than males; while majority of IR workers are aged between 31 and 40years.

While majority of personnel (89.48%) are registered with a professional body all of which require annual licensure based on proof of attendance of continuous professional development (CPD) learning; a comparatively high number of staffs (86.67%) had attended at least one CPD event in the six months preceding the study. There was noted to be a low number of workers trained in non-core supportive management skills, with IR nursing, Radiation safety and Advanced intervention work being highly demanded competences.

78.95% of respondents were emphatic that the department is ill equipped for the current work load and 68.42% indicated that erratic consumable material supply in the IR department curtailed service delivery.

88.24% of respondents hailed the existing referral system as encouraging inter-disciplinary consultation and a further 70.59% as promoting feedback to referring clinicians. Nonetheless, Unclear IR policy, Late patient referrals, Ignorance of available IR scope by referring clinicians and a Manual health management system were among the identified gaps bedeviling the department.

The mode of total radiology turnaround time in the IR department was estimated at one week with multiple factors contributing to prolonged waiting time. These include, delays in clients raising procedure fees, machine breakdown and high workload, among others.

Majority (53.33%) of the respondents felt that the current service charges of the IR services should be reduced while 20% think the prices are exorbitant.

### **Conclusion**

The findings of this study demonstrate that the delivery of IR services at the Kenyatta National Hospital are affected by the training and qualification of IR staff, the department's physical infrastructure, the patient referral system in place, the total radiology waiting time in the IR department and the cost of IR services.

Several growth and improvement areas are identified which addresses the need for IR policy formulation and implementation as well as the improvement of the department's existing processes for optimal service delivery(28).

## **INTRODUCTION**

Interventional radiology is a specialized medical discipline which employs both imaging and management of disease simultaneously with minimal invasion into the patient's body. It involves image guidance and directing treatment or diagnostic modalities enabling fast delivery without surgical open operation. This approach ensures timely service, quick recovery, reduced hospital stay and promises affordability to the patient. Diagnostic procedures include image guided biopsy, fine needle aspirate (FNA), cholangiograms and angiograms; while treatment procedures include transhepatic chemoembolization, percutaneous biliary drainage or biliary stenting, nephrostomy to relieve obstructive uropathy and body cavity fluid drainage via subcutaneously inserted drain using image guidance for positioning; to name a few (1).

Radiology is part of the service industry (2) ; as such, there are a number of factors that contribute to the quality of customer service and satisfaction as well as quality assurance.

Radiology departments are also revenue centers for both private and public health institutions (3).

Additionally, diagnostic and interventional radiology centers draw their clientele from referrals by either internal or external clinicians as well as walk in patients (2).

Understanding these dynamic issues will go a long way to help upscale customer satisfaction, a key ingredient in repeat business. Additionally, service that exceeds customer expectation is a quality signature that affords a facility high approval, rating and access to accreditation (2).

### **Background of the Study**

High service quality and good service delivery are both necessary to improve the performance of radiology departments (3). This, coupled with inter-departmental cooperation and cohesion is particularly true for a young sub department as the KNH intervention radiology. This is because academic and institutional radiology departments are considered as revenue centers in their hospitals (3). As such these centers must prove their contribution to the strategic position of the institution so that they may attract necessary support such as resource allocation.

To achieve the objective a department needs to position itself as a Centre of excellent customer service, constantly and consistently exceeding customer expectations. For most organizations, customer service represents an important factor in retaining customers and in maintaining high profits, as well as in securing new customers (2).

To achieve high service quality, an organization has to maintain a work force of well-trained, motivated employees in an environment with adequate technological, infrastructural as well as seamless informational facilitation.

Organizations do not exist in mutually exclusive environments but in interdependent operational atmosphere. Radiology departments depend on the referring physicians to drive demand for their service (3), hence the need to maintain healthy working relationship among different medical disciplines.

The quality of a service is measured and quantified through reproducibility of favorable customer experience and process standardization. This is achievable by accreditation of an organization's processes, which improves the provision of health care services (4).

A check on the Kenya medical and Dentist Council website reveals that there are only two registered and active interventional radiologists as at 11<sup>th</sup> March 2022. Furthermore, there are a hundred and sixty active registered radiologists. (5).

There has been positive development in training of interventionists, with the University of Nairobi department of diagnostic imaging and radiation medicine starting a full-time fellowship program in 2021. (6)

While there are multiple centers that offer diagnostic and interventional radiology services, only a handful are able to offer highly specialized procedures. These facilities are only concentrated within Nairobi city and include Kenyatta national hospital, Nairobi hospital, Nairobi West hospital, MP Shah and Aga Khan hospitals. (1).

## **LITERATURE REVIEW**

### **Training and Qualification of Service Providers**

With an ever changing and dynamic health services environment, what is standard practice today may be obsolete in a few years. Keeping this in mind as a specialized health care provider helps to prioritize the training needs of your staff at all levels.

There are a ton of benefits arising from continuous training of employees in health care, among them being highly skilled staff, high staff retention, superb reputation, optimized financial performance, better patient outcomes, less medical malpractice litigation (7).

The flip side of not maintaining a routine of employee training is high employee turnover leading to underutilization of an organization's capacity, disgruntled employees, dissatisfied customers and time wastage. All of these will cause higher costs and disrepute. (7).

Training need not only focus on professional abilities but core organizational culture and values including interpersonal work relations, work ethics, customer care and communication skills are pivotal to successful service provision. A study on the impact of health care provider training on patient's communication, revealed that there was positive impact on the health provider's knowledge and practice towards communication with patients in many areas, resulting to good patient satisfaction (8).

Health care management teams also need continuous training as this was shown to have significant difference in the implementation status of priority projects and therefore major impact on health system performance indicators, compared to non-trained management teams (9).

Realizing the vital role interventional radiology would play in the delivery of health care in Kenya and with the reality of an existing capacity gap, the University of Nairobi department of diagnostic imaging and radiation medicine began a two year full-time interventional radiology fellowship program in 2021. (6). There are currently four (4) fellows in training.

This, coupled with regular rotations in the IR department by resident radiologists as part of their training has contributed to capacity building and demystification of IR among Kenyan medical practitioners (1).

Being a pioneering program, it is not without challenge. The lack of mentors in all interventional procedures, frequent down time of key interventional equipment and delays in its repair or maintenance as well as a higher university fee highlight some of the main limitations. These are among factors that hinder African nations from hitting world standards and goals in health care. (10).

## **Physical Infrastructure**

Interventional radiology uses minimal invasion techniques and tools including ultrasonography, computed tomography, fluoroscopy and magnetic resonance imaging to deliver targeted therapeutic procedures on patients. It has advantage over open surgery in that there is reduced post procedure hospital stay; it is minimally intrusive and has versatile application in almost all health care fields (11).

Putting up an IR suite is a huge investment. It requires dedicated operating rooms, pre-procedure and recovery rooms, staffing, imaging machinery and patient support equipment. These are essential for optimal patient flow, efficiency and safety as prescribed in the Society of Interventional Radiology Standards for Interventional Radiology (12).

As the initial cost outlay of setting up IR suites are gigantic, health care leaders must research and explore the organization's current and future growth prospects so that it maximizes on the investment. Moreover, the hospital administrator must take the team leaders position to balance the various competing needs of different teams in the project (13).

## **Referral System**

An efficient health referral system is one that affords smooth and transparent processes of patient movement from one level of care to the other. The reality however is that there exist multiple gaps between care providers and specialists. Such challenges lead to operation inefficiency, broken referral chain, missing patient information and delayed intervention; all of which cause poor patient outcomes (14).

A key deliverable indicator according to the Kenya Health Sector Referral Strategy 2014-2018 is an efficient health delivery system that maximizes health outcomes. Referral has an enlarged scope to include not only the movement of patients but specimens, services, experts, and client parameters (15).

Over reliance on manual referral procedures and slow or lack of adoption of technology integrating the referral process is one key handicap in improving health referral systems. This is a well-known long standing and documented hurdle causing frustration among the referring teams; in particular, primary care providers and specialist practitioners (16).

Among the recognized challenges of a manual referral system is (a) poor documentation where critical information about a client condition is omitted or is not clear. (b) lack of coordination between care teams, resulting in frustrated teams and dissatisfied clients (c) delay in referral and/or intervention (d) loss to follow up, (e) lack of referral tracking and (f) medical error leading to death (17)(18).

The solution to the multiple problems bedeviling health referral systems could be addressed by adoption of electronic referral (e-referral) systems. These have been found to improve communication and coordination among care teams and decrease lead times. There is however limited evidence on their clinical and economic contribution (19).

### **Total Radiology Waiting Time**

The time difference between when a patient is admitted at the radiology department and when an investigation or procedure is done to when they receive an outcome is termed total radiology waiting time (TRWT). There are various components to this time depicting different steps of transition through the radiology department. The pre-examination time is the period between referral and actual examination or procedure, while report turnaround time is the period after the test or procedure to getting a result (20).

The interventional radiology patient must go through a pre-procedure process of ensuring that the intended intervention is beneficial and that they are fit for it. As such the patient must be informed of the intervention to be undertaken, benefits and risks emanating from it including other available treatment options and an informed consent obtained.

The lead doctor must also ensure that the patient is physiologically optimized through running appropriate laboratory tests (21). All these steps take time and reflect on the total radiology waiting time.

While radiology turnaround time is a major yardstick of radiologist efficiency, delays in result reporting and radiological intervention will lead in dissatisfaction among referring physicians and their clients (22).

With most departments focusing on value-based care, management should streamline the various processes with an aim of total quality improvement. This is where the right procedure is performed on the right patient every time in a timely fashion. Quality management therefore looks into quality assurance, staff and patient safety as well as timeliness of service (23).

Standardizing patient information access and interoperability are other ways to improve on efficient and faster radiology service delivery. Interoperability involves sharing of client history and diagnostic data including diagnostic radiology output and interventions across departments and indeed across institutions through accepted standards and protocols for radiological and medical information technology. Digital Imaging and Communications in Medicine (DICOM) is an example of such standard (24)(25).

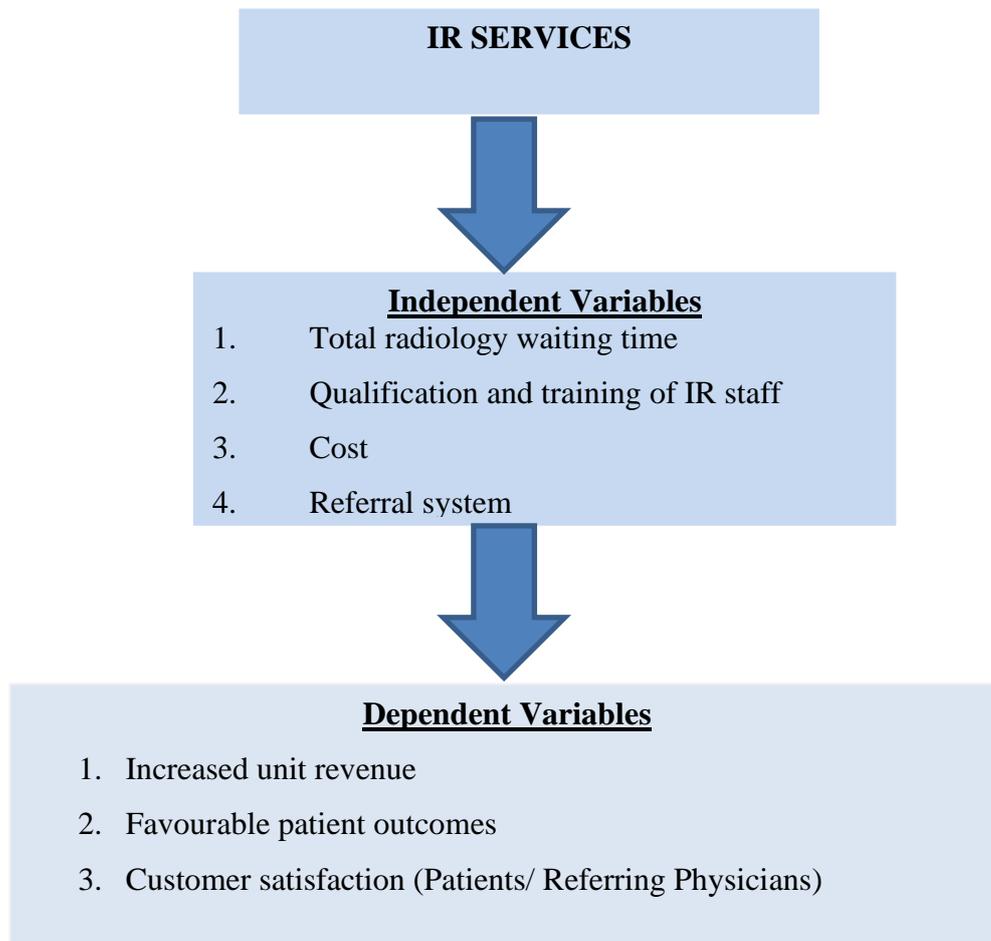
### **Cost of IR service**

Compared to invasive surgical modalities, it has been shown that minimally invasive IR services are more cost-effective owing to quick recovery times and reduced hospital admission time. Additionally, a comparative study on the cost of chest tube insertion by a surgeon vis a vi through image guidance was shown to cost more by up to 193% owing to the fact that IR services seldom use anesthesiologist and procedures are done in a dedicated suite outside of the operating theatre (26).

In a system where the health insurance cover such as the National Hospital Insurance Fund (NHIF) pays par or full cost of procedure and or hospital stay; as is the case with KNH, there is need to ensure that the patient gets value for what is paid, for every service (27).

Owing to the high initial capital cost of setting up IR unit and equipment as well as pricy consumables used to perform procedures, the price of IR services may be prohibitive to the patient and may be contributing to low acceptability, and growth of IR in Kenya (1).

## Conceptual Framework



**Figure 1: Conceptual Framework**

### Justification of the Study

There is need to look at interventional radiology services as revenue drivers;(3), for health facilities as well as centers of optimal service efficiency thereby align them with the best interest of the client in focus. The study set out to determine factors contributing to the delivery of intervention radiology services. This knowledge informs and likely influences policy as well as drive the quality improvement agenda at the KNH. There exists no paper on a similar subject in literature; it therefore adds onto the body of knowledge on this scanty written field.

## **Questions of the Study**

The research project sought to answer the following main and sub questions.

- a) What are the main determinants to the delivery of intervention radiology services at KNH?
- b) How does the training and qualification of service providers at the intervention radiology unit of KNH affect the delivery of services?
- c) How does the available physical infrastructure at KNH affect the delivery of intervention radiology services?
- d) What are the characteristics of the referral system at KNH and how do they determine service delivery at the intervention radiology unit?
- e) How does a radiology turnaround time at the KNH intervention radiology unit affect service delivery?

## **Objectives of the Study**

### **Broad Objective**

To determine the factors affecting delivery of interventional radiology services at Kenyatta National Hospital.

### **Specific Objectives**

- a) To evaluate how the training and qualification of service providers affect delivery of interventional radiology services at KNH.
- b) To determine how the physical facilities in KNH intervention radiology department affect delivery of services.
- c) To determine how the referral system, affect delivery of interventional radiology services at KNH.
- d) To evaluate how interventional radiology *total radiology waiting times* affect delivery of services at KNH.
- e) To analyze how cost of service affect the delivery of interventional radiology services at KNH.

## **RESEARCH METHODOLOGY**

### **Research Design**

as it sought to elucidate the current determinants affecting delivery of intervention radiology services. A structured questionnaire with fixed alternative and open-ended questions was administered to the target population for primary data collection.

### **Study Area Description**

The study was carried out at the KNH interventional radiology department located at the suite number eleven within the Radiology department including the outpatient clinic 23. The outpatient clinic is the area of triage where patient history and physical examination are performed and the previous images including laboratory tests are reviewed to ensure that the patient is physiologically fit for IR procedures.

The operating suite eleven has a Phillips fluoroscopy machine which is the main work horse in vascular procedures including but not limited to cerebral angiography, four vessel angiography, carotid body tumor embolization, aneurysmal embolization, transhepatic chemoembolization, percutaneous transhepatic cholangiography, biliary stenting, percutaneous nephrogram and nephrostomy drain insertion. There are also two Phillips ultrasound machines used in image guided biopsy of abdominal viscera, fine needle aspirate biopsy and intracavitary collection drainage tube insertion, to name a few. Procedures that require CT guidance are performed at the department's available two CT scanner rooms.

### **Target Population**

In this research, the primary data was obtained from the Kenyatta National Hospital staff working at the interventional radiology department. This group of personnel includes interventional radiology specialists, in fellowship interventionists (drawn from the University of Nairobi fellowship program), interventional Radiographers, anesthetists, nurses and nurse assistants. Additionally, administrative officers including head of finance, assistant finance, head of technical unit, head of IR unit and head of radiology department were interviewed regarding equipment supply, maintenance and pricing of services.

### **Inclusion/Exclusion Criteria**

The study population involved the personnel who were on duty during the duration of study. Workers who were on leave were excluded from the interviews

### **Sample Size and Sampling Method**

In this cross-sectional study, the sampling frame consisted of all members of the target population because they are a small group of less than one hundred individuals. An entire population or census of the elements was intended to be included and administered with the questionnaire.

### **Data Collection Instrument and Method**

A structured questionnaire with open and closed ended questions was used to acquire raw data on the different factors affecting service delivery at the KNH intervention radiology department. The printed hard copy questionnaire was administered to each participant and they were requested to fill and return as expediently as possible. A reasonable time limit for returning the questionnaire was set at two days. A register of questionnaire distribution and return from the members of staff was maintained. The data collection tool was simple and straight forward; as such it did not need to be pretested before administration.

### **Ethical Considerations**

Potential ethical issues that might have arisen included authorization to conduct the study, privacy and confidentiality of information obtained from the participants. Authority to conduct the study was requested from the ethics and research committee of KNH and University of Nairobi. A register of administered questionnaires' serial numbers was created to keep the respondents anonymous.

### **Quality assurance**

To ensure data integrity, consistency and reliability there was serialization of the data collection tool, with the participants being allocated one questionnaire each. Additionally, no data tool indicated the names of the participant; while a register of participants and serial number of questionnaires was maintained separately.

### **Validity and Reliability**

To ensure consistency in data and results the internal reliability of the data tool was evaluated as well as a percentage of absolute agreement calculated for repeat measurement.

The tool had been formulated with input from supervisors and peers to ensure that it measures what it was supposed to measure. It had adequate face, construct and content validity.

## Data Analysis and Presentation Plan

The data obtained was analyzed using quantitative computer analytics such as excel and SPSS. The results are presented using descriptive statistics as well as tables and charts.

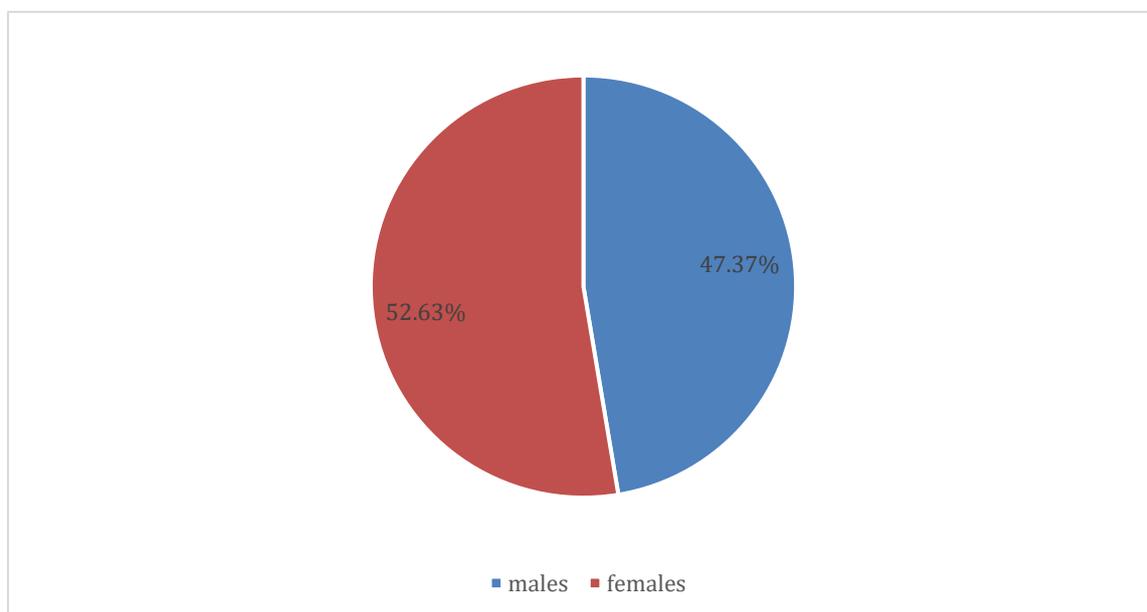
## STUDY RESULTS

### Study Demographics

The majority of respondents were between 31 to 40 years of age as shown in table 4.1 while there were slightly more female staff than males as depicted in figure 4.1 below.

**Table4. 1:Age distribution**

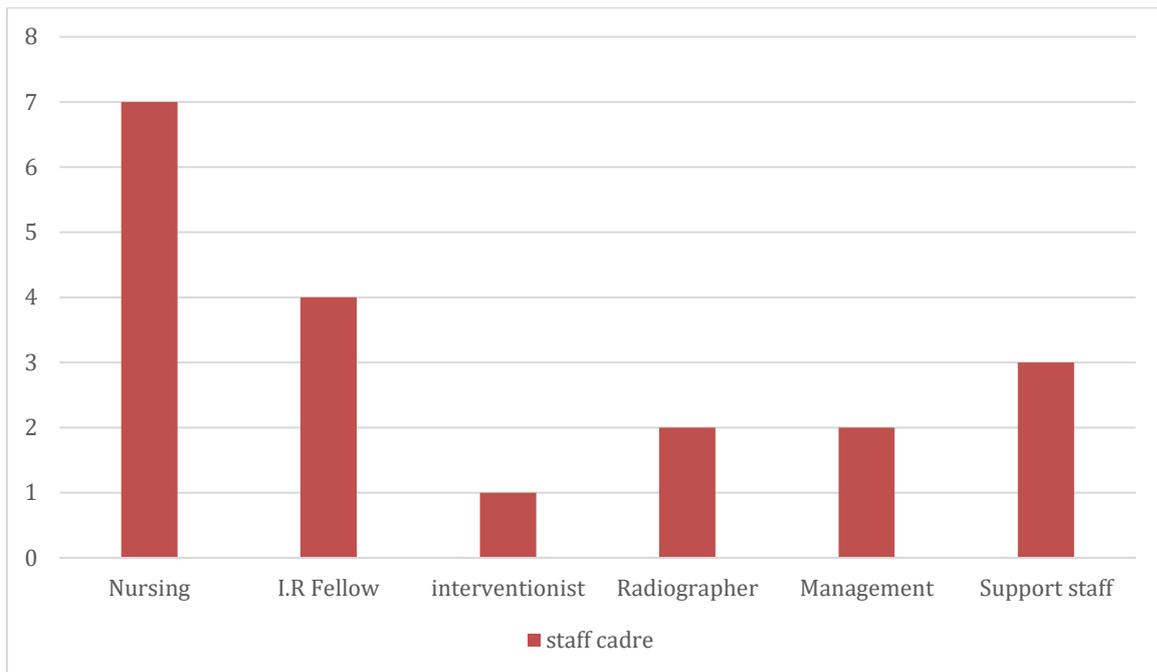
Age Group	Frequency
20-30	6
31-40	9
>40	4
Total	19



**Figure 4. 1:Gender distribution**

The study involved all cadre of staff at the IR and two management staff. A total of 19 staff were interviewed excluding the staff who were on leave during the study period.

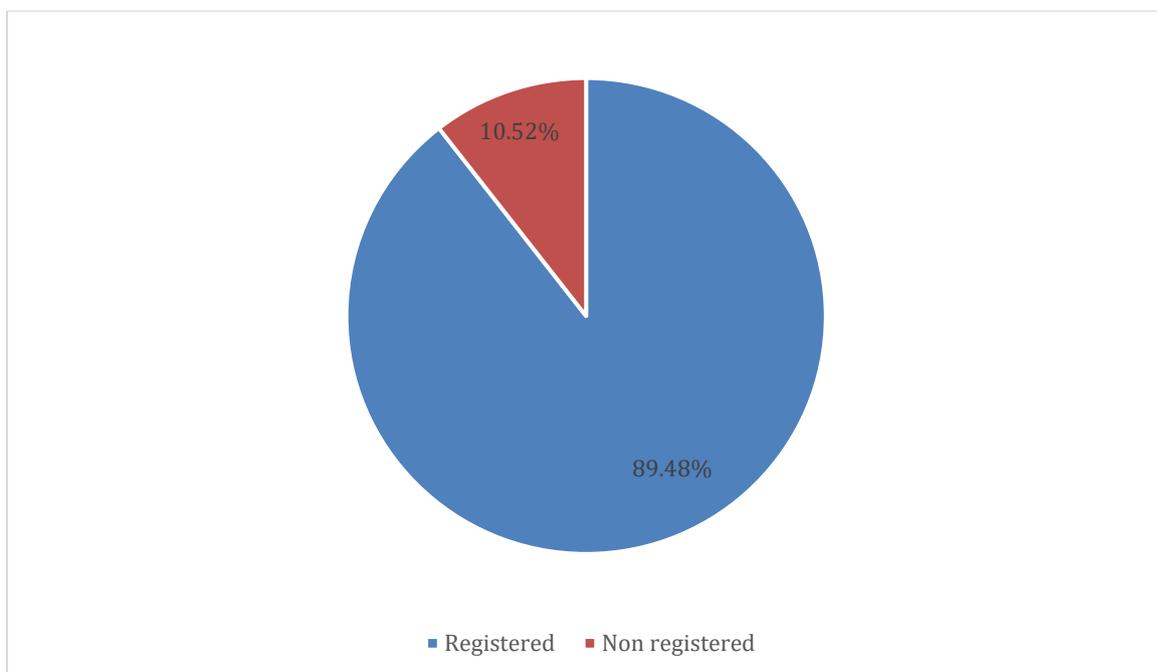
Staff distribution according to cadre is illustrated in figure 4.2 below.



**Figure 4. 2:Staff cadre**

### Training and Qualification of IR staff

Majority of personnel n=17 (89.48%) are registered with a professional body. This is illustrated in figure 4.3



**Figure 4. 3:Registered by professional body.**

All professional bodies require evidence of attendance for continuous professional training annually as indicated in the table below.

**Table4. 2:Frequency of continuous professional development audit**

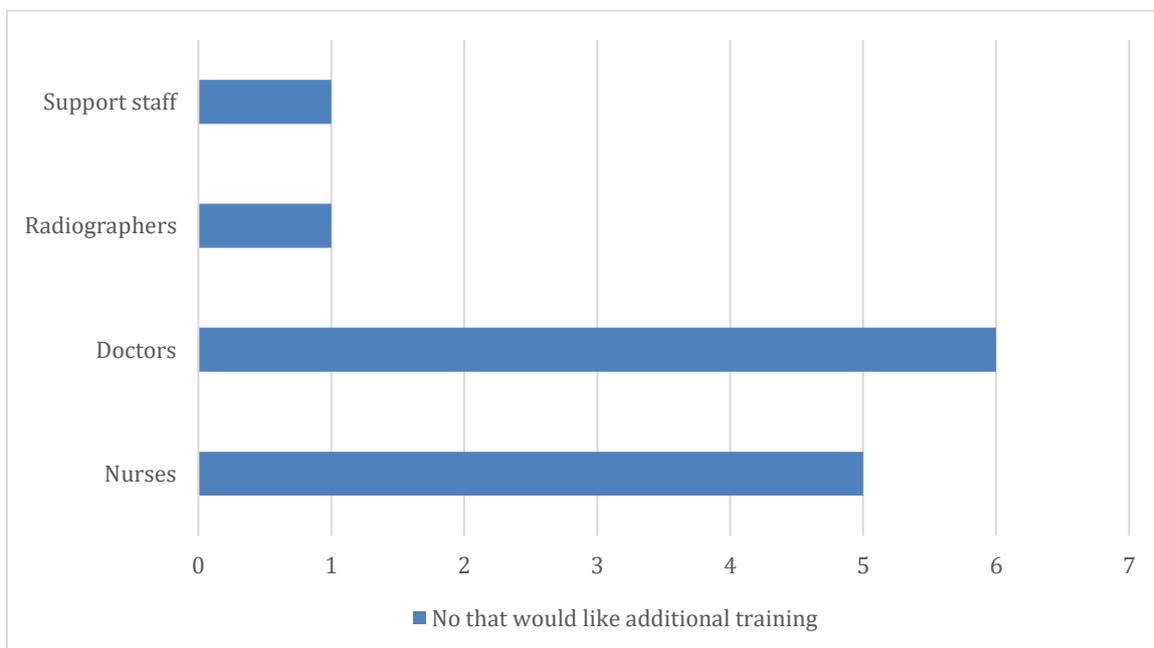
Professional licensor time	Proportion of registered staff
Annual	100%
Other	0%

Majority of staff n=16 (86.67%) had attended a professional training within the six months preceding the study as depicted in the table below.

**Table4. 3:Last professional training attended**

Last professional training attendance	Number of staffs	frequency
0-6 months	16	84.21%
7-12 months	2	10.52%
>12months	1	5.26%

Most staff indicated that they would benefit from additional professional training as represented in the following bar graph.



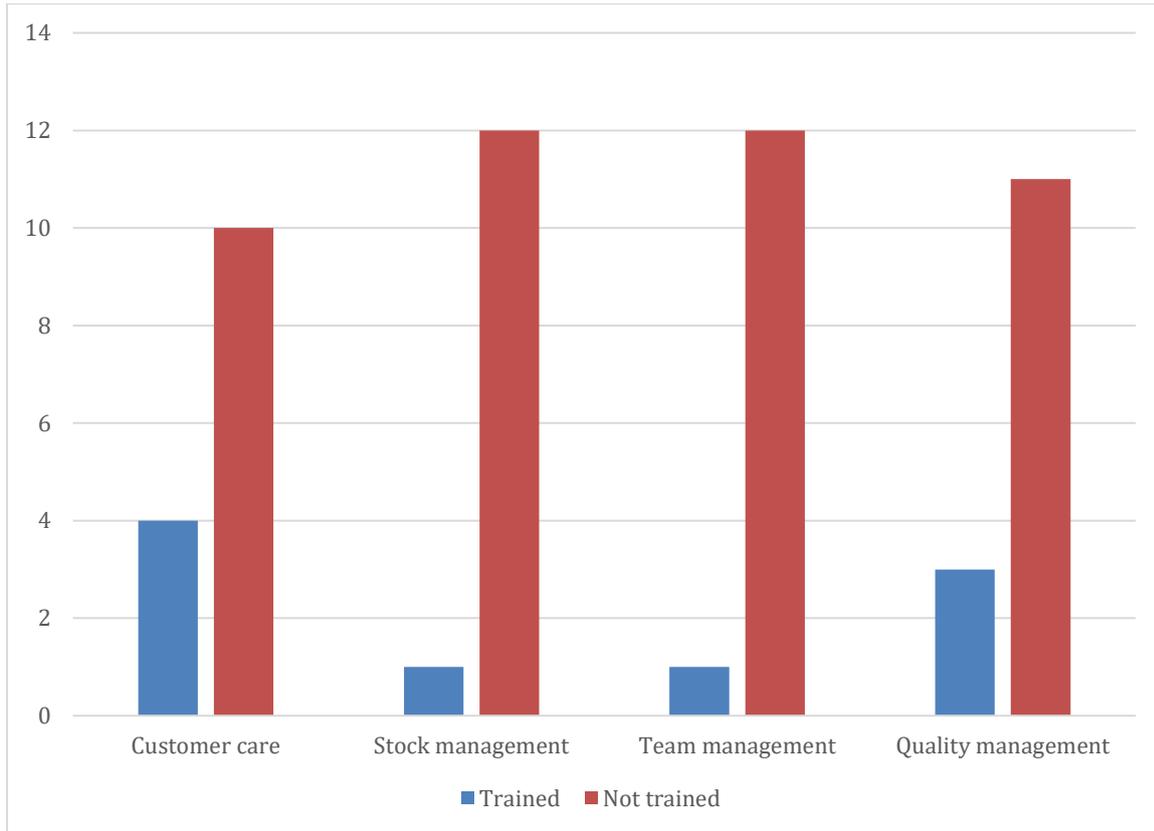
**Figure 4. 4:Number of staffs Requiring additional professional training.**

The specific areas of preferred extra professional training as indicated by various staff cadre is outlined in the table below.

**Table 4. 4: Specific area of demanded professional training**

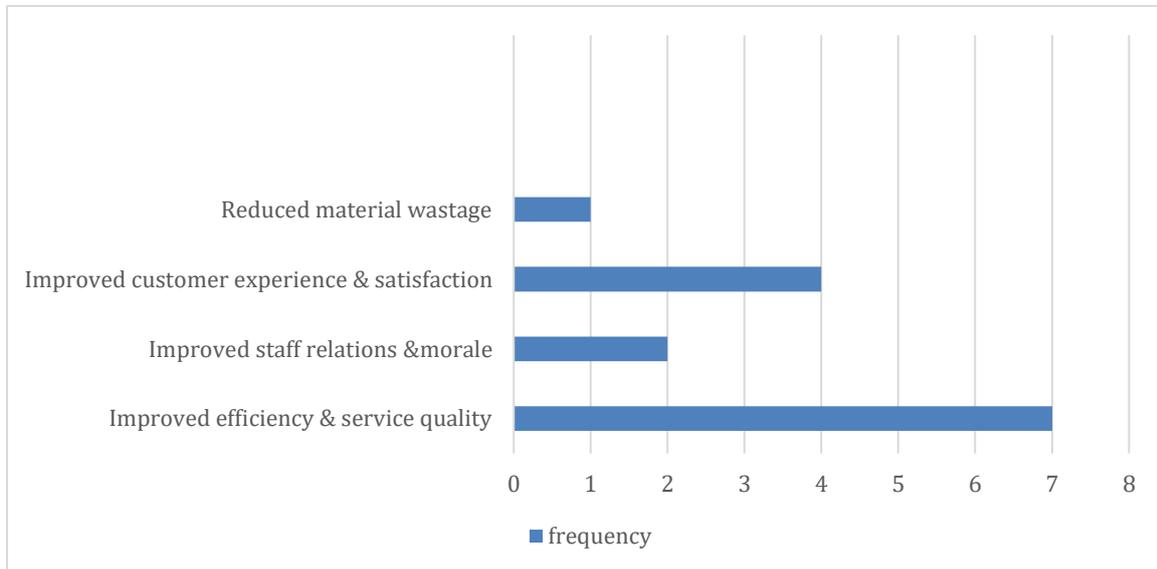
Subject	%
IR nursing care	27.27
Radiation safety	27.27
Patient critical care	0.1
Advanced interventions	27.27
Infection control	0.1

There was a low number of staffs trained in support areas as depicted in the histogram below.



**Figure 4. 5: Hospital sponsored additional trainings**

Various benefits likely arising from supportive management trainings were outlined as represented in the figure below.

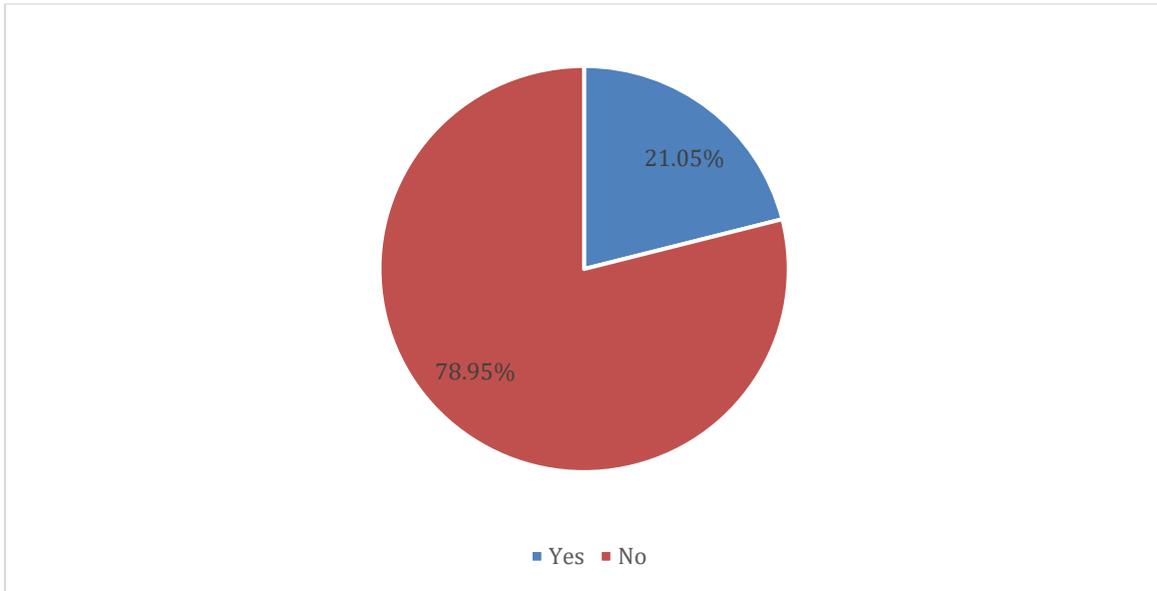


**Figure 4. 6: Perceived benefit from additional training**

### **Infrastructure**

Majority of respondents n=15 (78.95%) stated that the department is not adequately equipped for its current work load. This is higher than was cited in a Canadian study; where 35% of respondents were of the view that operation equipment shortage curtailed delivery of IR services (28).

The pie chart below demonstrates the interviewee position on adequacy of IR department equipment.



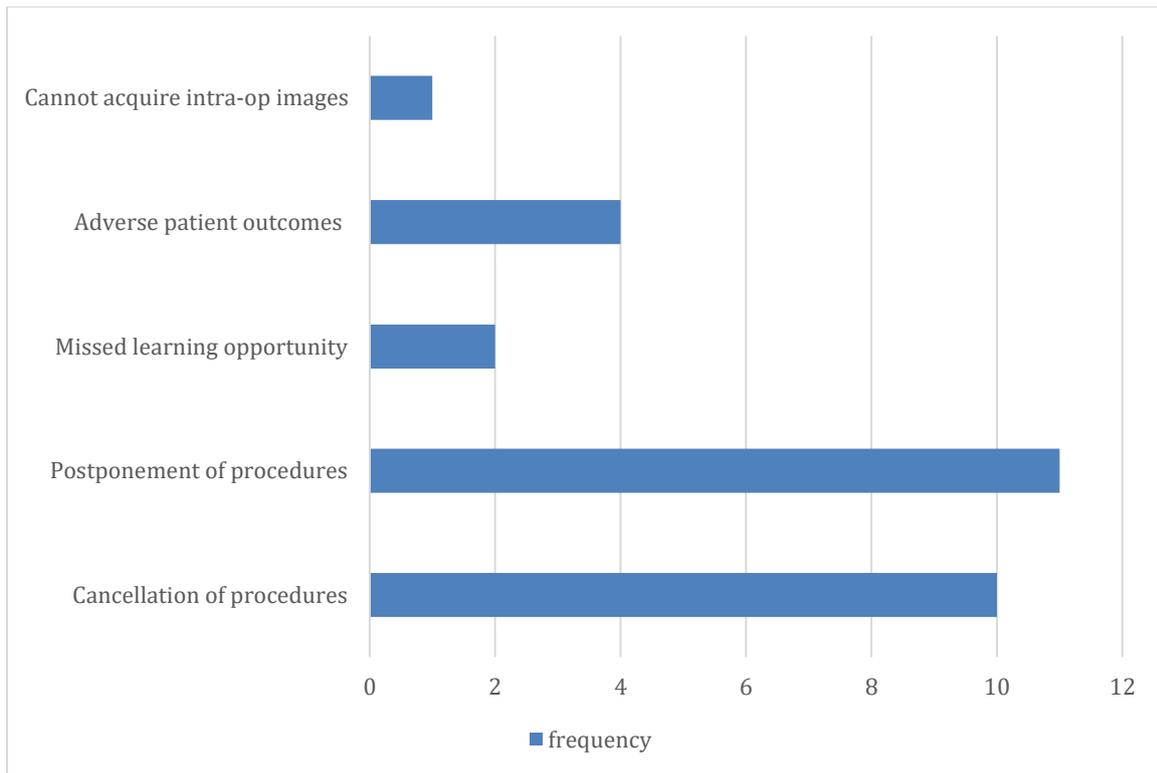
**Figure 4. 7:Adequacy of department's equipment**

All respondents indicated that machine downtime is a challenge to the department as outlined in the following table.

**Table4. 5:Machine down time is a challenge**

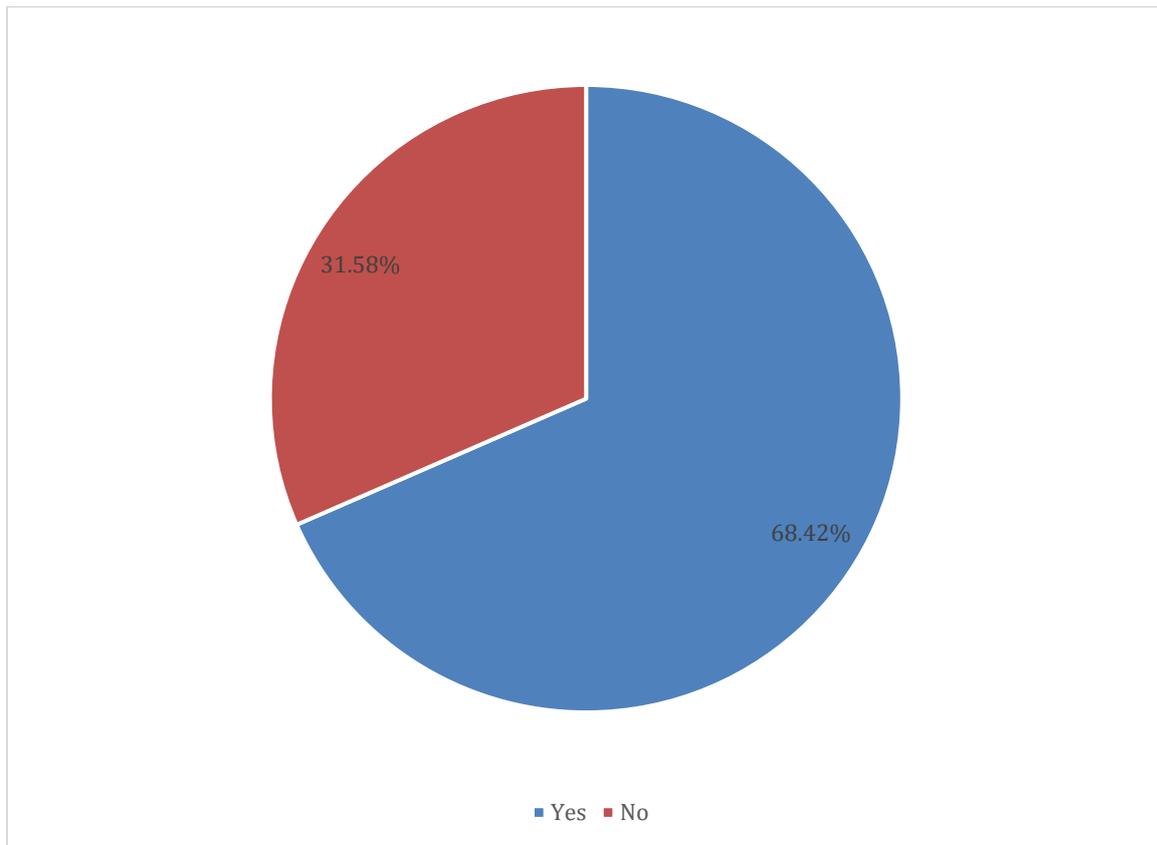
	YES	NO
Frequency of machine downtime is a challenge to the dept	100% (n=19)	0

The effects of machine downtime on service delivery were enumerated as outlined below.



**Figure 4. 8:Effects of machine downtime on service delivery**

Most respondents n=13 (68.42%) indicated that consumable material supply in the IR department was inadequate as illustrated in the pie chart below.



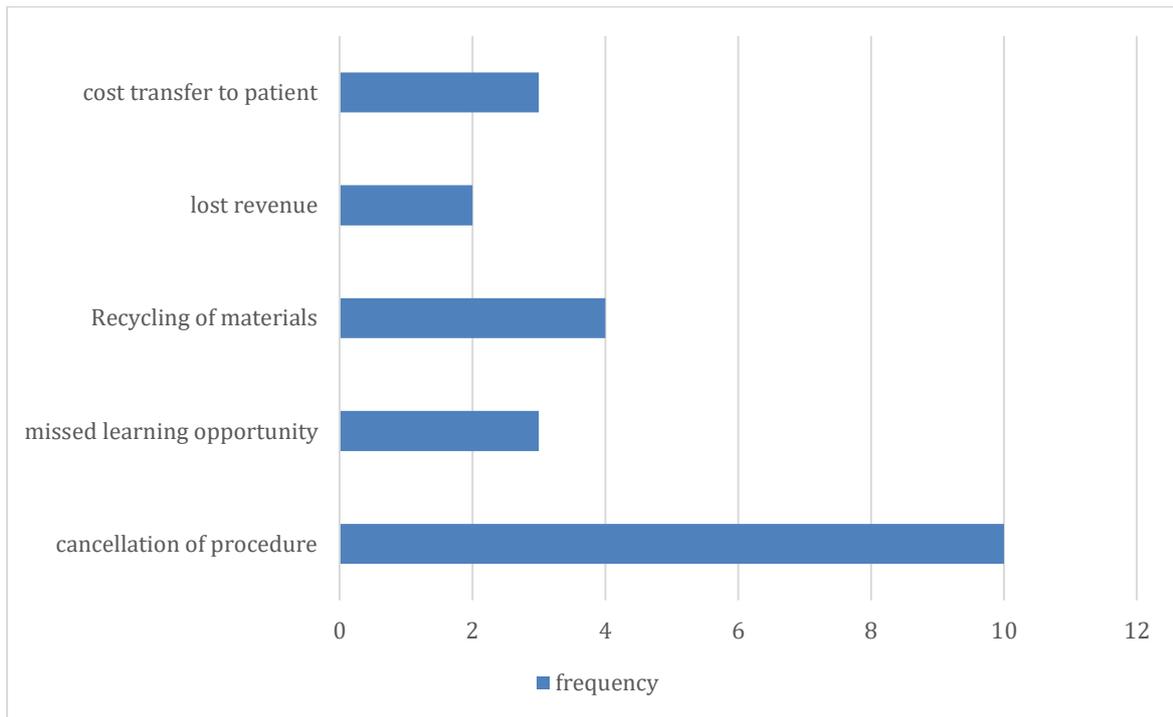
**Figure 4. 9:Adequacy of consumables supply**

N=17 (89.47%) of interviewees stated that consumable materials stock out in the department poses a challenge to service delivery as outlined in the following table.

**Table4. 6:Materials stock out is a challenge**

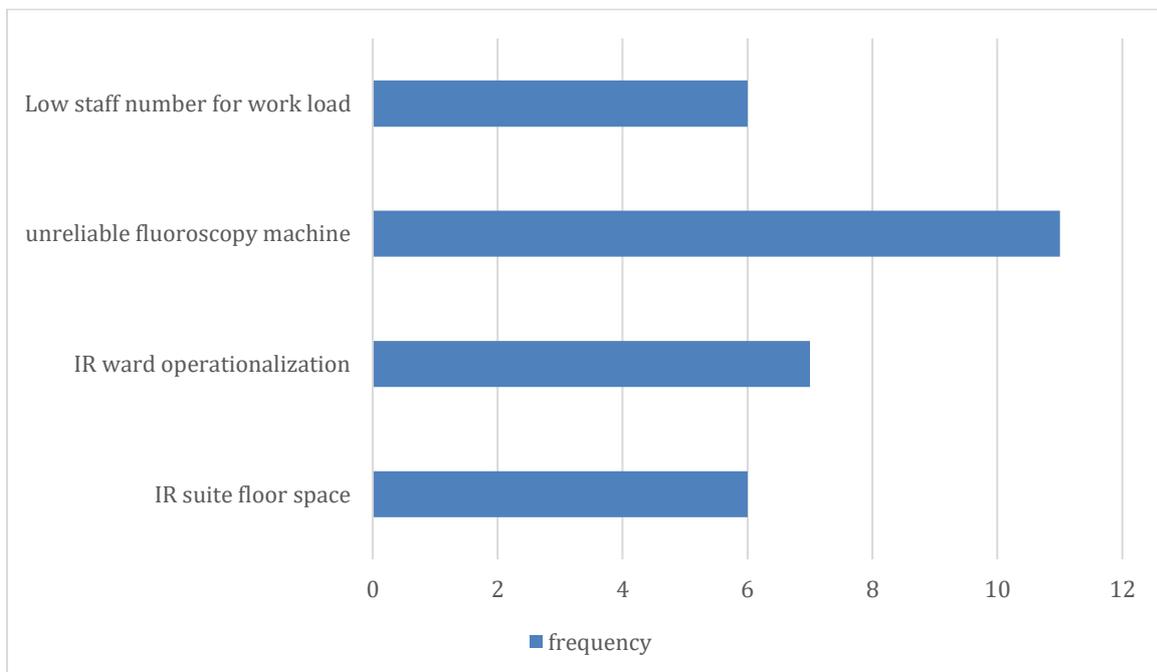
	YES	NO
Materials stock out is a challenge	89.47% n=17	10.53% n=2

The effects of frequent consumable materials stock outs at the IR department on service delivery were enumerated as depicted in the bar graph below.



**Figure 4. 10:Effects of materials stock out on service delivery**

Several other gaps that need improvement were identified as enlisted in the diagram below.

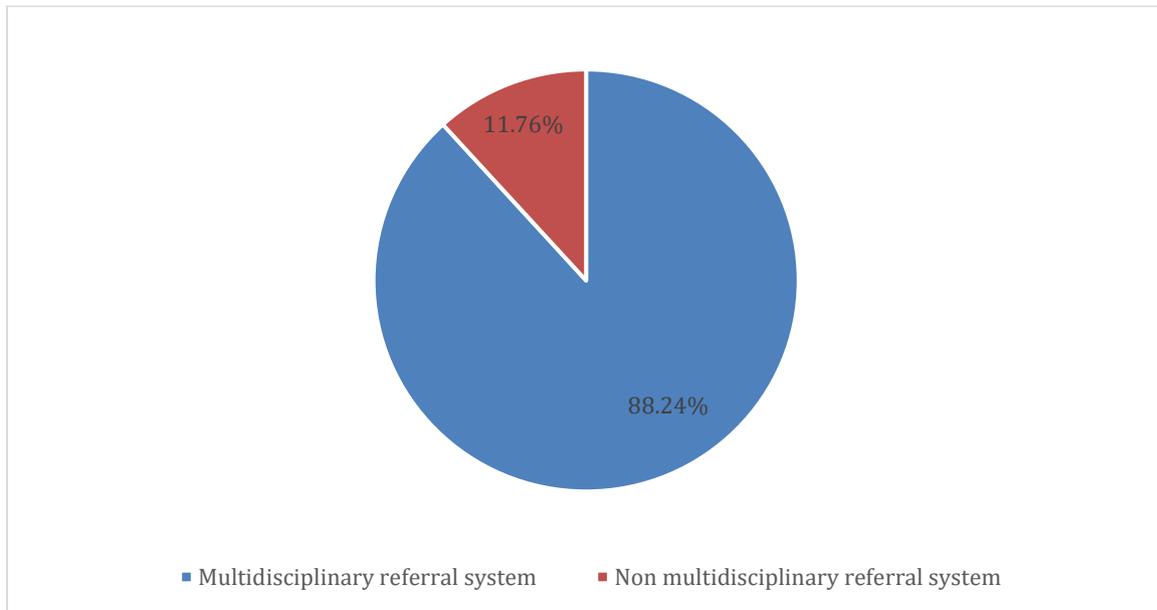


**Figure 4. 11:Other identifiable infrastructure gaps**

Radiologist shortage (33%) as well as room shortage (35%) was found to contribute to limitations of IR service delivery in Canada (28). Compared to 20% on inadequate staff for work and limitations on IR suite space respectively cited in our study.

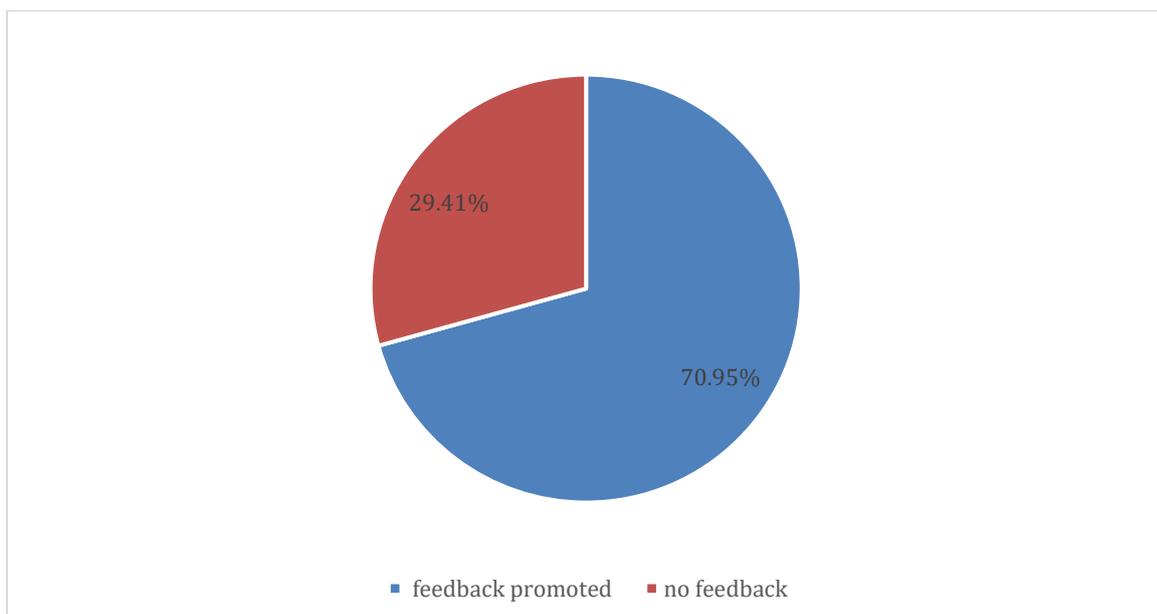
### Referral System

88.24% (n=15) of respondents concurred that the existing referral system at the KNH encourages inter-disciplinary consultation as represented in the following pie chart.



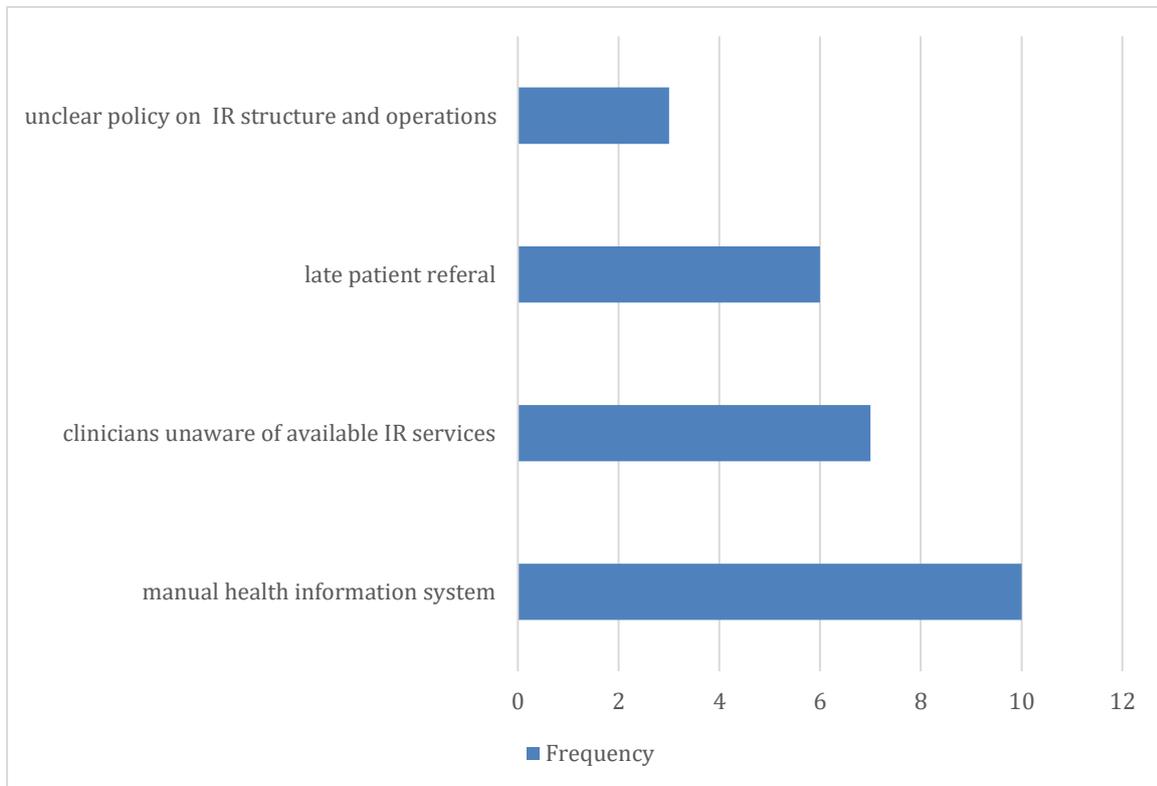
**Figure 4. 12: Current referral system encourages multi-disciplinary consultation**

The referral system also promotes feedback to referring clinicians as indicated by n=12 (70.59%) interviewed staff. This is shown diagrammatically below.



**Figure 4. 13:Referral system encourages backward feedback**

Several limiting factors within the referral system that would require improvement were enumerated as illustrated below.



**Figure 4. 14:Identifiable gaps in referral system**

A national survey by Canadian Interventional Radiology Association cited lack of support from referring services as the major contributor to non-performance some core procedures (56%) (28).

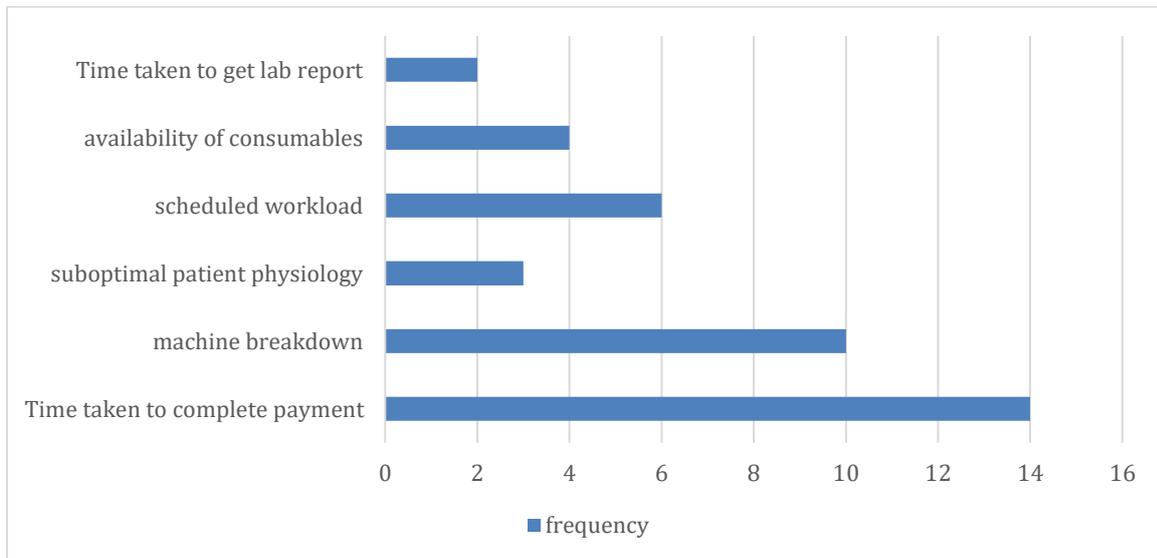
**Total Radiology Turnaround Time**

The average total radiology turnaround time in the IR department was estimated with a mode of within a week as elucidated in the following table.

**Table4. 7:Average TRWT**

Number of days patient waits for service	Frequency
1-7days	43.75%
8-14days	37.50%
>14days	18.75%

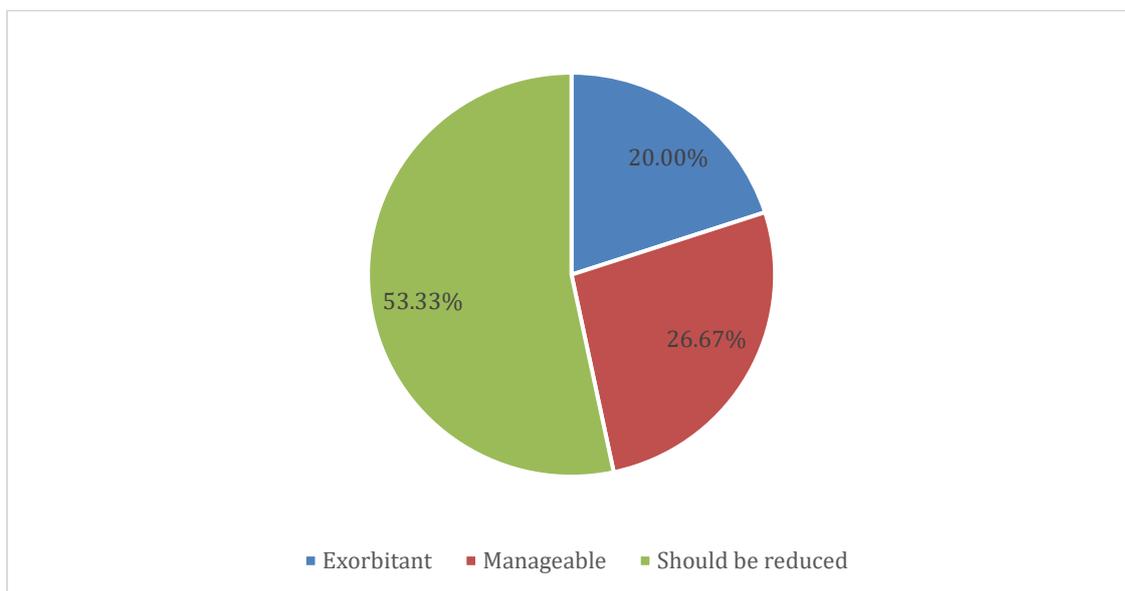
Several factors were identified as contributing to the total radiology waiting time. These are represented in the bar graph below.



**Figure 4. 15:Factors contributing to TRWT**

**Cost of IR services**

Majority n=10 (53.33%) of the respondents felt that the current service charges of the IR services should be reduced while 20% think the prices are exorbitant. The following diagram depicts what respondents think of current price regime at IR department.



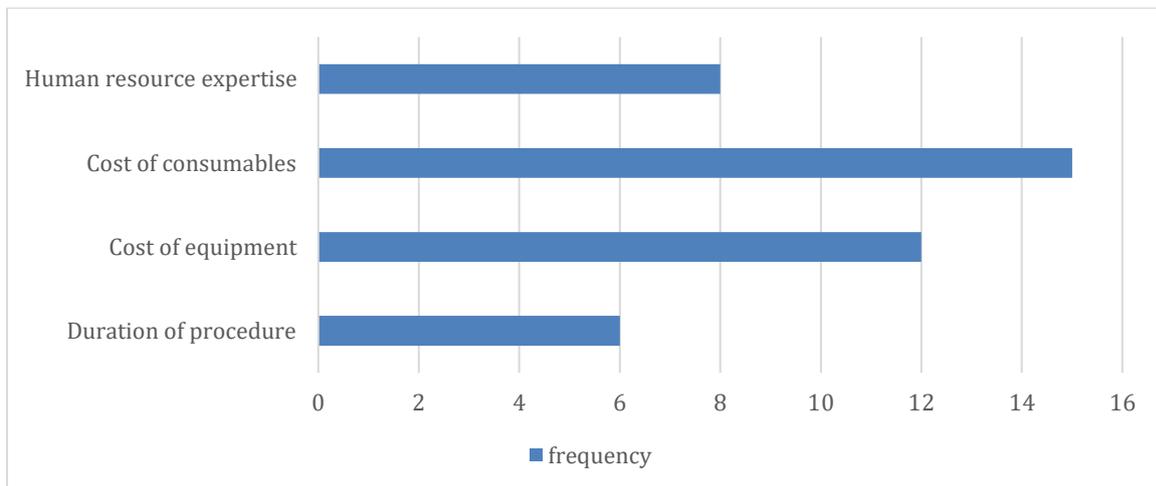
**Figure 4. 16:Perception of the current IR service charges**

The effect of current prices on access to IR services was seen to be prohibitory as depicted below.

**Table 4. 8:Effect of current prices on service accessibility**

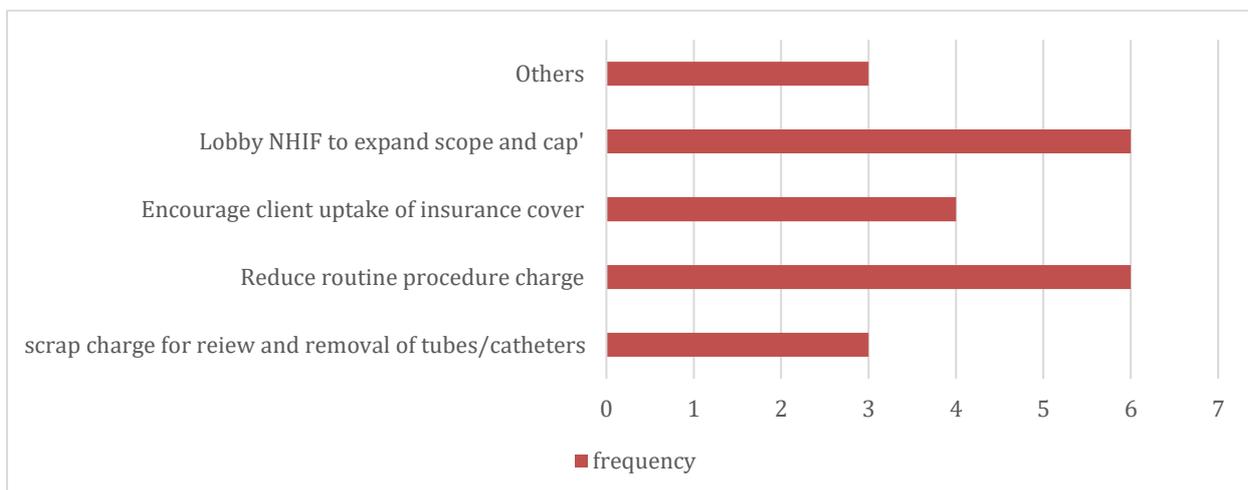
Effect of price on service accessibility	frequency
Prohibitory	85.71% (n=16)
Does not hinder access to service	14.29% (n=3)

Various components were identified as contributors to the cost of IR services as represented in the diagram below.



**Figure 4. 17:Components of service cost**

There were several suggested approaches to encourage access to IR services at the KNH. These are represented diagrammatically below.



**Figure 4. 18:ways of enhancing accessibility to IR services**

## **DISCUSSION**

This study set out to determine the factors affecting delivery of IR services at the Kenyatta national hospital. This section discusses how the training and qualification of IR staff, the physical infrastructure, the patient referral system in place, the total radiology waiting time in the IR department and cost of IR services affect service delivery in the hospital. Limitations to the study, as well as recommendation for further study are outlined in this section.

### **Training and Qualification of IR Staff**

The Kenyatta National hospital IR staff are adequately trained in their profession with 88.24% being registered by relevant professional bodies, all of whom annually renew their licensure. It is commendable that staff also regularly participate in continuous professional development trainings.

Certain key areas of professional training were identified as need areas to improve patient and work environment safety as well as professional capacity among IR staff. Key among these training demanded subjects is IR nursing, radiation safety and advanced intervention procedures such as neurology and advanced vascular intervention. The United State of America's Department of Health and Human services enlists the minimum training exposure requirement for IR (29).

Non-core supportive human skill is low among IR staff. While it is a recognized valuable set of skill as it leads to improved efficiency, staff interpersonal relations, reduced wastage, better communication and customer satisfaction (Umbeli et al., 2015) among others; the lack of exposure of staff to these soft skills robs the department of the accruable benefits(30).

### **Physical Infrastructure**

At the KNH interventional radiology department, equipment malfunction and breakdown are a major challenge hampering effective and cost-efficient service delivery. In particular the unit's fluoroscopic machine which is the departments workhorse has numerous downtime periods because it is old and out of service.

This has contributed to undesirable outcomes including cancellation and/or postponement of interventional procedures and failure to document intra operative images among others.

IR Room shortage and inadequacy was sighted as contributing to non-delivery of services in Canada (28).

Setting up and running a functional interventional radiology unit is a costly affair as it requires high capital outlay for equipment, suit planning and modification, as well as seamless supply of useable materials (Baerlocher et al., 2017)

The supply of consumable materials and intervention devises was also noted to be a big challenge and contributing to suboptimal service, missed learning opportunity, loss of revenue, cost transfer to patients (patient sources for the required treatment device such as stents) as well as unfavorable patient outcomes increased morbidity and mortality.

There is urgent need to replace the unit's fluoroscopy unit as well as modify the units floor space to create proper patient reception, post-operative recovery and observatory or emergency rooms. These functions are currently performed in the general patient's waiting area.

The number of staff available for current work load particularly in the nursing section also requires to be optimized so as to improve efficiency of service delivery. Each functional area of the IR department; for example, receiving and preparing patients, operating rooms, recovery etc. should have responsibility allocation of a staff. Currently the nurses within IR department are shared among three sub units namely Magnetic Resonance Imaging, Computed Tomography and IR. This on most occasions causes delays in the workflow within the three sub-units, further compromising the quality of care. In their 2016 "standards of practice staffing guidelines for the interventional radiology suite," the society of interventional radiology reiterated the need to have dedicated IR teams and stressed that IR nurses must not be shuffled with those from other departments.(31)

## **Referral System**

The patient referral from different disciplines of medicines for minimally invasive intervention at the KNH is robust. It involves interdisciplinary professional communication and collaboration. There is also in place good structure for referral feedback to the originating clinic or ward. This has enabled seamless continuity of patient care.

It is noteworthy that, like any organization's processes require continuous incremental improvement, the referral process at KNH has identifiable action areas for growth and development. Such potential is in defining and actualization of the IR policy guidelines, popularization of services offered in IR department and deployment of a comprehensive hospital management system (20) (28).

### **Total Radiology Turnaround Time**

Total radiology turnaround time is a key determinant to efficiency of a department's processes. This study did not do the actual observational measurement of throughput time. A patient is likely (43.75% of the time) to get through the Kenyatta national hospital IR processes within a week. Nevertheless, waiting times of more than two weeks to a month are sometimes experienced. This delay is attributable to multiple factors including lengthy waiting periods for insurance pre-authorizations or to raise cash for service, consumable devices stock outs, machine down times, high work load and suboptimal patient physiology. This mirrors findings of a study on factors contributing to waiting time in radiology services at the KNH (32)

### **Cost of IR Services**

The cost of a service is a major determinant to the accessibility of the service. The cost of IR services at Kenyatta National Hospital are viewed as inhibiting access to interventional radiology services (85.71%). Among the contributors to the cost of services are; cost and maintenance of machines, cost of consumables, the human resource and skill costs as well as duration of time a procedure takes.

To improve access to IR services, various approaches to pricing and enabling clients to afford it are suggested. Reduction of the price for some routine procedures such as image guided ascitic and pleural fluid catheter drain placement as well as scrapping review charges for the same procedures will ease the financial burden on patients and likely increase the number of persons able to afford the lifesaving procedures. This will not only ensure that more patients benefit from interventional services but improve the department's revenue inflow.

Additionally, there is need to educate and encourage clients on the benefits of acquiring an insurance cover. Mostly the national hospital insurance policy is used at the KNH, which will improve affordability. Lobbying the NHIF to increase the scope of procedures covered as well as increase the capitation amount allocable to interventional procedures is seen as another way to increase the scope IR services.

## **CONCLUSION**

The findings of this study demonstrate that the delivery of IR services at the Kenyatta National Hospital are affected by the training and qualification of IR staff, the department's physical infrastructure, the patient referral system in place, the total radiology waiting time in the IR department and the cost of IR services.

Several growth and improvement areas are identified which addresses the need for IR policy formulation and implementation as well as the improvement of the department's existing processes for optimal service delivery(28).

## RECOMMENDATIONS

Through the study, a number of gaps and improvement areas were identified. Addressing these potential areas will help the hospital achieve world class interventional radiology service standards. The study thus recommends as follows.

- There is need to empower staff with relevant support managerial skills which will improve efficiency, quality of service and enhanced customer experience.
- IR departments need to maintain modern and serviceable work equipment such as fluoroscope units etc. as this was cited as the major cause for non-delivery of services and missed learning opportunity due to down time.
- Streamlining supply chain weaknesses for consumable materials used in IR is essential to service delivery optimization for improved patient outcomes, reduced financial and logistical burden on clients and overall reputation of the hospital.
- There exists a real need to re-plan and increase the IR suite floor for optimal function (as a normal operation theatre; complete with separated receiving, operation and recovery areas as well as supplies stores, staffroom and changing rooms)
- IR departments ought to have clearly defined and operational IR policy for optimal service delivery and teaching (for example operational IR ward and dedicated nursing staff)
- A comprehensive digital hospital management system is required so as to eliminate time wastage for instance in getting lab results, delayed patient review once a requisition is raised, material supply hitches as well as enable seamless inter-departmental continuity of care. The additional benefit of revenue collection and accounts management arise from such systems.
- The unit should popularize services offered through interaction with other departments and clinicians through MDTs, CMEs and training symposia.
- Hospital management should lobby for NHIF to speed pre-authorization procedure, increase capitation per procedure and expand the scope of covered procedures.

## REFERENCES

1. Muruka J. Intervention Radiology In Kenya. *Ann Afr Surg.* 2018;15(1):1–3.
2. Metz D, Ilieş L, Nistor RL. The impact of organizational culture on customer service effectiveness from a sustainability perspective. *Sustain.* 2020;
3. Hoe JWM. Service Delivery and Service Quality in Radiology. *J Am Coll Radiol.* 2007;
4. Alkhenizan A, Shaw C. Impact of Accreditation on the Quality of Healthcare Services: a Systematic Review of the Literature. *Ann Saudi Med.* 2011 Jul;31(4):407.
5. KMPDC [Internet]. [cited 2022 Mar 11]. Available from: [http://kmpdc.go.ke/Registers/Specialist\\_Practitioners.php](http://kmpdc.go.ke/Registers/Specialist_Practitioners.php)
6. FELLOWSHIP IN INTERVENTIONAL RADIOLOGY OF UNIVERSITY OF NAIROBI (Fell.Interv.Rad) | Department of Diagnostic Imaging & Radiation Medicine [Internet]. [cited 2022 Mar 11]. Available from: <https://dirm.uonbi.ac.ke/programs-content-type/fellowship-interventional-radiology-university-nairobi-fellintervrad>
7. The Importance of Continuous Education in Healthcare - HealthManagement.org [Internet]. [cited 2022 Mar 10]. Available from: <https://healthmanagement.org/c/healthmanagement/issuearticle/the-importance-of-continuous-education-in-healthcare>
8. Umbeli T, Murwan I, Kunna A, Ismail S, Sulman M, Elmahgoub A. Impact of Health Care Provider’s Training on Patients’ Communication During Labor at Omdurman Maternity Hospital, Sudan 2011. *Sudan J Med Sci.* 2015 Mar;9(4):211–6.
9. Chelagat T, Rice J, Onyango J, Kokwaro G. An Assessment of Impact of Leadership Training on Health System Performance in Selected Counties in Kenya. *Front Public Heal.* 2021 Feb;0:1099.
10. Oleribe OO, Momoh J, Uzochukwu BSC, Mbofana F, Adebisi A, Barbera T, et al. <p>Identifying Key Challenges Facing Healthcare Systems In Africa And Potential Solutions</p>. *Int J Gen Med* [Internet]. 2019 Nov 6 [cited 2022 Mar 13];12:395–403. Available from: <https://www.dovepress.com/identifying-key-challenges-facing-healthcare-systems-in-africa-and-pot-peer-reviewed-fulltext-article-IJGM>
11. Provision of Interventional Radiology Services, second edition, September 2019 | News and Updates | BSIR [Internet]. [cited 2021 Sep 12]. Available from: [https://www.rcr.ac.uk/system/files/publication/field\\_publication\\_files/bfcr198-provision-interventional-radiology-services-second-ed.pdf](https://www.rcr.ac.uk/system/files/publication/field_publication_files/bfcr198-provision-interventional-radiology-services-second-ed.pdf)
12. Baerlocher MO, Kennedy SA, Ward TJ, Nikolic B, Bakal CW, Lewis CA, et al. Society

- of Interventional Radiology: Resource and Environment Recommended Standards for IR. 2017;
13. Smart Planning for Successful Interventional Radiology Suites [Internet]. [cited 2022 Mar 14]. Available from: <https://blog.array-architects.com/kc/smart-planning-for-a-successful-interventional-radiology-suite>
  14. Campbell C. Common Challenges of Referral Management Solutions.
  15. GOK/MOH. Kenya Health sector referral implementation guidelines 2014 1st edition. 2016;1–44.
  16. Mehrotra A, Forrest CB, Lin CY. Dropping the baton: Specialty referrals in the United States. *Milbank Q*. 2011 Mar;89(1):39–68.
  17. Gandhi TK, Sittig DF, Franklin M, Sussman AJ, Fairchild DG, Bates DW. Communication breakdown in the outpatient referral process. *J Gen Intern Med*. 2000;15(9):626–31.
  18. Makary MA, Daniel M. Medical error-the third leading cause of death in the US. *BMJ*. 2016 May;353.
  19. Azamar-Alonso A, Costa AP, Huebner L-A, Tarride J-E. <p>Electronic referral systems in health care: a scoping review</p>. *Clin Outcomes Res*. 2019 May;11:325–33.
  20. Olisemeke B, Chen YF, Hemming K, Girling A. The Effectiveness of Service Delivery Initiatives at Improving Patients’ Waiting Times in Clinical Radiology Departments: A Systematic Review. *J Digit Imaging*. 2014 Nov;27(6):751–78.
  21. Kohi MP, Fidelman N, Behr S, Taylor AG, Kolli K, Conrad M, et al. Periprocedural patient care. *Radiographics* [Internet]. 2015 Oct 1 [cited 2022 Mar 13];35(6):1766–78. Available from: <https://pubs.rsna.org/doi/abs/10.1148/rg.2015150038>
  22. Report Turn-Around Time | Radiology Key [Internet]. [cited 2022 Mar 14]. Available from: <https://radiologykey.com/report-turn-around-time-2/>
  23. Kruskal JB, Eisenberg R, Sosna J, Yam CS, Kruskal JD, Boiselle PM. Quality Improvement in Radiology: Basic Principles and Tools Required to Achieve Success. <https://doi.org/101148/rg316115501>. 2011 Oct;31(6):1499–509.
  24. Marcheschi P. Relevance of eHealth standards for big data interoperability in radiology and beyond. *La Radiol medica* 2016 1226. 2016 Nov;122(6):437–43.
  25. Towbin AJ, Perry LA, Larson DB. Improving efficiency in the radiology department. *Pediatr Radiol*. 2017 Jun;47(7):783–92.
  26. White SB. Value in Interventional Radiology: Achieving High Quality Outcomes at a Lower Cost. *Rev Comment • Editor Radiol* [Internet]. 2020 [cited 2022 Mar

- 13];297:482–3. Available from: <https://doi.org/10.1148/radiol.2020203407>
27. Interventional Radiology Cost Analysis [Internet]. [cited 2022 Mar 14]. Available from: <https://www.radiologytoday.net/archive/rt0316p10.shtml>
  28. Brien JO, Otto ÆEM, Asch MR, Hayeems ÆE, Kachura ÆJR. Limitations Influencing Interventional Radiology in Canada : Results of a National Survey by the Canadian Interventional Radiology Association ( CIRA ). 2007;847–53.
  29. Kim HS, Nikolic B, Misra S, Resnick SA. HHS Public Access. 2015;24(11):1609–12.
  30. Gaspard J, Yang C. Training needs assessment of health care professionals in a developing country : the example of Saint Lucia. BMC Med Educ [Internet]. 2016;1–6. Available from: <http://dx.doi.org/10.1186/s12909-016-0638-9>
  31. Baerlocher MO, Kennedy SA, Ward TJ, Nikolic B, Bakal CW, Lewis CA, et al. Society of Interventional Radiology Position Statement : Staffing Guidelines for the Interventional Radiology Suite. J Vasc Interv Radiol [Internet]. 2016;27(5):618–22. Available from: <http://dx.doi.org/10.1016/j.jvir.2016.02.010>
  32. Catherine W. Factors contributing to waiting times among patients undergoing computerized tomography, ultrasonography and general radiography at kenyatta national hospital, nairobi kenya. 2019;(May).

**III RESEARCH PERSONNEL.** Please provide the information requested below for research administrators, co-investigators and collaborators in this research project.

Last name ONYAMRU First name CALEN Academic Degrees MBS, MMedRAD, PDGM  
Professional titles and/or work position within your home institution  
KENYATA NATIONAL HOSPITAL, UNIVERSITY OF NAIROBI  
Home institution(s) and department (s) approving this research project

Mailing address, telephone and fax numbers, e-mail address

[Signature] Date 21/03/2022  
Research Administrators' Signature

[Signature] Date 21/03/2022  
Co-Investigators' Signature

\_\_\_\_\_  
Collaborator's Signatures Date \_\_\_\_\_

**REQUIRED ATTACHMENTS**

1. Letters of Study Approval from the Principal Investigator's Home Institution (Department).
2. One copy of the Curriculum Vitae of each member in the research team describing their research qualifications and experience.
3. Research Personnel Information (Roles and responsibilities in the research project).

**IV FUNDING INFORMATION**

Briefly describe current and pending grant and contract information

**SELF-FUNDED**

**V. DESCRIPTION OF RESEARCH PROJECT**

Please provide an executive summary of this research project including, in non-technical language, the following information:

**1) Background and Purpose of Research**

- a) A clear justification for the study, its significance in meeting the needs of the country and/or participant population.
- b) Summarize information on previous studies and on published research on this topic, including nature, extent and relevance of animal studies and other preclinical and clinical studies.
- c) Explain what hypotheses or research question(s) this activity is designed to answer, its assumptions and its variables. Please state specific objectives and/or aims.

The provision of radiological services needs to be examined from the point of customer-oriented delivery. This, in the business sense, would put into consideration various factors among them being