# DEMAND, PERCEIVED BARRIERS AND AVAILABLE INFRASTRUCTURE FOR RADIOLOGY SUBSPECIALISATION TRAINING IN KENYA

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## Declaration:

This dissertation is my original work and has not been presented for a degree in any other University.

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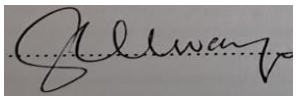
**Signature:**  **Date:** 17/11/2022

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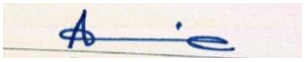
**Signature:**  **Date:**

## Abbreviations and acronyms

| | |
|---|---|
| WHO | World Health Organization |
| PACS: | Picture archiving and communication system |
| HIS | Hospital Information System |
| UON | University of Nairobi |
| KNH | Kenyatta National Hospital |
| AKUHN | Aga Khan University Hospital- Nairobi |
| KAR | Kenya Association of Radiologists |
| KMPDC | Kenya Medical Practioners and Dentist Council |
| ACCGME | Accreditation Council for Graduate Medical Education |

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## Abstract

### Background:

The current trend in Radiology training worldwide is to culminate in fellowship training. Drivers for this trend include the rapid innovation in radiology technology as well as changing job market dynamics that demand constant development in clinical expertise to improve employability and provide high-end quality services.

Multiple studies in developed countries have looked into the trends in radiology fellowship training for purposes of strengthening existing fellowship programmes and developing new programmes. In Sub Saharan Africa, there is paucity of literature on the level of interest in pursuing radiology fellowship training, preferred radiology fellowship courses and factors that determine the choice of subspecialty training. Additionally, knowledge on the available infrastructure to support fellowship training and perceived barriers to the development of radiology fellowship training is lacking. Bridging this knowledge gaps will inform and encourage further partnerships that would develop more local fellowship training depending on need.

**Objective:** To determine the demand, perceived barriers and available infrastructure for radiology sub specialization training in Kenya.

**Study design**: A mixed study method; A Cross-sectional study design was used to acquire quantitative data and semi-structured interviews of key informants was used for the qualitative data.

**Sampling method and sample size**: Total population sampling included all registered radiologists and residents in training totaling 200 participants. Purposive sampling of key informants to include consenting chairs of department in the radiology training institutions in Kenya and the chair the Kenya Association of Radiologists (KAR).

**Method**: Following Kenyatta National Hospital-University of Nairobi Ethics Review Committee (KNH-UoN ERC) approval, consent forms and self-administered electronic surveys were sent out to radiology residents and consultants in What'sApp groups of KAR and radiology training institution. Participants read and filled out the consent forms prior to filling the study questionnaire. The online questionnaire assessed the demographic details of the respondents such as gender, age, year of graduation as a medical doctor. Radiologists

additionally indicated their current clinical practice setting and whether they have fellowship training. Other aspects of the questionnaire assessed interest in radiology fellowships, factors that determine these preferences, perceived barriers to establishment of fellowship programs and imaging modalities available at centers of training and practice. Semi structured key informant interviews were carried out to explore the themes in study objectives. Quantitative data analysis was performed using Microsoft Excel Version 2010. Categorical data on the factors that influence choice of fellowship courses is depicted using graphs and charts and associations assessed using chi square. Descriptive variables which are quantitative in nature such as age, number of participants and the available training infrastructure is summarized using measures of central tendency such as mean, median and mode. Qualitative Data from the semi structured key informant interviews was transcribed, summarized and analyzed for themes.

**Results**: A total of 128 respondents were included in the current analysis. 59% were consultant radiologists while 41% are radiology residents. Additionally, three key informant interviews were carried out. There were eight sub specialized radiology consultants in the following fields: head and neck (1), breast imaging (1), neuroradiology (1), oncology (2) and interventional radiology (2). All sub specialists received this training outside the country. The other consultants (68) are general practiotners. Majority (77.3%) of the consultants practiced in urban centers.

Ultrasonography (100%), conventional radiography (98.4%), mammography (82.8%), CT scan (87.5%) and MRI (78.9%) were the most widely available imaging modalities. Sity-one percent (61%) of residents and general practice consultants indicated that they had always wanted to pursue subspecialist training. A further 6.6% and 4.1% did not want to pursue subspecialist training but were likely to do so in order to get a job and because of encouragement by their residency program. Respondents had interest in 12 subspecialist tracts with the most frequent being interventional radiology (33%), musculoskeletal imaging (9.9%), breast imaging (8.3%), neuroradiology (7.4%), pediatric imaging (6.6%) oncology (5.8%) and body cross-sectional imaging (5.8%). The subspecialty of interventional radiology was more frequently chosen by male trainees while the gynecological/breast subspecialty was exclusively chosen by female trainees.

Peers (33.1%), mentors (24%) and university websites were the main sources of information on fellowship training. Personal factors that were reported as extremely important included successful/enjoyable rotation during training (88.2%), strong personal interest (87.5%), and influential mentor or program director (55.5%). Work-related factors that were

reported as extremely or very important included direct impact on patient care (87.5%), Increased employability and advanced or a variety of imaging modalities (82.1%).

Ninety-six percent (96.1%) of respondents were in favor of fellowship training with reasons given being improvement of patient management (96.9%), increases research output (91.4%), assist radiology residency training (99.2%) and increase interest in sub specialty training locally (99.2%).

As for infrastructure, 87.7% of respondents indicated there are adequate case volumes for residency and subspecialty training while 35.9% and 21.1% indicated lack of adequate equipment and staff for subspecialty training. Only 29.7% thought that there is effort and good will from institutions for the establishment of local fellowships. Majority (91.4%) of the respondents indicated that international partnerships were necessary for the establishment of local radiology subspecialty courses.

The main themes extracted from the key informant interviews were: the need for continued medical education in Kenya, the growing demand and importance of subspecialty training in the Kenyan setting, the importance of mentorship and peer review in radiology training and practice, the need to restructure radiology practice in training institutions and large centers into subspecialties in order to improve clinical output and the need to develop academic and research interests radiology trainees.

**Conclusion**: Majority of radiology residents and general practice radiologists plan on pursuing fellowship training and often receive their fellowship information from mentors, peers and university websites Fellowship training is increasingly becoming crucial and building the capacity for local training will mitigate brain drain from subspecialized consultants who settle outside the country after qualification. There is need for robust efforts from local residency training programs as well as international collaboration for this to be achieved.

# 1 Chapter One

## 1.1 Introduction

Radiology as a medical specialty was created in 1895 with the discovery of x-rays by Wilhelm Roentgen (1). Since then, rapid advances in imaging modalities included the discovery of radioactivity in 1986, mammography in 1913, Positron Emission tomography in 1950, Ultrasonography in 1957, Computed Tomography in 1971 and Magnetic Resonance Imaging in 1977 (2).

In developed countries, radiology training programs were developed during world wars I and II after the widescale use of radiography for shrapnel localization and fracture characterization (3). Acknowledgement of the necessity to obtain even more knowledge and clinical skills led to fellowship training programs (4). By 1930s fellowship-equivalent positions were available in Europe with the first fellowship program in North America started in 1959 by Taveras in Neuroradiology at the University of Columbia (5).

Numerous systems based and modality-based fellowship tracts are now currently available with the trend towards increasing subspecialisation continuing (6). Most radiology residents now take 1 or more years of fellowship training before entering either academic or private practice (6) . Factors that influence the choice of training are personal and work related and include, to enhance employability and personal interest (7).

In Kenya radiology residency training was established in 1974 (8). There currently exists only one radiology fellowship in Kenya that had the first intake in 2020 (9). The technological advances and demand for further training and specialized clinical services in the country are similar to developed countries (10). General radiologists in Kenya are thus seeking fellowship training outside the country to meet these demands.

There is no Kenyan data on the level of interest, choice and factors that influence the choice of radiology fellowships amongst radiology residents and consultants. Further barriers and available infrastructure for setting up local radiology fellowships is unknown. Bridging these knowledge gaps is crucial for tailoring mentorships and partnerships that meet the local demand for fellowship training and set a framework for establishment of radiology fellowships in Kenya.

## 1.2 Literature review

### 1.2.1 Health Workforce status and availability of radiology services in sub-Saharan Arica and Kenya.

Shortage of healthcare providers is a global phenomenon and the greatest impact is in the low-income countries of sub-Saharan Arica (11). Attributable factors cited include civil wars, corruption, poor formulation and implementation of health and education policies, brain drain and concentration of the few health care workers in urban centers (12).

Kenya is among nations that have a crisis in health human resource including doctors. There are currently 7300 medical doctors registered by the Medical Practitioners and Dentist Board(13). 2,089 (36.9%) are specialists with the number of registered radiologists being a paltry 150 (13). With a population of 51.6 million, the doctor to patient ratio in Kenya is 0.14 to 1,000 against the recommended ratio of 1 to 1000 (6) while that of radiologists stands at 1: 389,255 (12). This low number of radiologists is reflective of other countries within sub-Saharan Arica such as Nigeria which has a radiologist to population ratio of 1: 566,000 (14). Attributable factors for radiologist shortage include poor understanding of the scope of radiology, better pay and prestige in other specialties such as obstetrics and gynecology, internal medicine, general surgery and pediatrics (15).

Radiology is an interactive field that cuts across all other medical disciplines therefore a dearth in radiology resources, both human and technical, is a pivotal point in disrupted health care. Inequalities in the availability of specialists across counties means that Kenyans living in marginalized counties lack access to specialized services (16,17). In addition to limited specialist services, there is inequitable distribution of radiology equipment in sub-Saharan Arica with state of the art imaging modalities available in urban centers and largely lacking in rural areas (18). Measures to spread out the limited radiology specialist services within urban and rural areas through Mobile Diagnostic Units (MDU), Picture Archiving and Information systems (PACS), Radiology Information System (RIS) and Hospital Information System (HIS) have been looked into in East African countries with promising results and await adoption by the key stakeholders (19,20).

### 1.2.2 Establishment and development of radiology training in developed countries.

Education is one of the of the three major pillars of the specialty of radiology, which also includes clinical practice and research (21). Radiology is faced with rapid innovation in radiology technology which demands constant development in training opportunities and practical experience to provide high level of clinical services (10).

In developed countries residency programs were developed and formalized in the early 19$^{th}$ century (14). By 1930s, fellowship-equivalent positions were available in Europe with the first fellowship program in North America being started in 1959 by Taveras in Neuroradiology at the University of Columbia (5). Fellowship training in developed countries has since grown with an approximate 80 to 94 % of radiology residents in the North America pursuing at least one fellowship training after their residency before entering academic or private practice (19,22). Subspecialty fellowship is offered in 55% (12 out of 22) European countries with less than 50% of radiologist in these countries travelling abroad for specialization (10). Most fellowship courses run an average of one to two years and the decision to pursue fellowship is arrived at by residents in their second, third or fourth year of residency and followed through within three years after residency.

According to research, reasons for the moderate to high interest in fellowships among trainees in developed countries include attaining clinical competence, gaining specialized skills and acquisition of marketable skills (23). In addition, intrusion of the radiology practice by artificial intelligence, sonographers, and other medical subspecialists performing regional ultrasounds, echocardiograms, vascular and interventional procedures demand that the radiology consultants match up or exceed the prevailing circumstances (24). Further, it is no longer possible for any individual radiologist to master and maintain the expertise and depth of knowledge required to provide the high-quality interpretation across all modalities and all body parts (25). Subspecialty training is therefore not only crucial in maintaining a proportionate workforce equipped to meet the diverse needs of patients but also safeguard the radiologist's career.

Beyond sharpening their clinical skills and improve job prospects, majority of surveyed radiology residents who have an interest in pursuing fellowship also show interest in teaching medical students or residents with institutions in developing countries recruiting and training fellows to fill in academic and research positions (7). This practice has seen fellows comprising most of the faculty in radiology residency and fellowship programs in western countries. This shift has seen better clinical skills being passed on and the enhancement of scholarly output

directly through the academic activities that fellows pursued in terms of research and publications (26).

Various studies have looked into the trends in fellowship training and the factors affecting the choice of fellowships among radiology residents in developed countries in an attempt to strengthen existing programs. These factors are both personal and work related, and include but not limited to strong personal interests, enjoyable rotation during training, spousal or family considerations, direct impact on patient care, advances in imaging modalities, projected income, teaching and training opportunities (27). Organ system-based fellowships tracts currently offered worldwide include interventional radiology, neuroradiology, abdominal or genitourinary body imaging, musculoskeletal, cardiothoracic or chest, nuclear medicine, breast, gynecology, pediatric radiology and oncology. A few centers offer modality-based multiorgan fellowships in ultrasound, CT and MRI while other centers offer non clinical fellowships in research and quality improvement (28).

### 1.2.3 Radiology training in Sub-Sahara Africa.

In Sub-Saharan Africa, radiology residency was first introduced in 1974 at the University of Nairobi (UON), Kenya (8) and in 1976 at the University College Hospital, Ibadan, Nigeria (29). To further bridge the gap in radiology services, a higher residency intake is seeing more radiologists being trained in East Africa with Kenya currently offering postgraduate training in Radiology in two additional institutions: Aga Khan University hospital (AKUH) and Moi University (MU).

Similar to their global counterparts, radiology specialists in sub-Saharan Arica are faced with the need to evolve not only to keep abreast with advancement in technology and offer specialized clinical services but also to have an edge that ensures job security. Subspecialty fellowship training programs are however not readily available in sub-Saharan Arica and are currently offered in only three countries; Ethiopia, South Africa and Kenya (9,30).

Ethiopia has subspecialty programs in pediatric radiology, adult body imaging and, cardiothoracic imaging, South Africa offers fellowships in interventional and pediatric radiology and Kenya offers training in interventional radiology (9,10,30). Radiologists in other countries within sub-Sahara Africa largely outsource subspecialty training. Some of the factors cited as hindrances to setting up subspecialist programs in developing countries include inadequate funding for equipment and low numbers of subspecialist faculty (10,24).

In Kenya, collaborations between local universities in other medical fields with international societies has seen the successful establishment of fellowship programs in cardiology, pediatric anesthesia, oncology, infectious disease and pediatric neurology (31,32). While job opportunities abound for generalist radiologists locally, the changing job market has invariably necessitated fellowship training to confer a competitive edge for Kenyan radiologists seeking to delve into academia, offer sub specialized clinical services and pursue research opportunities in the main public and private referral hospitals. Partnerships between local universities and international institutions through workshops run in the course of residency and scholarships and school fees subsidies offered for some external fellowship programs has in the past seen a slow but steady rise in the cohort of Kenyan residents seeking fellowship training in developed countries. International fellowship opportunities are however notably costly and highly competitive with limited capacity making them not readily available to absorb all the radiologists from Kenya seeking fellowship training. Further, the financial incentives for local fellows trained abroad to remain out of the country to work results to "brain drain" of the much-needed sub specialty services locally (30). In a move to build local capacity for radiology fellowship training, a partnership between RAD-AID, the University of Nairobi and the University of North Carolina Division of Vascular and Interventional Radiology has seen the establishment of a Fellowship in Interventional Radiology at the University of Nairobi that had its first intake in September 2020 (9). Other radiology subspecialties remain unexplored with few or no trained local fellows.

There is paucity of knowledge about the level of interest in fellowship training, influencers of choice of fellowship training, available infrastructure to support fellowship training and the perceived barriers to the development of local radiology fellowship program in Kenya. This knowledge is crucial in planning for mentorship programs and collaboration amongst local and international radiology community that would see the growth of specialized radiology services in Kenya.

### 1.2.4 Requirements for radiology subspecialty training.

Establishment of postgraduate radiology training programs is faced with three key hurdles: curriculum development, securing formal accreditation and acquisition of funding (30,33). A well-developed curriculum is crucial in ensuring quality fellowship training. Local key stake holders for curriculum development include the Kenya Association of Radiologists, local sub specialist radiologists, senior radiology faculty, institutional programs directors and departmental heads. The main aspects of the curriculum include specification of the entry requirements of trainees, duration of training, key competencies to be achieved at each level of training and outline of the requirements necessary for course completion (34). Due to the few number of local radiology subspecialists, coordinated efforts in collaborations with key international radiology societies and training institutions is indispensable in capacity building to establishment curricula that meet internationally acceptable standards (9,30). In Ethiopia, the pediatric radiology fellowship was set up through a four-year collaboration between the Addis Ababa University, Radiology Society of Ethiopia and the Children Hospital of Philadelphia. The partnership foresaw development of a curriculum, the initial training of the first pediatric radiologists as well as enhanced the pediatric aspects of residency training (30). After the curriculum is completed formal accreditation is essential to ensure credibility of fellowship training. This will entail application through the university academic committee and senate for approval by the Ministry of Health and KMPDC.

In education finance, the sources of funds and the size of the resources are key determinants of the quality of education (35). Funding for radiology postgraduate training is necessary for acquisition and maintenance of imaging equipment and staff salary payments. Residency fellowship funding in North America is a joint venture from federal government Medicare fund at 50%, hospitals and department funds as well as trainee's tuition (33). In Kenya, funding for postgraduate medical education has been through grants, scholarships, international collaborations and tuition payment by trainees. With dwindling federal government support, scholarships and grants in the United States have failed to offer a sustainable source of funding with the burden of funding falling on tuition thus limiting the operational efficiency of fellowship training (33). The same situation is mirrored in Kenya where funding for postgraduate courses falls mainly on scholarships and self-sponsored trainees. Proposed solutions that can be adopted locally include establishment of an education policy that would see consistent government funding as well guide the establishment of a national radiology trust that would receive cash inflow from grants and local radiologists (33).

# 2 Chapter Two

## 2.1 Study justification

Fellowship training is significant for the growth of radiology and is not only crucial in maintaining a proportionate workforce equipped to meet the diverse needs of patients but also safeguard the Kenyan radiologist's career (7)). Radiology fellowship training in sub-Saharan Africa, is still in its early stages and is available in only three countries: Ethiopia, Kenya and South Africa (9,10,30) Despite multiple factors cited as hindrances to setting up subspecialist programs (10,24)other medical specialties within Kenya have overcome these hurdles to set up fellowship programs (32)There is paucity of literature in Kenya on the preferred fellowship courses and factors that determine these choices among radiologists and radiology residents. In addition, knowledge on the available infrastructure and perceived barriers to setting up fellowship training in Kenya is lacking.

It is therefore paramount to understand the local demand and trends in fellowship choices as well as available infrastructure in order to lay a good framework for development of mentorship programs, collaborations and policies towards establishment of fellowship training.

## 2.2 Research question

What is the demand, perceived barriers and available infrastructure for radiology subspecialisation training in Kenya?

## 2.3 Study objectives

### 2.3.1 Broad Objective

To determine the demand, perceived barriers and available infrastructure for radiology fellowship training in Kenya.

### 2.3.2 Specific objectives

1. To determine the level of interest in the various radiology sub-specializations.
2. To determine the factors that influence choice of radiology sub-specialization.
3. To determine the perceived barriers to developing local fellowship training programs.
4. To determine the available infrastructure for radiology fellowship training in Kenya.

# 3 Materials and methods

## 3.1 Study design

The study was  mixed with a Cross-sectional study design used to acquire quantitative data and semi-structured interviews of key informants used for the qualitative data.

## 3.2 Study Location

An online questionnaire developed on the Survey Monkey platform was shared through WhatsApp to all eligible participants. Additionally key informant interviews were carried out via ZOOM.

## 3.3 Study population

Study participants were recruited from KRA as well as the three residency training institutions in Kenya: University of Nairobi, Moi University and Aga Khan University Hospital.

### 3.3.1 Inclusion criteria

Radiologists available in the Kenya Association of Radiologists database and radiology residents undergoing postgraduate training who consented to participate in the study and filled out the online questionnaire.

### 3.3.2 Exclusion criteria

Radiologists and radiology residents who did not respond or opt out of the online survey.

## 3.4 Sampling procedure

The quantitative arm of the study aimed to recruit a total of 200 participants through total population sampling. This was an estimate of the sum total of all the radiologists and radiology residents registered with KAR and residency training institutions.

Purposive sampling method was used to recruit key informants for the qualitative arm of the study. The key informants list was obtained from the KAR, UON, AKUH and MU

## 3.5 Research tools

An online questionnaire was developed based on previous publications (Barfett et all 2019, Mok et al 2015, Smith et al 2009). The questionnaire assessed the demographic details of the respondents including gender, age, year of graduation as a medical doctor. Radiology residents additionally indicated the year in residency training, and centers of training while consultants will indicate year of graduation from residency, current practice setting and whether they have fellowship training. Other aspects of the questionnaire included the proportion of residents and radiologists who plan on pursuing or have already attained fellowship training and factors that determine the choice of fellowship. Imaging modalities available at their centers and perceived barriers to establishment of fellowship programs will also be assessed.

Factors that influence the choice of fellowship course were divided into personal and work-related factors. These factors were assessed using a Likert scale. Personal factors examined included strong personal interest, successful/enjoyable rotation during training, intellectual challenge, spousal/ family considerations and exclusion of other specialties. Work-related factors included direct impact on patient care, advanced or a variety of imaging modalities, direct patient contact, flexibility of working hours, research and teaching opportunities, increased employability and better income.

A semi structures interview guide was used for key informant interviews conducted on Zoom. The interviews were recorded and thereafter transcribed in English. The sessions explored the themes identified in the questionnaire and also sought to identify themes unique to the Kenyan context that may not have been covered in the questionnaire.

# 4 Chapter Four

## 4.1 Data management and analysis

Microsoft Excel Version 2010 was used for statistical analysis. Descriptive variables which were quantitative in nature such as age, number of participants and the available training infrastructure were summarized using measures of central tendency such as mean, median and mode. Categorical data on the factors that influence choice of fellowship courses were depicted using graphs and charts.

Qualitative Data from the semi structured key informant interviews were transcribed, summarized and analysis done to identify various themes

## 4.2 Study results dissemination plan

The findings shall be published in a journal on medical education and an abstract or poster submitted for presentation in a conference.

## 4.3 Study limitation

The main limitation for the study is response bias where respondents who are more interested in fellowship training or those who have undergone fellowship training more likely to respond to the survey. Therefore, this study may have overestimated the number of residents and consultants who are planning to pursue fellowship training.

# 5 Chapter Five

## Ethical considerations

Institutional ethical approval was obtained from KNH-UON ERC. Participation was voluntary with an online consent form, Appendix 1, being filled out prior to filling out of the study questionnaire. No personal identifiers were obtained in the study with participants assigned serial numbers in the order of participation. Contact details of participants were obtained after ethical approval was given from mailing lists that were available at the training institutions as well as KAR database. These details are only accessible to the study investigators for purposes of this study.

# 6 RESULTS

## 6.1 General demographic characteristics

A total of 128 Kenyan radiology residents and consultants responded to the online survey giving a response rate of sixty-four percent (64%) Majority of the respondents were aged between 31 to 40 years (78, 60.9%), where the mean age was 38.6 (SD 8.4) years, and the minimum and maximum age being 27.0 years and 66.0 years. There were 55 (43.0%) males and 72 (56.3%) females with 57.8% of the respondents being consultant radiologists while 41.4% were residents.

**Table 1: General demographic characteristics**

| | | **Frequency *(n=128)*** | **Percent** |
|---|---|---|---|
| **Age** | ≤30 | 12 | 9.4 |
| | 31 – 40 | 78 | 60.9 |
| | 41 – 50 | 28 | 21.9 |
| | >50 | 10 | 7.8 |
| **Gender** | Male | 55 | 43.0 |
| | Female | 72 | 56.3 |
| | Non binary | 1 | 0.8 |
| **Qualifications** | Consultant radiologist | 75 | 57.8 |
| | Resident | 53 | 41.4 |

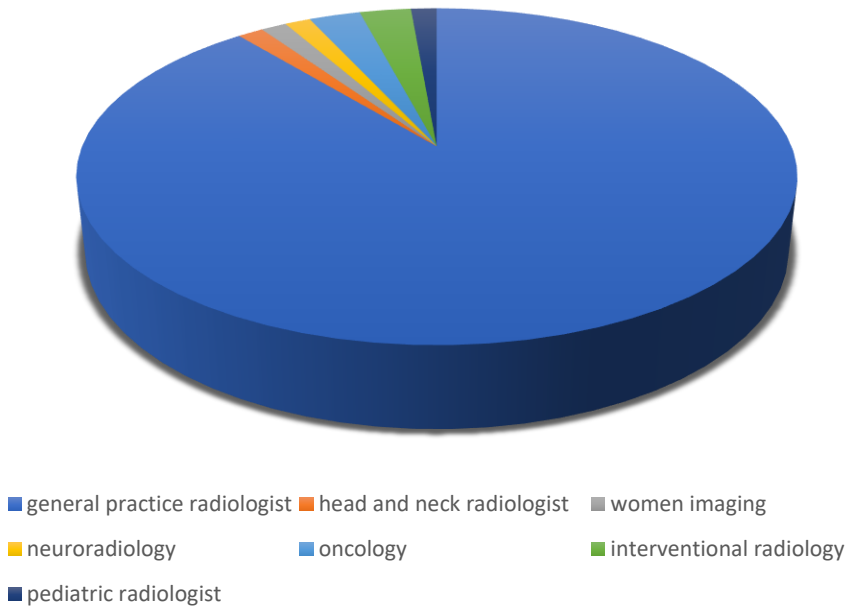
### 6.1.1 Consultant radiologists

Amongst consultant radiologists, sixty-five (86.7%) were general practitioners while eight(10.7%) and two (2.6%) were subspecialized and currently undergoing subspecialist training respectively. The subspecialists were two radiology oncologiststwo interventional radiologists, one pediatric radiologist (retired), one head and neck radiologist, one mammography/breast/women imaging radiologists, and one neuro-radiologists. The two of the consultants in training are studying interventional radiology.

**Table 8: Consultant radiologists details**

| | | Frequency |
|---|---|---|
| General practice radiologists | | 65 |
| **Sub-specialty** | Head and Neck Imaging | 1 |
| | Mammography/breast/women imaging | 1 |
| | Neuroradiology | 1 |
| | Oncology | 2 |
| | Vascular or non-vascular interventional imaging | 2 |
| | Pediatric radiology | 12 |
| | Currently in sub-specialty training | |

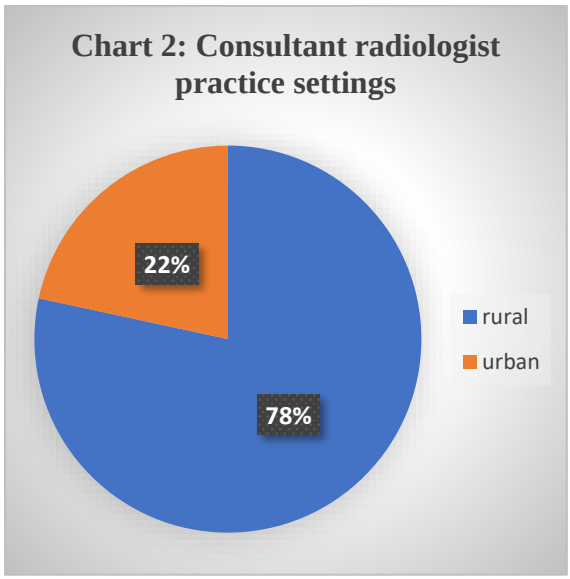
**Chart 1: Radiology sub-specialists kenya**



Fifty-eight (77.3%) consultants practiced in urban setting while the rest, sixteen (21.3%), had rural practices. One(1.3%) was retired and did not indicate previous practice settings.

**Table 3: Consultants location of practice**

| | | Frequency n 75 | Percent |
|---|---|---|---|
| **Practice settings** | Rural | 58 | 77.3 |
| | Urban | 16 | 21.3 |
| | Retired | 1 | 1.3 |

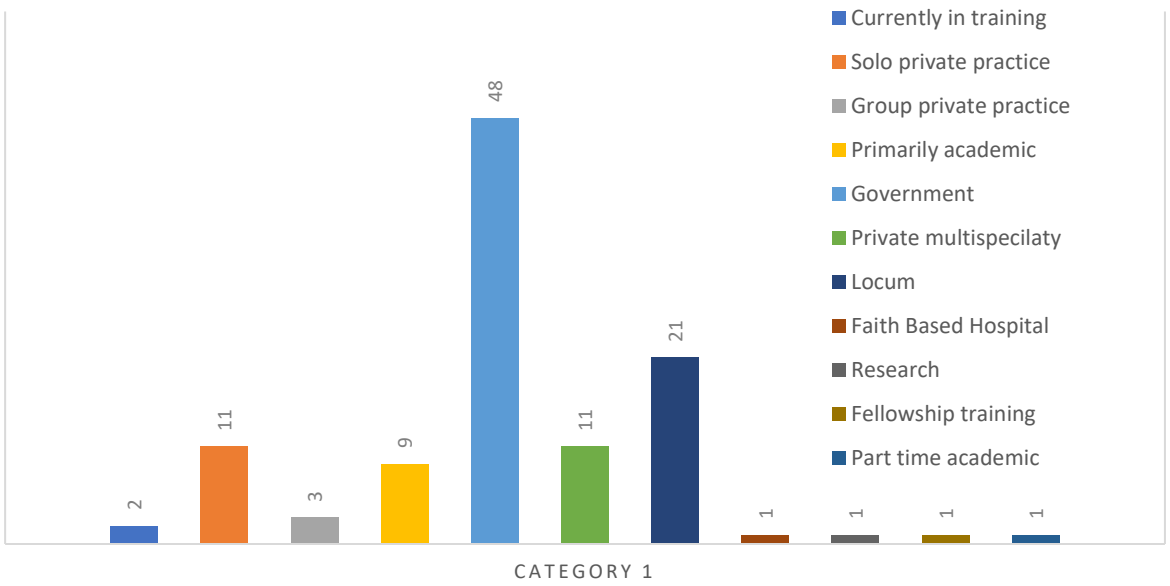



As per the practice setting, forty-eight (64.9%) of the consultants were under government employment with twenty-one (28.4%), eleven (14.9%) and nine (12.2%) being on locums, employed in private hospitals and having solo private practices respectively. Nine (12.2%) of the consultants were primarily academic.

**Table 4: Consultants practice setting**

| **Practice settings** | **Frequency** | **Percent of Consultants *(n=74)*** |
|---|---|---|
| Currently in training | 2 | 2.7% |
| Solo private practice | 11 | 14.9% |
| Group private practice | 3 | 4.1% |
| Primarily academic | 9 | 12.2% |
| Government | 48 | 64.9% |
| Private multi-specialty | 11 | 14.9% |
| Locum | 21 | 28.4% |
| Faith Based Hospital | 1 | 1.4% |
| Research | 1 | 1.4% |
| Fellowship training | 1 | 1.4% |
| Part time academic (adjunct faculty) | 1 | 1.4% |

**Chart 3: Consultant radiologist practice settings**



## 6.2 Training characteristics

Majority (115 ,90%) of the respondents received their undergraduate medical training locally with most (92, 71.9%) from University of Nairobi. Most consultants, fifty- seven (77%), received their radiology residency training at the University of Nairobi Nine (12.2%) and Six (8.1%) trained at Aga Khan university hospital and Moi school of medicine respectively. Similarly, University of Nairobi residents comprised a majority (75.9%) of the resident respondents. Across the local radiology residency training programs, majority of the responses were from PGY1 and PGY2 residents at 29.6% and 27.8% respectively.

**Table 5: Training characteristics**

| | | **Frequency** | **Percent** |
|---|---|---|---|
| **Undergraduate training** | Aga Khan University Hospital | 1 | 0.8 |
| | Charles University prague | 1 | 0.8 |
| | Egerton University | 1 | 0.8 |
| | Hubert Kairuki University Tanzania | 1 | 0.8 |
| | Kampala International University | 4 | 3.1 |
| | Kenyatta University | 6 | 4.7 |
| | Moi University School of medicine | 16 | 12.5 |
| | Pune University India | 1 | 0.8 |
| | Russia | 1 | 0.8 |
| | Saratov state Medical university | 1 | 0.8 |
| | Tumaini University Tanzania | 1 | 0.8 |
| | University of Nairobi | 92 | 71.9 |
| | University of Zimbabwe | 1 | 0.8 |
| | Voronezh State Medical University Russia | 1 | 0.8 |
| **Consultants institute of residency training *(n=74)*** | University of Nairobi | 57 | 77.0 |
| | Aga Khan University Hospital | 9 | 12.2 |
| | Moi University School of Medicine | 6 | 8.1 |
| | Makerere University, Uganda | 1 | 1.4 |

| | | | |
|---|---|---|---|
| | Muhimbili University of Health and Allied Sciences | 1 | 1.4 |
| **Residents institute of training *(n=54)*** | University of Nairobi | 41 | 75.9 |
| | Aga Khan University Hospital | 2 | 3.7 |
| | Moi University School of Medicine | 10 | 18.5 |
| | Retired | 1 | 1.9 |
| **Current level of residency training *(n=54)*** | PGY 1 | 16 | 29.6 |
| | PGY 2 | 11 | 20.4 |
| | PGY 3 | 15 | 27.8 |
| | PGY 4 | 11 | 20.4 |
| | Retired | 1 | 1.9 |

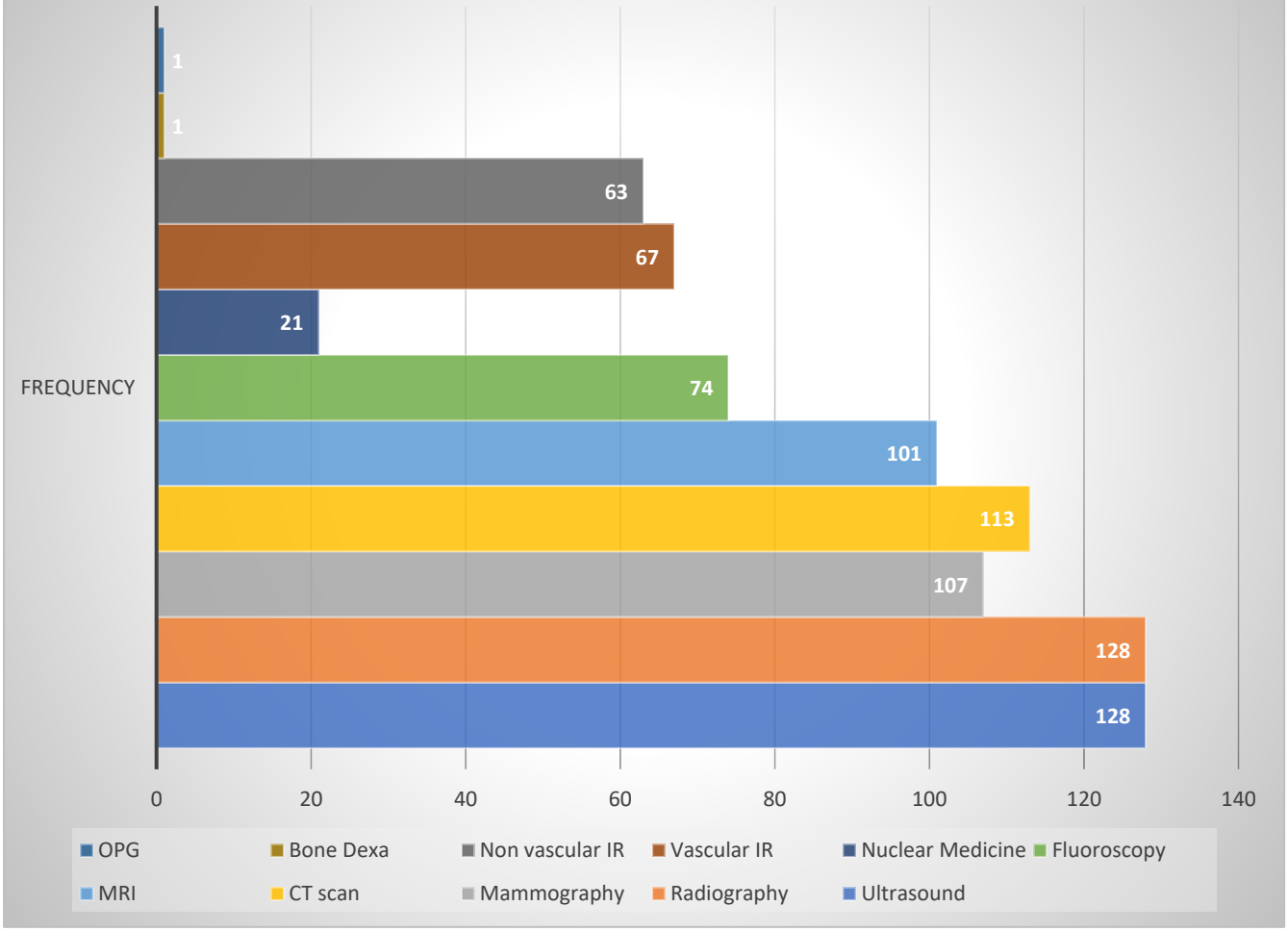
## 6.3 Imaging services

Sonography, conventional radiography, mammography, CT, MRI and fluoroscopy were widely available to the respondents while nuclear medicine was the least available imaging service.

**Table 6 : Imaging services available**

| | **Frequency** | **Percent of respondents *(n=128)*** |
|---|---|---|
| Ultrasound | 128 | 100.0% |
| Radiography | 128 | 98.4% |
| Mammography | 107 | 82.8% |
| CT Scan | 113 | 87.5% |
| MRI | 101 | 78.9% |
| Fluoroscopy | 74 | 57.8% |
| Nuclear Medicine | 21 | 16.4% |
| Vascular Interventional Radiology | 52 | 40.6% |
| Non Vascular Interventional Radiology | 63 | 49.2% |
| Bone Dexa | 1 | 0.8% |
| OPG | 1 | 0.8% |
| Interventional Radiology | 15 | 11.7% |
| PET Imaging | 2 | 1.6% |

**Chart 4: Accessiblility of imaging services**



## 6.4 Radiology subspecialty services

Seventy-five (58.6%) of respondents indicated had sub-specialty services offered at their centers. These services included vascular and non-vascular interventional radiology, neuroradiology, head and neck imaging, pediatric radiology, breast imaging, MSK ultrasonography and nuclear medicine..

**Table 7: Radiology subspecialty offered at center**

| | **Frequency *(n=128)*** | **Percent** |
|---|---|---|
| Yes | 75 | 58.6 |
| No | 53 | 41.4 |

## 6.5 Radiology fellowship training preferences

### 6.5.1 Sub-specialists

Amongst sub-specialists, the decision to pursue fellowship was arrived at after residency in four out of eight respondents Four madethe decision during residency. Two sub-specialists received their training in United Kingdom, one in Israel and one in Pisa. The other four consultants only entered the area of training as outside the country without indicating specific areas. The two consultants in subspecialist training are interventional radiology fellows at the University of Nairobi. Mentors (57.1%), peers (28.6%) and social networks (14.3%) were the key sources of information on fellowship training. Other sources included university websites and advertisements in journals.

The least duration of fellowship training was six months while the maximum period of training was two years. Majority of the fellowships run for 2 years.

The main influencer for choice of fellowship training among subspecialists were self-interest, peer influence and a gap in knowledge and practice of the same.

Four of the subspecialized radiologists were self-funded, three were sponsored by their employers while one was a paid fellowship position.

### 6.5.2 Residents and general radiologists

Seventy-four (61.2%) of radiology residents and general practitioner consultant radiologists have always wanted to and plan to pursue a radiology sub-specialty training. Eight (6.6%) do not want but are likely to pursue fellowship to get a job while five (4.1%) and thirty-one (25.6%) do not want and are unsure about fellowship training respectively. Vascular and nonvascular interventional radiology was the most preferred fellowship tract at forty (37.2%%) with other popular tracts being MSK 12(9.9%), mammography 10 (8.3%), neuroradiology 9 (7.4%) and pediatric imaging 8 (6.6%).

**Table 8: Plans to pursue fellowship and Fellowship preferences**

| **Plans to pursue fellowship** | **Frequency** | **Percent** |
|---|---|---|
| ***(n=121)*** | | |
| Always wanted and planned to do a fellowship | 74 | 61.2 |
| Do not want to, but likely necessary to get a job | 8 | 6.6 |
| Do not want to but encouraged by residency program | 6 | 4.1 |
| Unsure | 31 | 25.6 |
| Currently pursuing a fellowship | 2 | 2.5 |
| **Preferred fellowship *(n=121)*** | | |
| Musculoskeletal imaging | 12 | 9.9 |
| Vascular or non-vascular interventional imaging | 40 | 37.2 |
| Abdominal/body/ chest cross sectional imaging | 8 | 6.6 |
| Mammography/breast/women imaging | 10 | 8.3 |
| Neuroradiology | 9 | 7.4 |
| Nuclear medicine | 6 | 5.0 |
| Thoracic imaging | 2 | 1.7 |
| Pediatric imaging | 8 | 6.6 |

| | | |
|---|---|---|
| Ultrasound | 3 | 2.5 |
| Oncology | 7 | 5.8 |
| Undecided | 14 | 11.6 |
| Vascular or interventional radiology | 9 | 7.4 |
| Cardiac imaging | 2 | 1.7 |

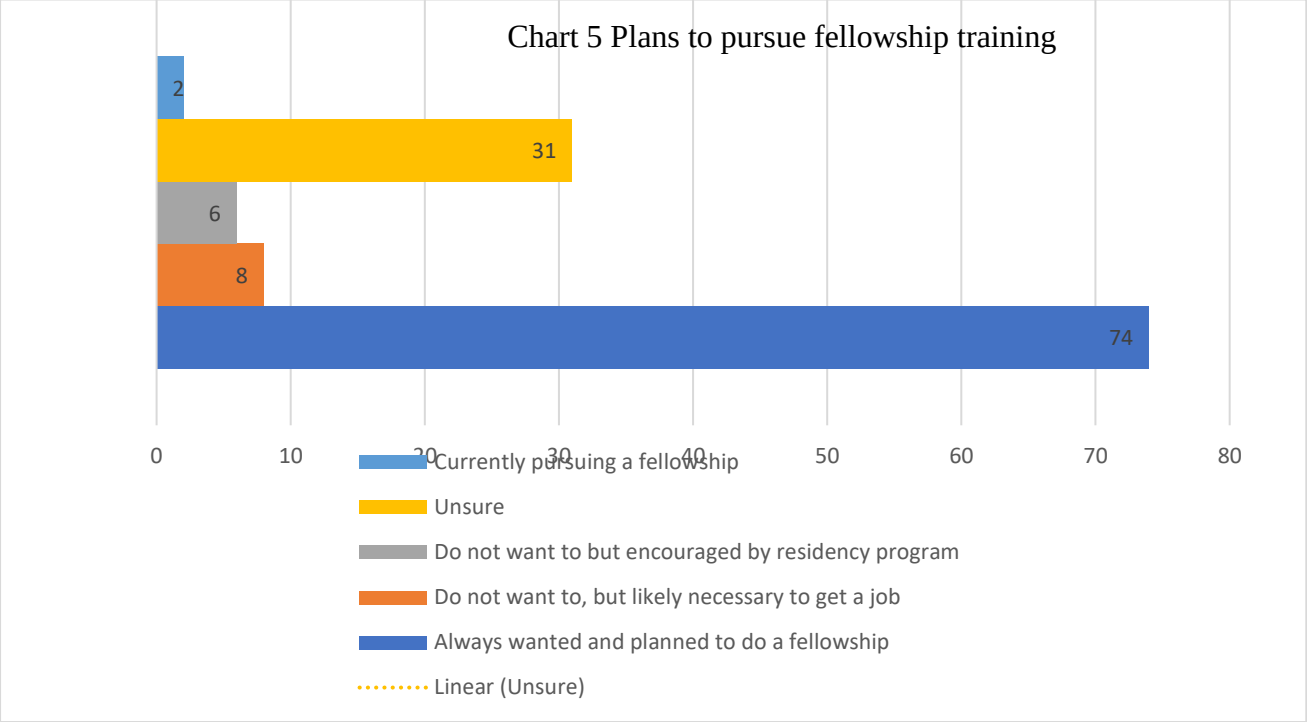


Chart 6: Radiology fellowship preference

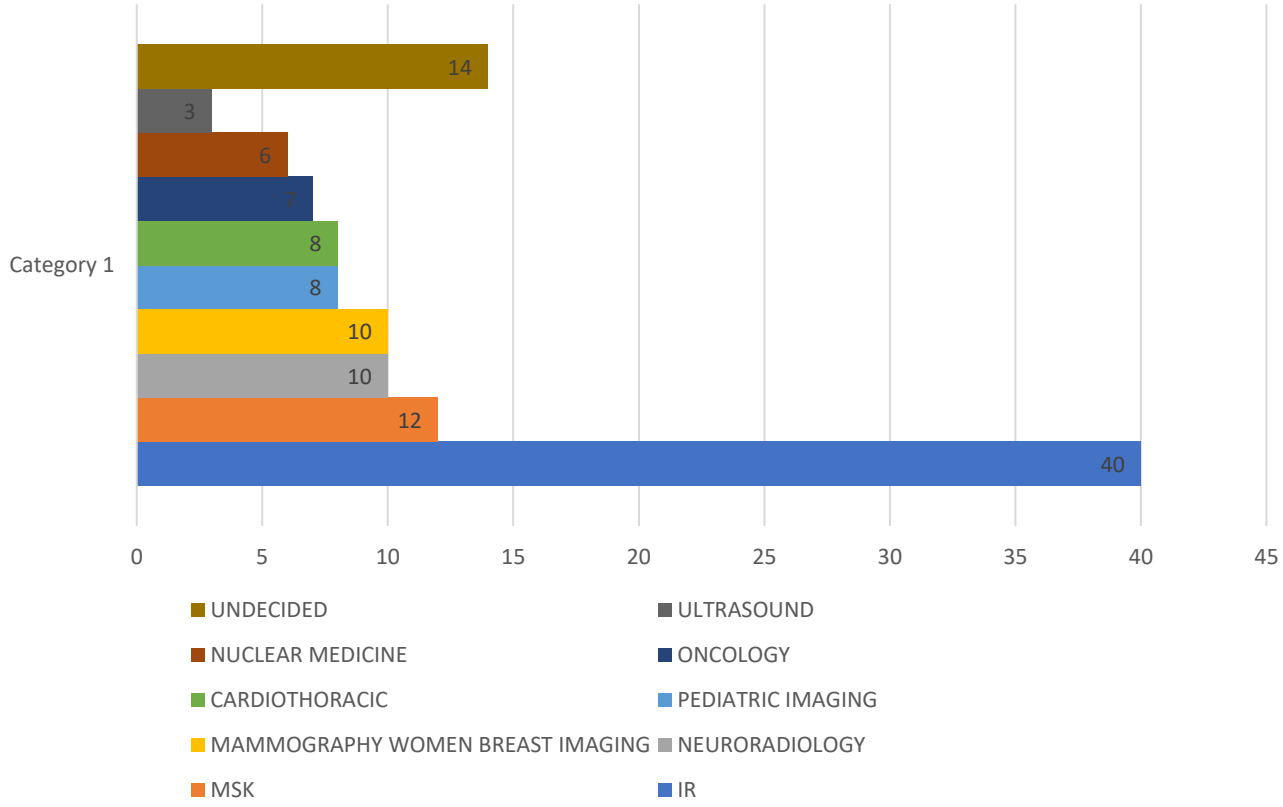


**Table 9 Choice of radiology subspecialty by gender and level of qualification.**

| | Gender | | Year of residency training | | | | consultant |
|---|---|---|---|---|---|---|---|
| **Subspecialty** | **female** | **male** | **1** | **2** | **3** | **4** | |
| **IR** | **13** | **27** | **8** | **6** | **5** | **3** | **18** |
| **n 40** | **32.5%** | **67.5%** | **20%** | **15%** | **12.5%** | **7.5%** | **45%** |
| **MSK** | **5** | **7** | **1** | | | **2** | **9** |
| **n 12** | **41.7%** | **58.3%** | **8.3%** | | | **16.7%** | **75%** |
| **Mammography** | **9** | **1** | **1** | | **1** | | **8** |
| **Breast** | | | | | | | |
| **Women imaging n 10** | **90%** | **10%** | **10%** | | **10%** | | **80%** |
| **Cardiothoracic** | **2** | **2** | | | **1** | | **3** |
| **n 4** | **50%** | **50%** | | | **25%** | | **75%** |
| **Neuroradiology** | **5** | **5** | **1** | **1** | **1** | **1** | **6** |
| **n 10** | **50%** | **50%** | **10%** | **10%** | **10%** | **10%** | **60%** |
| **Pediatric** | **7** | **1** | **1** | **1** | **1** | **2** | **3** |
| **n 8** | **87.5%** | **12.5%** | **12.5%** | **12.5%** | **12.5%** | **25%** | **37.5%** |
| **Abdomen** | **5** | **3** | | | **2** | **1** | **5** |
| **Body imaging** | | | | | **25%** | **12.5%** | **62.5%** |
| **n 8** | **62.5%** | **37.5%** | | | | | |
| **Oncology** | **4** | **3** | | | **1** | **1** | **5** |
| **n 7** | **57.1%** | **42.9%** | | | **14.3%** | **14.3%** | **71.4%** |
| **Nuclear medicine** | **4** | **1** | **2** | | | | **3** |
| **n 5** | | | | | | | |
| | **80%** | **20%** | **40%** | | | | **60%** |
| **Ultrasonography** | **2** | **1** | | | | | **3** |
| **n 3** | **66.7%** | **33.3%** | | | | | **100%** |
| **Undecided** | **11** | **3** | **2** | **3** | **2** | **2** | **5** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **n 14** | **78.6%** | **21.4%** | **14.3%** | **21.4%** | **14.3%** | **14.3%** | **35.7%** |

Similar to radiology subspecialists, residents and general radiologists indicated peers (33.1%) and mentors (24%) as their main sources on information on fellowship training. University websites (19%) and social networks (19%) ranked next and adds in journal came in last at 3.3%

**Table 10: Source of information on fellowship training for radiology residents and general practitioner**

| | | **Frequency** | **Percent** |
|---|---|---|---|
| **Source *(n=121)*** | Peers | 40 | 33.1 |
| | Mentors | 29 | 24.0 |
| | University websites | 23 | 19.0 |
| | Social networks | 23 | 19.0 |
| | Ads in publication and journals | 4 | 3.3 |
| | None | 2 | 1.7 |

## 6.6 Factors that influence radiology fellowship preferences

The relative importance of personal and work related factors influencing fellowship preferences in all respondents is shown in Table 9. The main personal factors were personal interest one hundred and twelve respondents (87.9 %) and enjoyable rotation during residency training one hundred respondents (88.2%).

Significant work related factors were ability to have direct impact on patient care one hundred and twelve respondents (87.9%), increase employability one hindred and five respondents (82.1%), Availability of advanced or a variety of imaging modalities and to get a better income each at ninety one hundred and twelve respondents nine( 76.6 %) .

**Table 11: Personal influencers**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Successful/enjoyable rotation during training | 9 (7.0) | 11 (8.6) | 8 (6.3) | 56 (43.8) | 44 (34.4) |
| Personal interest | 9 (7.0) | 4 (3.1) | 3 (2.3) | 26 (20.3) | 86 (67.2) |
| Influential mentor or program director | 10 (7.8) | 24 (18.8) | 23 (18.0) | 37 (28.9) | 34 (26.6) |
| Social or family considerations | 15 (11.7) | 32 (25.0) | 18 (14.1) | 28 (21.9) | 35 (27.3) |
| Financial constraints | 18 (14.1) | 29 (22.7) | 22 (17.2) | 21 (16.4) | 38 (29.7) |

*Strongly disagree (1), Disagree (2), Undecided (3), Agree (4), Strongly agree (5)*

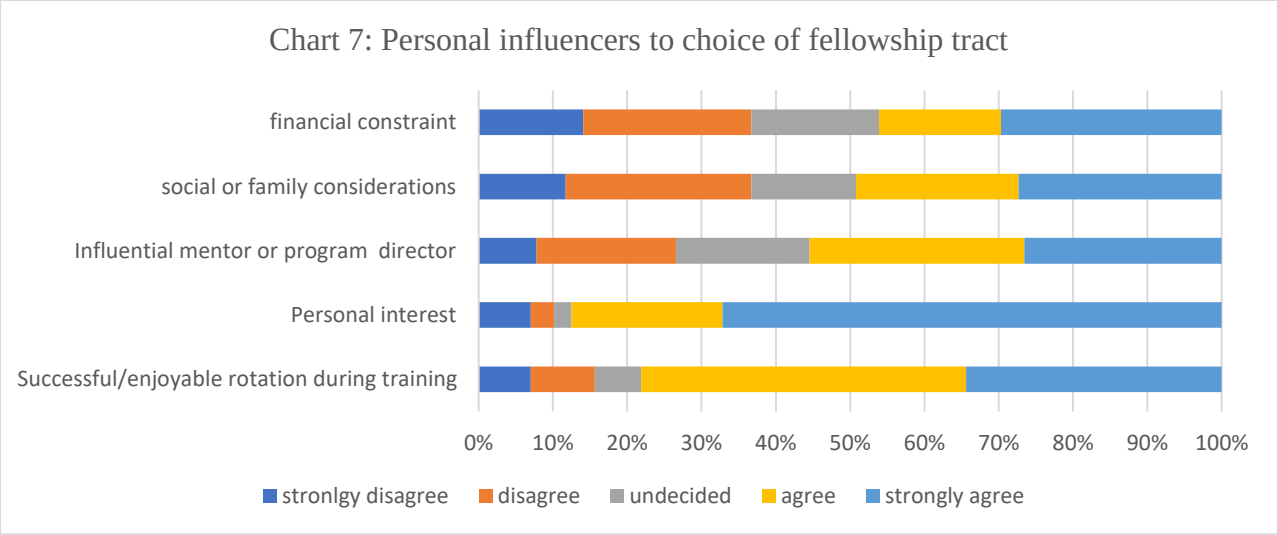
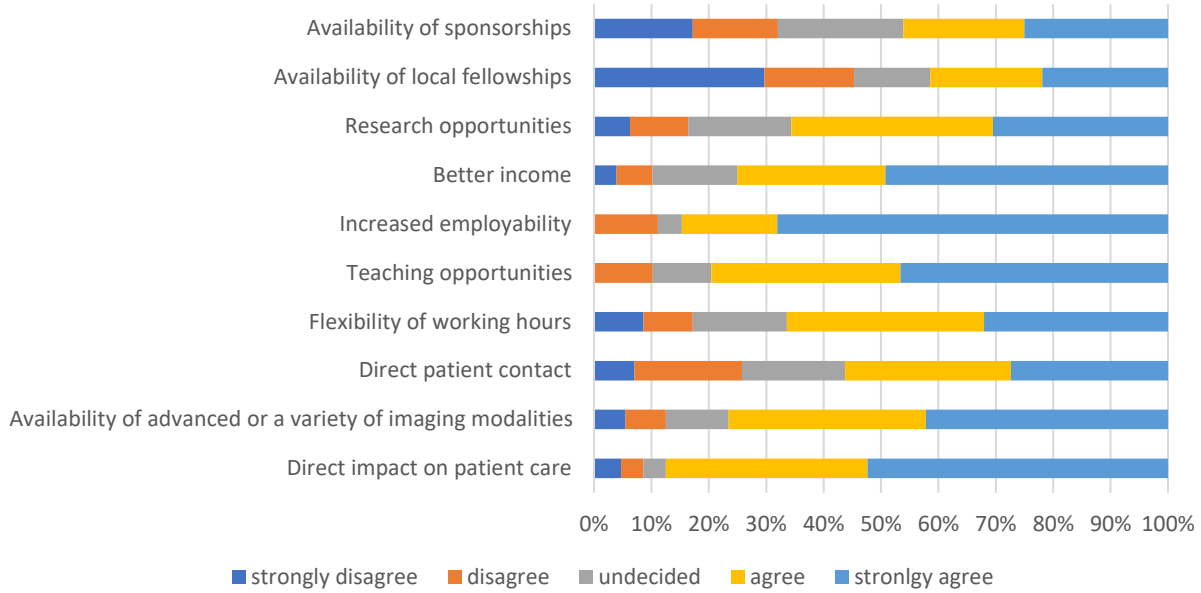


**Table 12: Work related influencers**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Direct impact on patient care | 6 (4.7) | 5 (3.9) | 5 (3.9) | 45 (35.2) | 67 (52.3) |
| Availability of advanced or a variety of imaging modalities | 7 (5.5) | 9 (7.0) | 14 (10.9) | 44 (34.4) | 54 (42.2) |
| Direct patient contact | 9 (7.0) | 24 (18.8) | 23 (18.0) | 37 (28.9) | 35 (27.3) |
| Flexibility of working hours | 11 (8.6) | 11 (8.6) | 21 (16.4) | 44 (34.4) | 41 (32.0) |
| Teaching opportunities | 9 (7.0) | 9 (7.0) | 29 (22.7) | 41 (32.0) | 40 (31.3) |
| Increased employability | 8 (6.3) | 3 (2.3) | 12 (9.4) | 49 (38.3) | 56 (43.8) |
| Better income | 5 (3.9) | 8 (6.3) | 19 (14.8) | 33 (25.8) | 63 (49.2) |
| Research opportunities | 8 (6.3) | 13 (10.2) | 23 (18.0) | 45 (35.2) | 39 (30.5) |
| Availability of local fellowships | 38 (29.7) | 20 (15.6) | 17 (13.3) | 25 (19.5) | 28 (21.9) |
| Availability of sponsorships | 22 (17.2) | 19 (14.8) | 28 (21.9) | 27 (21.1) | 32 (25.0) |

*Strongly disagree (1), Disagree (2), Undecided (3), Agree (4), Strongly agree (5)*

Chart 8: Work related influencers to choice of fellowship tract



## 6.7 Benefits fellowship training

One hundred and twenty-four (96.9%), one hundred and seventeen (91.4%) and one hundred and twenty- seven(99.2) respondents felt that local fellowships would improve patient management, research output, residency training and fellowship interest respectively.

**Table 13: Benefits of local fellowship programs**

| | | **Frequency (n=128)** | **Percent** |
|---|---|---|---|
| **Preference for local training** | Yes | 123 | 96.1 |
| | No | 4 | 3.1 |
| | I don't know | 1 | 0.8 |
| **Benefits of local radiology fellowship training** | | | |
| | | N 128 | Percentage |
| **Local training improve patient management** | Yes | 124 | 96.9 |
| | No | 0 | 0 |
| | I don't know | 4 | 3.1 |
| **Local training improve research output** | Yes | 117 | 91.4 |
| | No | 2 | 1.6 |
| | I don't know | 9 | 7.0 |
| **Local program benefit radiology training** | Yes | 127 | 99.2 |
| | I don't know | 1 | 0.8 |
| **Local fellowship increase interest in subspeciality** | Yes | 127 | 99.2 |
| | I don't know | 1 | 0.8 |

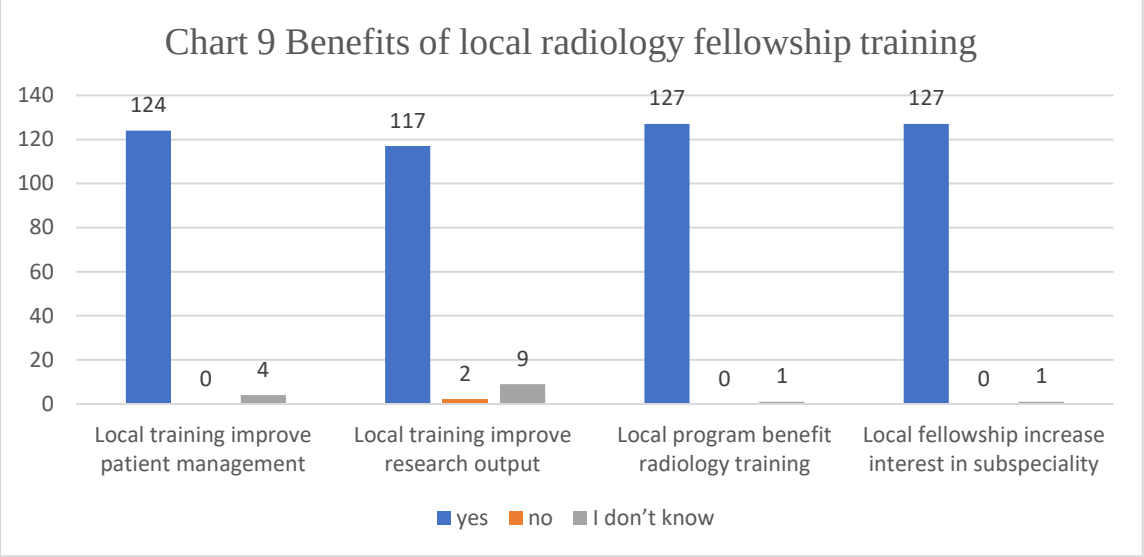


Chart 9 Benefits of local radiology fellowship training
140
120
100
80
60
40
20
0
124
0
4
117
2
9
127
0
1
127
0
1
Local training improve patient management
Local training improve research output
Local program benefit radiology training
Local fellowship increase interest in subspeciality
yes
no
I don't know

## 6.8 Barriers to set up local fellowship programs

Seventy (54.7%) of the respondents indicated there are inadequate equipment for fellowship training. Additionally, seventy-eight respondents (60.9%) of the respondents indicated there are inadequate staff for fellowship training One hundred and twelve respondents (87.5%) indicated that there were enough case volumes.

One hundred and seventeen respondents (91.4%) indicated that international partnerships were necessary for the set-up of local fellowships. Only thirty eight (29.7%) of the respondents indicated there was enough effort from stakeholders for set up of local fellowships.

**Table 14: Barriers to set up local fellowship programs**

| | | Frequency | Percent |
|---|---|---|---|
| **Adequate equipment** | Yes | 46 | 35.9 |
| | No | 70 | 54.7 |
| | I don't know | 12 | 9.4 |
| **Adequate staff** | Yes | 27 | 21.1 |
| | No | 78 | 60.9 |
| | I don't know | 23 | 18.0 |
| **Adequate case volumes** | Yes | 112 | 87.5 |
| | No | 8 | 6.3 |
| | I don't know | 8 | 6.3 |
| **International partnership** | Yes | 117 | 91.4 |
| | No | 4 | 3.1 |
| | I don't know | 7 | 5.5 |
| **Effort and goodwill** | Yes | 38 | 29.7 |
| | No | 54 | 42.2 |
| | I don't know | 36 | 28.1 |

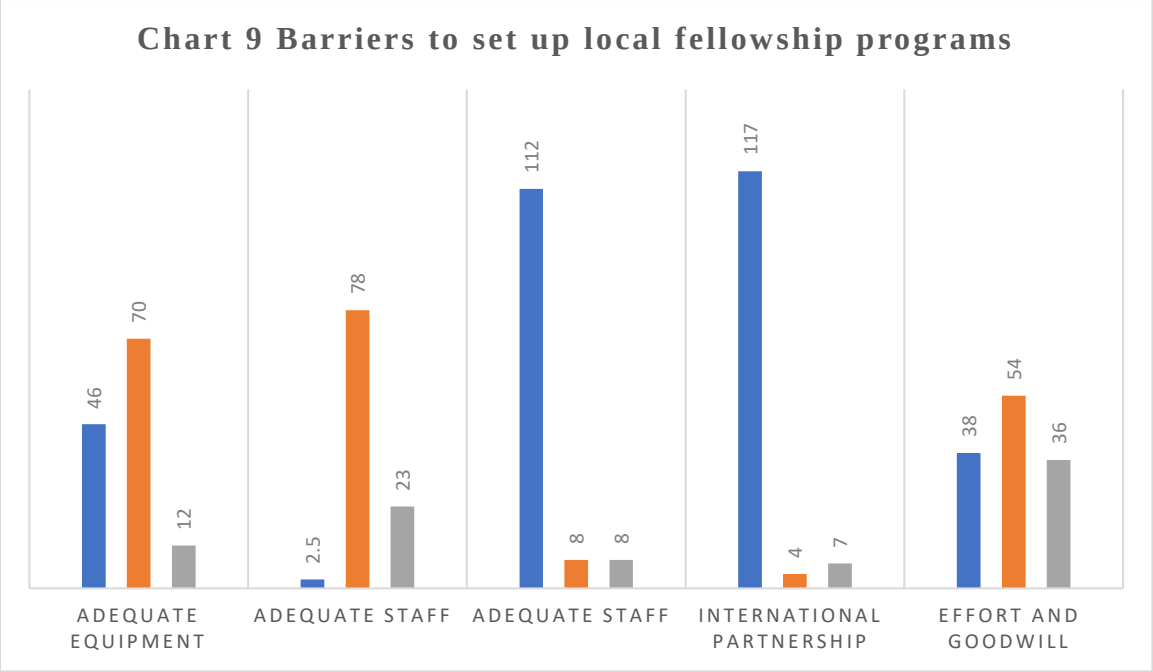


Chart 9 Barriers to set up local fellowship programs
46
70
12
2.5
78
23
112
8
8
117
4
7
38
54
36
ADEQUATE EQUIPMENT
ADEQUATE STAFF
ADEQUATE STAFF
INTERNATIONAL PARTNERSHIP
EFFORT AND GOODWILL

# 7 Key informant interviews

The following themes were identified:

## 7.1 Emerging market needs locally and internationally for Kenyan radiologists

The market dictates for continuous professional development through continuous medical education and sub specialization Continuous medical education sessions are organized by KAR and the teaching hospitals. Review of journals is also encouraged to refresh radiological knowledge and offer best practice medicine to the patient.

There is need for both general and sub specialized radiologists in Kenya. General radiologists are needed to meet. general population needs while Sub specialized services are needed more in the referral centers and teaching hospitals where there is a high concentration of physician subspecialty services and availability of comprehensive radiological services.

Sub specialization

> **KII1 page 1** "Increasingly internationally sub specialization is becoming important. Locally, sub specialization appears to be more limited to large hospital and teaching hospital facility but interventional radiology is useful across the board. other fellowship tracts while useful in the broader employment space are not yet as beneficial. The return on investment is not being seen yet unless someone is in a large hospital setting or a teaching hospital setting"
>
> **KII2 Page1** "I think when you look at it, it needs both aspects. You still need the General Radiologist especially to balance out within the region and also when it comes to sub specialized areas where patients are seeking second opinions and referrals"
>
> **KII3 Page 2** "Sub specialization is key together with the sub specialization there's also need to have updated protocols in place and these protocols being followed"

CMES, review, journal articles,

> **KII1 P3** "I think the national regulatory authority which is the Medical Practitioners and Dentist Council has mandated continuing professional development as part of renewal of licensing for all medical practitioners and therefore that in and of itself is adequate"
>
> **KII2 Page 2** "I can actually imagine that if you trained ten (10) years ago then there are things which have changed in certain areas but this continuous medical education meeting then we are able to improve on that".

**KII3 Page 2** "The key channel that we have as Radiologists who've qualified is CMEs that are set up by KAR. The other issue will be to encourage people to read review papers and journal articles I think the University should consider providing CMEs and I think they are already providing CMEs. One can get CPD points"

## 7.2 Ability of current radiology residency training sufficient to meet local and international clinical, research and academic needs

The informants all agreed that residency training, especially the clinical work is sufficient to meet local and international standards. There was note of need to emphasize the research and academic aspects of residency training with an aim to increase quality and quantity of research output and train residents who can take up academic positions after qualification.

**KII1 Page 2** "So with regard to clinical needs, yes, it is sufficient BUT I feel that it is not sufficient in that the academic side and the research side. exposure to research labs, exposure to international research collaborations and even multi facility research at least to the best of my knowledge is not something that is currently happening and not being given prominence in our radiology training. a desire for research radiology, there should be a sub specialty in research radiology. That does not exist. If there is a desire for academia, there should be emphasis in that direction with the option perhaps to sort of take units geared toward that. There should be collaboration between the universities and the national research organs, whether it is KEMRI and other research organizations"

**KII2 Page 2** "I believe so and I say this based on the experience we've had with our residents. Once they've finished training and they've been able to go and work in other countries and other institutions and we've gotten good feedback from that and even when they go for their elective turns like in the UK. So I think the training is quite robust and we are able to compete at a similar level to our international counterparts".

**KII3 Page 4** I think, we reviewed the curriculum and we ensured that we go through the different specialties of Radiology and to make sure that the core lectures in each of that is covered. I do think that our program has adequate content in it in terms of

Radiology, Research, practical exposure. In terms of the training, the main issue is the supervision, but also the other thing comes into personal initiative

# 8 Local trends in radiology subspecialty training among Kenyan radiologists? In terms of decision to pursue fellowship and fellowship tracts

## 8.1 Decision to pursue fellowship

All respondents stated that there was definite interest in radiology sub specialty training. Majority of the sub specialists in Kenya have trained externally. Radiologists who follow through on their desire for fellowship training have mostly been supported by their local institutions with few getting paying external fellowships. Without this support, the decision to leave their families and current work stations as well as high cost of fellowship and the uncertainty of academic recognition and financial remuneration once they return to Kenya discourages most from pursuing fellowship.

> **KII1 Page 4** "Yes there is. Most people who are leaving the MMed are keen to pursue one fellowship or another to distinguish themselves from the general population of general radiologists. So there is an increase appetite for it".

> **KII2 P 4** "People will be okay performing as general radiologists but there's still that desire for sub specialty training. They look at what is required of them including leave your family and you have to stop earning an income, settling in a new country for at least 6 months or up to a year while you pursue that sub specialty training. how is it going to improve my life? So you may see it in terms of a growth in academics but there are those who will say I will sacrifice all this but I don't know whether it will have a commensurate increase in income. Even if one is ambitious and they have that desire, that dream for further training in terms of their fellowships, it's just the accessibility that I think is lacking"

> **KII3 Page 5** "There's also the issue of we might bite off more that we can chew because it takes quite a bit of work to develop this, and we might offer them and still people might not turn up especially now with the new fee structure. I think people are more likely to turn up for IR because it is a high-income earner and then the other factor that

we have to put in is the duration; how much time are people willing to put aside for fellowship?"

## 8.2 Support for the development of local sub specialty programs, why and what are the benefits

The setup of local fellowships was unanimously supported. Advantages to the practice of radiology in Kenya include improved patient management, improved research activities and improve training of residents and medical students. There is also brain drain from trained specialists opting to work outside as opposed to build local capacity. Local fellowships will help mitigate this.

**KII1 Page 4**: "I would be in favor of it for a few reasons;

Number 1: It ensures that we develop our local skill set in training and practice of radiology.

Number 2: It would allow for those who are currently specializing to have avenues of entering into academic radiology and possibly research radiology.

Number 3: It would likely reduce the brain drain because when radiologist go out of the country to train in fellowships, the appetite to come back is reduced if they are offered opportunities that are more lucrative out there".

**KII2 Page 4** "Yes I would be much in favor and I am a big proponent of that.

I think by people pursuing their fellowship trainings a, you come back and you understand your local needs and you are able to build the numbers and

you first build a network of that multidisciplinary team that's required and the numbers that would be required for that fellowship training broad and coming back within the country helps us to build the capacity to set up that tract"

**KII3 Pages19, 20**: "I Am definitely in favor of local fellowship training because of what I've seen. I've gone out to do observer ship and I have seen that penetrating systems out there is not easy. You have to be registered by their board and one has to sit down and do all the exams. So, it's a much more tedious and sensitive process ? if one has a young family then again, those are things that they have to take into account.

Then at the end of the training, the likelihood of that person coming back to their country, unless they are bonded, becomes even lower. You are actually having a lot of Brain Drain at the end of the day because you are having very good Radiologists who have gone out and they are not coming back to Kenya. I am in favor of having local fellowships because we need to develop our capacity locally and develop then, the rest of the world"

### 8.3 Fellowship tracts

There has been need and interest for development of interventional radiology in KNH. This tract is most attractive because of the direst impact on patient management and financial remuneration IR training was started after local specialist were supported to get training externally and thereafter collaborated with RAD AID. Due to the limited expertise in these fields, mammographyand pediatrics also require capacity to be built. Fellowship training in these areas will aid in achieving this. Within the private residency training program, the department encourages residents to pursue fellowship tracts as per the hospitals needs with no emphasis on a particular fellowship tract.

**KII1 Page 3** "By and large most people who pursue fellowship trainings pursue opportunities out of the country due to first lack of options within and secondly also the cost of pursuing a fellowship locally where you have to pay fees as opposed to outside the country where you will be paid. The only local fellowship pathway that has recently started is the fellowship in Interventional Radiology at the University of Nairobi in collaboration with RAD-AID"

**KII2 Pages 4, 5** As a department we aspire to have specialist in the various sub sections and so it's encouraged that people pursue those particular areas. so I wouldn't say that there's a trend to one (1) particular subspecialty and there's been a variation in terms of subspecialties people have pursued and especially to meet the gaps that are there within the department.

**KII3 Pages 4, 5, 6, 7** So, the needs assessment has shown that there's need for IR. What I've noticed is that many of the residents even during their training wanted to do Interventional Radiology. IR definitely has a great impact but this one was a little bit more specific in terms of that therapeutic component attached to it or for patients who

are terminal you could make their lives a little bit better. Additionally, they had already separated the rooms out for IR. There were already externally trained people and so, there was some nucleus of IR specialists. Once you have that nucleus, then it makes it easier to get an international collaboration now to strengthen it further and start a program. There is a need especially for Breast Specialization. Breast like IR is reorganized a bit in the department in terms of we do have a mammography machine. we do have ultrasound probes in the department upstairs which we can actually use. I know a lot of people do feel challenged when they have to look at those mammograms. So, I think there is a need to have either certification or a fellowship in breast imaging and more so because I think almost every county has a mammogram machine that has been brought in by the MES project. I think all the Level 5 hospitals too so it's good that we churn out Radiologists who have adequate knowledge in breast imaging

Another key area is definitely Pediatric Radiology. Many people tend to avoid looking at imaging children or even reporting the images. The children tend to be fairly different from the adults. The protocols are also different, and this is an issue that really requires to be developed. So, if we had a public hospital geared for children which had its own radiology department then I think this definitely a fellowship that would be long overdue. I think the way we manage our children would be much better.

### 8.4 Availability of infrastructure in terms of imaging equipment and procedures, picture archiving and storage system (PACS), case volumes and staff to support training of both residency and radiology fellowship in Kenya?

Aside from nuclear medicine, all imaging modalities are available within the teaching and referral hospitals. Teaching institutions that are in partnership with referral hospitals are however heavily reliant on hospitals to train residents as they lack functional imaging equipment. This can be limiting as often times the focus from the hospital arm may be heavily service delivery based and less academic or research.

Restructuring of clinical work to be specialty based and increase of workstations and increasing the capacity of the PACS system to include all modalities is likely to improve patient service delivery, improve residency training and ease transition into fellowship training

Case volumes were noted to be adequate across the teaching hospitals but varied in terms of dominant patient characteristics Private institutions were noted to offer more emergent IR procedures and screening radiological services with the government referral centers handling more of oncological cases and non-emergent vascular and non-vascular IR procedures.

Available staff are adequately trained. Within the private training institutions there is adequate faculty to trainee ratio. There is a shortage of trainers within the government institutions

> **KII1 Pages 5,6** "Current there are three (3) residency training programs in Kenya. The Aga Khan University program has the highest support. The residents are paid and they have very current equipment with a very robust support structure around them. The next best supported training program is MTRH(Moi Teaching and Referral) in that most if not all of their residents are sponsored, so they don't then have to work(study) during the day and moonlight at night".
>
> The University of Nairobi in and of itself owns or controls very little by way of radiology infrastructure and therefore rely on Kenyatta National Hospital for more advanced work for example interventional radiology, CT and MRI Secondly, there's a large number of residents who are self-supporting and what that then means is that in addition to the academia, dissertations and clinical work load, they then have to find time to handle raise money for themselves and their families. That is a huge challenge Case volumes depend on the hospital. Kenyatta will have an increased burden of oncology simply because it is a referral hospital. Aga Khan which is predominantly private. has more preventive and promotive healthcare. MTRH also may have a different spectrum
>
> And what is the minimum required workload to achieve adequate fellowship training? So the only fellowship training that we currently have that's running is the International Radiology Fellowship at the University of Nairobi to my knowledge and in that regard when I look at the number of faculty, the faculty to"

> **KII2 Pages 7,8** So in terms of infrastructure I think we have grown. Now in many of the places. you will find the CT scans, MRIs, Radiograph, Ultrasounds and all the other imaging modalities and now we have at least two institutions in the country which have Pet CT imaging so that also helps us in terms of molecular imaging. So equipment wise,

I think we are pretty much ready and if we don't even have the equipment, we can make a case for it.

Infrastructure; I think we've made a big headway in that direction and we can still do more and I think in terms of like reading material and resources, now they are more readily accessible online and so I think we have all the ingredients that will help us offer fellowship trainings I think we have been very fortunate in that we are able to retain a lot of residents who have finished their training programs as instructors. That helps them get mentorship in the years that they would like to sub specialize in terms of fellowship

The other aspects would be in terms of the human resource that you would require and much younger people who come for fellowship training, you've also have networks where they've trained. You will find a lot of the people that you train with there are very willing to support you in setting up even your own local practice. So, in that aspect, I think from our point we have adequate faculty

**KII3 Pages 11. 12** "I think a missing link is having a PACS system for the entire Radiology Department. I really think the basic infrastructure we really need now is a very good Picture Archiving and it should come with adequate capacity. If it can combine with the hospital information system whereby, we can now get the history, the lab works, the pathology, it would really improve on our reporting. I think that is definitely a missing link in terms of infrastructure We do need also more personnel. So, in terms of the equipment there is of course some modalities still missing in KNH because we can't do nuclear medicine. That becomes a big area that is missing for us. Then of course we do need more workstations Then also the need of personnel segregated into the different sections. We need to reorganize KNH into specialties so when it's in specialties, then one would not feel like they are only in ultrasounds then we would have both ultrasound, CT, MR, Fluoroscopy being an area and that would really

help the patients".

## 8.5 Support from regulatory framework and barriers in setting up local fellowship training

It was noted that there were elaborate frameworks for the setup of local training programs in local universities. The onus is on the departments to identify need areas and initiate processes as well as seek out international partnerships to streamline the programs with internationally acceptable standards.

> **KII1 Page 7** : The support framework from how I understand it is one where the person who is interested in setting up a fellowship training bears the bulk of the burden to mobilize resources, get the faculty and fulfill the requirements of the commission of university education. In that regard I think the support is not adequate. There should be more effort put in by government, more effort put in by the training institutions, more collaboration set up

> **KII2 Pages 9, 10** "When it comes to private institutions such as ours, there have like a way or structure in which they conduct their further training of faculty development and needs. So in that aspect when you do need a faculty to pursue a certain line, there are ways to cut that out. There's enough support and I think maybe sometimes from a government standpoint and my experience is that they need the people on the ground to really guide them to understand what is happening on the ground because it's you that deals with the patients from day to day basis

> **KII3 Page** 12 At the end of the day, it will be the department that will be tasked and then the leadership of that department would be the ones who would spearhead together with the rest of the faculty when it comes to any training. The person who would be tasked will be the Chair of the department together with faculty in terms of developing the curriculum. the Commission of University Education again also have the goodwill. They have put standards in place, and I think as long as you follow these standards, there are templates in place. what are your learning objectives? What are your learning outcomes? Those are things that you have to sit down and develop. Who is teaching? Who is going to be the Program Director and take the lead in it? That sort of thing. And where are you going to do the training? Are the facilities there? Are the books there? Are the journals there? So, by the time you go through that checklist, you are able to even gauge for yourself. Are you in a position to start it or not?"

## 8.6 Mentorship

Mentorship is noted to be crucial in radiology not only to guide clinical practice but also career progression and personal growth.

> **KII2 Page 8** "We retain a lot of our former residents as programs as instructors. They get mentorship in the years that they would like to subspecialize in terms of fellowship from those who have gone and done their fellowships and come back. I think in every area there's someone who has a particular interest, a junior faculty so that in itself creates room for growth in terms of the department and building faculty to support the various fellowship programs".

> **KII3 Page 3**:" Peer Evaluation. We evaluate one another as peers for just continual growth to continue maintaining standards within the Radiologists. When I talk about peer evaluation, it is not something in terms of putting down someone to show them that they do not know, but a way in which all of us come and are there for the sake of the patient"

## 8.7 Need for international partnerships

All respondents intimated the need for international collaborations for the development of local fellowship training.

> **KII1, Page 8** I think they are, simply because we are still building our capacity in regards to high level trainers. So international fellowship collaborations are
>
> absolutely necessary and this is not something unique to our country. It's done
>
> world over. There are exchange programs done even in the first world between
>
> Europe and the USA where certain faculty or certain skills get to exposure to
>
> other fellows and vice versa.

> **KII2 Page 8** I think we can still double up with local and international faculty. Infrastructure; I think we've made a big headway in that direction a fellow ratio is adequate because they are taking two (2) fellows a year currently

> **KII3 Page 16** I think so. Even when we began our Radiology training in 1974, we had already an international collaboration then. So those are examples to show that really, we do need international collaborations to make sure that we are moving forward and

at the end of the day you have to be benchmarking and implement best practices. For the collaboration would assist us with benchmarking, assist us to see what the best practices are, helps us to learn with others who've walked the journey, to see what we can do and also to adopt and adapt into our situation.

# 9 Discussion

## 9.1 General demographic characteristics

The response rate of this study was 64% with 128 responses out of a targeted 200 respondents. Similar studies on the demand and factors influencing the choice of radiology fellowship tracts in Nigeria, Saudi Arabia and Canada had 117, 105 and 103 responses respectively. Response

rate from Nigeria and Canada were 87% and 31% respectively with that of Saudi Arabia not given (7,27,36)

From an analysis of 365 medical surveys published between 2006 and 2019 the response rate was variable with an average response rate of 45% and a standard deviation of 25% (37). Health care professionals are known to have lower response rates compared to the general public (23). Reasons for lower response rates from physician surveys include busy schedules, perceived lack of importance, concerns about confidentiality and bias of the survey, either in general or for specific questions, survey fatigue from the large number of requests they receive (38). Nevertheless, surveys remain an essential data collecting tool on doctors' work arrangements, clinical practice, career plans, work–life balance, and other issues where representative data is required to ensure adequate medical workforce planning and improve the quality of clinical care (39).

The response rate to the online survey in this study is comparable to similar studies and is an indicator of similar levels of interest in radiology fellowship training internationally and among Kenyan radiology residents and consultants. The main limitations to surveys is non response bias ((37)). Offers in literature to improve the survey response rates generally fall into either design- or incentive-based interventions and include monetary and nonmonetary response incentives, personalized mailings, reminders and mixed study design methods (23). This study had a mixed study method, an online self-administered survey and the participation of key informants who allowed an in depth exploration of the study question thus strengthening the study power. Additionally, periodic reminders increased the study participation.

The gender ratio of the respondents was 1:1.3 with slightly more women responding. This ratio is not representative and may be due to a higher response rate from female participants in this study. The current radiology consultant gender ratio in Kenya stands at 1:3 in favor of males (13). In similar studies, Nigeria, reported a response ratio of 2.67: in favor of males and Saudi Arabia, reported one third female representation (27,36). These countries similarly had more male radiologists. The under representation of the female gender was attributable to fewer female radiology residents and consultants not only in clinical practice but academia and leadership positions of radiology organizations (40).

A recent survey of 29 professional radiological organizations in 26 countries indicated that, based on the organizations' membership compositions, approximately 33.5% of radiologists were women (41). This proportion varied widely between countries and was lowest in the USA,

at 27.2%. In Romania, Spain and Thailand, women made up more than 50% of radiologists, and in a majority of countries, they accounted for at least one third (41). Possible causes for this are inequality in education opportunities, fear of ionizing radiation among women and lack of role models and mentors (27,36,41).

## 9.2 Consultant radiologists practice location and settings

More than three quarters of the consultant radiologists practiced in urban and metropolitan areas. A previous study established that majority of radiologists in Kenya worked in urban settings with three quarters concentrating in three major cities (42). This distribution is attributable to access to multiple imaging modalities within urban centers (43). A bigger work load in the referral hospitals and main private hospitals translates to higher remuneration for locuming consultants or those who are under fee for service contracts. To mitigate this uneven distribution of specialists, the Government of Kenya attempted to develop new standards to improve working conditions in the health sector and retain staff by offering review and increase in salaries, offering hardship allowances, providing sponsorship for postgraduate training (44,45). Despite this, the pay disparity, poor work conditions with downed medical equipment, limited career growth (or unclear career progression) as well as concerns about safety and security have ensured persistently fewer radiologists in rural areas (44). Accessibility and standardization of radiological services in rural areas, where three quarters of the population in Kenya is located, still remains a challenge(46).

Majority (67%) of the consultants who participated in the study are under government employment. This can be explained by government sponsored residents being bonded to work in government facilities for a number of years after graduation as service for the sponsorship (17,44). Over time however, there have been reduced employment opportunities for doctors post medical internship and post subspecialty training by the central and county governments with employment after being subject to availability of vacancies in the health sector (47). This trend is the reason why senior specialists are under government employment while more recently qualified consultants are working on locum basis and in private institutions as opposed to being employed by the government as seen from the responses of this survey.

Nine consultants indicated being primarily academic with one other working as a part time faculty. This figure is in stark contrast to the number of instructors needed to train the increasing number of residents admitted for radiology training. “Existing faculty also currently bear the brunt of training undergraduate medical students and residents from other specialties who require some basic knowledge of radiology” (KII3, Page 4). Reasons cited for the low

number of faculty in Kenyan universities include inability to attract and retain competent staff due to adverse budgetary limitations as well brain drain syndrome and better remuneration and job satisfaction from nonacademic work (48).

Another attributable reason for the low number of radiology in academia is, residency training in radiology is heavily invested in churning out clinicians in order to expand the existing body of radiologists in the community. There is less emphasis on mentoring academicians and researchers. This was identified in the key informant interview: "I think there's a need to broaden the base of training so that we can get academic radiologists who can then transition into being lecturers as opposed to everyone being a clinical" (KII1, page 8).

Only one respondent indicated their practice setting as primarily research. Within local training institutions, research is a mandatory requirement for residency, subspecialty and doctoral qualifications (10). Consultants within the referral and training institutions actively participate in supervising trainees in their research work in addition to publishing their own research work. "More however needs to be done to build research capacity through local multifacility research collaborations and international research partnerships. In the same vein, outside clinical work, subspecialties in purely research and academia can be considered with the available human and infrastructural resources" (KII1, page 2). Mok et all also noted the need for more to be done to encourage research work outside what is required for specialty and subspecialty qualification in order to help trainees reach their full potential and advance the future of radiology (7). Furthermore, to ensure the future of radiology remains as bright as the past, it is important for radiologists to continue promoting their specialty to medical students, the general public and other medical specialties. One of the methods of accomplishing wider recognition is by conducting and publishing high-quality research and increasing public awareness, and educating the current residents to become the new leaders in the field is an excellent place to start. importance of research, research fellowship (7).

### 9.3 Imaging services

All respondents had access to sonography and conventional radiography services while more than three quarters of the respondents had access to CT, MRI and mammography services at their training institutions or places of work. Fluoroscopy and interventional radiology was accessible to half of the respondents.

In a study Muthoni et al, general radiography and sonography were the most accessible imaging modalities. Nairobi is the only region with the full range of imaging modalities as well as the highest total number of units per million of the population for each modality countrywide, followed by the Coast and Central regions which have the second and third highest resources. The bulk of the equipment in these areas is in the private sector (43).

In this study, nuclear medicine was available to a third of the respondents. This is not representative of the Kenyan setting as respondents were majorly residents, faculty and clinicians working in urban centers, where this imaging serviceis readily available. Muthoni et all similarly reported Positron emission tomography-computerized tomography as the least accessible imaging modality in Kenya, only being available within Nairobi (43). The same observation was noted in other countries within the region. Zimbabwe, Tanzania, Zambia and Uganda do not have PET/CT scanners, and PET/CT being the least available modality in South Africa in both public and private sectors(18,49,50).

When compared to other countries in the sub-Saharan region Kenya has greater resources than Tanzania, Zimbabwe, Zambia and Uganda in the public sector across all imaging modalities, with the exception of general radiography where Zimbabwe and Zambia have approximately 1.2-fold more units (43)

Worldwide, an estimated 50-67% of the world´s population has no access to basic radiological facilities, with the majority living in the rural areas of low- and middle- income countries (LMIC) (18,51)

The overall increase in the number of diagnostic radiology equipment in comparison to data published by Korir *et al.* in 2013 can, to a large extent, be attributed to the MES, a public-private partnership project (PPP) introduced in 2016, that has equally resulted in availability of more imaging modalities in the public sector with a relatively uniform distribution of resources across all eight regions (52).

The increasing accessibility of imaging services is a good performance indicator for the Kenyan health system as diagnostic imaging is of great value in individual patient management and health care systems as a whole (53)

## 9.4 Training characteristics

### 9.4.1 Undergraduate and post graduate training

Ninety-eight percent (98%) of the respondents received their undergraduate and postgraduate training within the sub-Saharan region. Attributable reasons include increased local medical colleges (54), availability of sponsorships and subsidized fees (35,44) as well as psychosocial support from families. Additionally, the establishment of a wide array of imaging modalities (43) and high patient volumes allow exhaustive coverage of postgraduate radiology coursework. The general tedious and expensive process of integrating into international training institutions for undergraduate and residency training is a major deterrent for training outside the region.

It was noted from the key informant interviews that current radiology residency training is sufficient to meet local and international clinical and academic needs "Once the residents have finished training and they've been able to go and work in other countries and other institutions and we've gotten good feedback (KII2 page 2).

## 9.5 Subspecialist training

Eight Kenyan subspecialist radiologists responded to the survey, all having trained outside the country. The reason for the outsourced subspecialty training is the lack of Kenyan fellowship training programs ((10,55)). This is in contrast to developed countries where 80% to 90% of radiology residents pursue fellowship with training offered in fifty five percent (12 out of 22) European countries with less than fifty percent of radiologist in these countries travelling abroad for specialization (10).

The low number of local subspecialists can be attributable the focus on training an adequate number of general practice radiologists to meet the population needs: Even with this goal, changing market needs has seen sub specialization develop in other fields in medicine. Moreover, rapid development of new imaging modalities, a more competitive job market, increased prospects of better remuneration and improved professional standing are all factors edging the Kenyan radiologists to advance their training beyond residency level (22,23,56). "When I look at it from a local perspective, I think we are still at a level where we need a lot of radiologists. I look at other subspecialties that are still specializing for example in Internal Medicine you can see that there are Cardiologists, Neurologists and the likes. So for us to be able to support them as Radiologists, we therefore need to up our level of knowledge and

expertise to match them and to be able to offer them the diagnostic and even interventional services that may be required" (KII2 page 1).

The low number of available sub specialists may be as a result of limited availability of fellowship programs regionally. All respondents agreed that the availability of these programs locally will likely increase interest in sub specialty training among Kenyan radiologists. A fellowship in interventional radiology was established at the University of Nairobi following a partnership between the institution and RADAID in 2020. The inaugural class started the same year. Two of the three respondents currently in subspecialist training are interventional radiology fellows at the University of Nairobi while one indicated their training locale as outside the country.

More radiology sub specialty training programs within Africa have been developed in the last decade (10,55). Eight (Egypt, Ethiopia, Kenya, Morocco, Nigeria, South Africa, Tanzania, and Tunisia) out of the eighteen African countries with well-established radiology residency training have local sub specialist training programs (55). Pediatric radiology sub specialty training is available in South Africa, Ethiopia, and possibly, Tunisia (55). Sub specialty training in IR is available in Egypt, South Africa, Kenya, Tanzania, Tunisia, and Morocco with anecdotal evidence of institution-based subspecialty training in Women's Imaging at Cairo University in Egypt and Tanzania (55).

Among Kenyan radiology subspecialists, the decision to pursue fellowship was arrived at after residency in four out of eight respondents. This is in contrast to what happens in developed countries where due to availability training opportunities, fellowship training is almost certain and the decision to pursue fellowship is made in the first and second years of residency with applications sent out in the third and fourth years of training (22).

### 9.6 Emerging market needs for Kenyan radiologists

Continual professional development was identified from the informant interviews as a necessity for Kenyan radiologists. This finding is in keeping with multiple publications identifying radiology as a field that is faced with rapid innovation in technology demanding constant development in training opportunities and practical experience to provide high level of clinical service ((4,7,10).

Areas identified as channels for professional development in order to meet market needs include Continuous medical education and sub specialty training. Informants pointed out that "Apart from subspecialty training, the KMPDB has mandated continuing professional

development as part of annual renewal of licenses of Kenyan doctors. This has seen universities and professional bodies including the Kenya association of radiologist organize frequent CMEs to keep its members' knowledge fresh and updated" (KII1 page 1)

### 9.7 Awareness of radiology subspecialty

All residents and general practice radiologists were aware of radiology fellowship training with mentors and peers comprising the main sources of information on radiology fellowship training. Additionally, sub specialists and fellows, pointed out mentorship as the main sources of information for sub specialty training. This observation underlines the value of the senior and peer mentorship in providing professional support, knowledge, advice and career-specific skills (9,10).Studies have shown that mentoring of sub specialty fellows and early career radiologists may lead to greater research productivity and retention whilst also improved job satisfaction and patient care (17,18). A formal mentorship programs would likely benefit residents and guide them through the radiology residency program, fellowship choices and future practice opportunities(7).

### 9.8 Demand for radiology subspecialty training

Majority (74, 61.2%) of radiology residents and general practitioner consultant radiologists have always wanted to and plan to pursue a radiology fellowship. This is in comparison to a 80 to 94 % of radiology residents in North America pursuing at least one fellowship training after their residency before entering academic or private practice. This can be attributable to the ready availability of multiple specialty training opportunities (19,22). In this study, eight (6.6%) do not want but are likely to pursue fellowship to get a job while five (4.1%) and thirty one (25.6%) do not want and are unsure about fellowship training respectively. The relatively lower demand for sub specialty training locally was attributable to the high cost of pursuing training overseas and the uncertainty that the qualification will attract better income and job satisfaction: "Fellowship paths locally are currently largely external and new to the Kenyan market. There is also uncertainty of its benefits across all Kenyan hospitals. The return on investment (from fellowship training) is not yet being seen" (KII1 page 1)

It was also mentioned in KII2 page 2 "Sub specialization in Kenya appears to be more limited to large hospital and teaching hospital facility with interventional radiology is useful across the board". This is appropriate as the referral the national government referral hospitals and the main referral hospitals have the capacity to support subspecialty services to manage nationwide transfers.

## 9.9 Choice of radiology subspecialty

Vascular and non-vascular interventional radiology was the leading choice followed by musculoskeletal imaging. Saudi Arabia and Nigeria also had interventional radiology as the main fellowship preference (27,36). Canada had respondents who mainly preferred Musculoskeletal and body imaging (7). Table 9 compares the difference in choice of fellowship tracts across four countries

The high interest in interventional radiology has been attributed to a direct impact on patient care, strong personal interest and better remuneration as procedures attract a highr pay (56) In developed countries the initial high interest in interventional radiology and neuroradiology has fluctuated over time with reasons given including a highly competitive admission process, and stressful work experience with increased radiation exposure and an undesirable lifestyle (57). As in previous publications, IR was preferred more by males (27,36).

Breast/mammographic/women imaging, pediatric, neuroradiology, nuclear medicine, thoracic imaging and ultrasonography were chosen as preferred fellowship tracts in declining order in this study. Pediatric, women imaging and nuclear medicine tracts have been consistently reported as less preferred choices in Western countries (7,58,59). In these countries reluctance of choosing pediatric radiology may be caused by a limited job market for pediatric radiology which is practiced mainly in major academic centers, thus depriving the applicants of private work and a better salary (59). Additionally, nuclear medicine is perceived as a too stressful subspecialty, while mammography is perceived as not an interesting field (60). Similar to the western countries, few purely pediatric hospitals are available locally with available centers being concentrated in the main cities with none being a referral center or affiliated to a radiology training institution (KII 3 page 6). This could be a limiting factor to radiologists who are interested in pediatric imaging but are not interested in working in urban centers.

Breast cancer is the most common cancer (34 per 100,000), accounting for 23% of all cancers of women in Kenya (61). Robust efforts towards early diagnosis and treatment breast cancer have led to increased clinical evaluation and breast imaging for screening (62). This may contribute to interest in breast and women imaging fellowships locally.

Ultrasonography in Kenya is the least preferred fellowship tract. An attributable cause is extensive utilization by obstetricians, cardiologists and more recently rheumatologist and pulmonologist in point of care sonography (63). Although point of care sonography is a limited examination the capacity to quickly answer simple clinical questions is beneficial to the patient

and the clinician who charges for the service but is largely undesired by radiologists as it reduces their income. Additionally, hospitals in Kenya generally prefer employing radiographers over radiologists to handle sonographic examinations in order to cap the wage bill. Sonography still remains pivotal in radiology practice and is now increasingly incorporated into body imaging fellowships together with CT and MRI.

Similar to Mok et al 14% of the respondents in this study wished to pursue fellowship but were unsure of the fellowship tracts.

**Table 9 A comparison of choice of fellowship tracts in Kenya, Saudi Arabia, Canada and Nigeria**

| Country / Fellowship tract | Kenya N 120 | Saudi Arabia Alturki et. Al 2019 N 105 | Canada Mok et. Al. 2016 N 103 | Nigeria Atalabi eta al 2013 N 117 |
|---|---|---|---|---|
| Interventional radiology | 37.2% | 20% | 36% | 52.1% |
| Musculoskeletal | 9.9% | 14.3% | 54% | 11.1% |
| Mammography/breast/women imaging | 8.3% | 8.6% | 20% | 19.7% |
| Body imaging (Abdomen) | 8.3% | 15.2% | 55% | 10.3% |
| Neuroradiology | 7.4% | 19% | 25% | 39.3% |
| Pediatric | 6.6% | 3.8% | 13% | 14.5% |
| Oncology | 5.8% | 0 | 0 | 0 |

| | | | | |
|---|---|---|---|---|
| Nuclear medicine | 5 % | 9.5% | 7% | 9.4% |
| Ultrasonography | 2.5% | 0 | 0 | 0 |
| Cardiac(Cardiothoracic thoracic) | 1.7% | 9.5% | 30% | 12.8% |
| Emergency radiology | 0 | 0 | 0 | 12.8% |
| Head and neck | 0 | 0 | 0 | 10.3% |
| Genitourinary | 0 | 0 | 0 | 9.4% |
| Undecided | 11.6% | 0 | 32% | 0 |

### 9.10 Personal and work-related factors influencing the choice of fellowship tract

The main influencer of choice of fellowship tract was increased employability and favorable financial compensation. This was closely followed by personal interest, availability of a variety of advanced imaging modalities and the ability to impact on patient care. Work-related factors generally had higher scores than personal factors as influencers. A study done by Arnold et al in USA ranked personal interest as the strongest motive behind fellowship choice with other lifestyle factors such as favorable working hours, workload and financial compensation ranking low (59). Personal interest and enjoyable rotation were similarly reported as the overall leading influencers by Parvizi et al, Mok et al and Artuki et al in UK, Canada and Saudi Arabia respectively (7,27). As in our study, Artuki et al reported direct impact on patient care and availability of varied imaging modalities were the leading work related influencers. Fellowship training in Kenya is still in its early stages with the few who achieved this level of training making tremendous personal and financial sacrifices to venture out for training overseas. These sacrifices include separation from their families in the period of training, incurring debt to finance their fellowship training and quitting their current jobs. Only half of the sub specialists who responded to the survey were sponsored. The rest were self-funded through personal loans. Considering this, it is understandable for Kenyan radiologist to prioritize work related benefits such as getting a competitive edge over peers and better remuneration over personal benefits.

### 9.11 Benefits fellowship training

Respondents overwhelmingly preferred the establishment of local radiology fellowship citing improved patient management, improved clinical skills being passed on to undergraduates and

residents and enhanced research output The same benefits of fellowship training were listed by Karpinski et al 2017 (26)

From the key informant interview it was noted that "It would likely reduce the brain drain because when radiologist go out of the country to train in fellowships, the appetite to come back is reduced if they are offered opportunities that are more lucrative out there" (KII1 Page 4). Several authors have noted that establishment of local fellowships might mitigate the attrition of African radiologists (64,65)

### 9.12 Requirements and barriers to set to set up local fellowship programs

Majority (87.5%) of the respondents indicated that there are enough case volumes for fellowship training. The patient characteristics varied according to the practice settings: "KNH receiving an increased burden of oncology simply because it is a referral hospital while Aga Khan where it's predominantly private will have more preventive, promotive and emergency interventional healthcare". This different practice setting can be exploited by matching fellowship tracts to the dominant patient characteristics and radiological input or intervention needed.

Considering the handful of local subspecialist most (60.9%) respondents indicated that there are inadequate staff for fellowship training and ninety one point four percent indicated that international partnerships are necessary for the initial set up of local radiology fellowships. A partnership between Radiology Society of Ethiopia and the Children Hospital of Philadelphia foresaw development of a curriculum, the initial training of the first pediatric radiologists as well as enhanced the pediatric aspects of residency training (30). Similarly, collaboration between RAD AID and the universities of Nairobi and Muhimbili National Hospital (MNH) in Dar es Salaam has seen the establishment of fellowships in interventional radiology in Kenya and Tanzania respectively (9,66).

Despite respondents indicating access to ultrasound, conventional radiography mammography, CT, MR and fluoroscopic services, fift four percent of the respondents indicated that there is insufficient equipment to support fellowship training. Proposals from the key informant interviews to maximize the utilization of available infrastructure in order to improve patient services and make the teaching of radiology more structured include "developing the PACS system to include all modalities and. reorganization of clinical work done by consultants to be sub specialty based". Additionally, acquisition of modern imaging equipment as well as the

maintenance and repair of the available equipment will ensure top-level educational environment required for specialist and subspecialist tutoring (29).

Nearly half (42.2%) of the respondents from the online survey thought that there was not enough effort and good will towards establishment of local radiology fellowships. One key informant interviewee agreed with this observation noting “The support is not adequate. There should be more effort put in by government, more effort put in by the training institutions and more international collaboration sought out” (KII1 Page 3).

Two key informant interviewees however noted that there are clearly outlined guidelines for the initiation of training programs. “There is definitely goodwill with regulatory bodies in terms of the Commission of University Education putting standards in place to follow” (KII3 Page 14). “There’s enough support and I think maybe sometimes from a government standpoint and my experience is that they need the people on the ground to really guide them to understand what is happening on the ground” (KII2 Page 7)

All interviewees noted that the onus rests with the individual institution program directors: “The person who is interested in setting up a fellowship training bears the bulk of the burden to mobilize resources, get the faculty and fulfill the requirements of the commission of university education” (KII1 Page 3). “At the end of the day, it will be the and specifically the chair of the department together with faculty who will spearhead and develop the curriculum” (KII3 page 14).

In literature, huddles to overcome in developing fellowship programs include securing funding, acquiring modern equipment, infrastructure and sufficient manpower to initiate fellowship training programs, securing governmental backing and funding for programs and reducing emigration of specialists and subspecialists (29,55).

Proposals to overcome these huddles include leveraging existing and emerging technologies and innovative training/learning methods to streamline the training of subspecialist radiologists (55). This includes using a combination of self-directed learning, webinars, workshops, research & teaching, as well as on-the-job training, simulation-based technology and immersive training environment for IR ((67,68)).

# 10 Conclusion

This study has highlighted the awareness and interest in the development of local radiology sub specialty training. The establishment of local training programs will curb brain drain from consultants who seek sub specialty raining outside the country and opt to settle outside Kenya after qualification.

Due to the shortage in training staff and for alignment with international standards, collaboration with well-established training bodies and organizations in the developed world is crucial. Training departments are tasked with developing sub specialty curricula and institutional approvals as well as seeking out international collaborations.

Mentorship and peer review efforts should be bolstered in order to improve radiology practice locally. Aditionally, existing residency programs should not only emphasize clinical skills development but also build research capacity in their trainees. Moreover, trainees interested in

academia should be identified in order to build ability to impart radiology knowledge, develop and implement curricula.

There is need to increase clinical output from existing radiology infrastructure through in cooperation of the picture archiving and storage system for all imaging modalities as well as restructuring work stations into sub specialties as opposed to modalities.

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# Appendices

## Appendix 1: Budget

| Item | Cost (Kenya Shillings) |
|---|---|
| Laptop | 30,000 |
| Internet Data | 10,000 |
| Statistician | 10,000 |
| Ethics Review Committee Fees | 5000 |
| Stationery<br>Printing paper<br>Printer<br>Proposal and dissertation binding | <br>500<br>5000<br>3000 |
| Miscellaneous | 5000 |
| Total | 68,500 |

## Appendix 2: Informed Consent Form

This is a consent form for a study being conducted by a team of doctors from Radiology and Psychiatry departments, University of Nairobi. The principal investigator is Dr. Anisha Gechuki, a level II resident doctor in Radiology. The supervisors are Dr. Gladys Mwango, consultant radiologists and senior lecture Department of Diagnostic Imaging and Radiation Medicine and Dr. Ann Mbwayo clinical psychologist psychiatrist and lecturer, Department of Psychiatry with experience in qualitative research.

The study is titled **"**Demand, perceived barriers and available infrastructure for radiology subspecialist training in Kenya'. It is in the field of medical education and aims to highlight the demand and trends in choice of radiology fellowship courses locally as well highlight the infrastructural needs for the establishment of local radiology fellowship training. The main study collection tool with be an online questionnaire developed on the Survey Monkey platform.

Your participation in the study shall be voluntary and you may opt out with no fear of victimization. Throughout the study, there shall be measures taken to uphold research ethics. Firstly, all data collected shall be stored securely and only be accessible to members of the research team. Secondly, any personal identifiers will be omitted with numerical serial identifiers assigned in the order of participant response.

The principal investigator shall be readily available to you throughout the study for any queries or concerns that pertain to the study. The contacts are as below

Dr. Anisha G. Onchong'a mobile number 0713863896; anishagechuki@gmail.com

We hereby, if agreeable, request for your consent to participate in this study by providing the following information

Signature:

Date:

Thank you

## Appendix 3: Questionnaire (Barfett et all 2019, Mok et al 2015, Smith et al 2009).

## DEMOGRAPHICS

1. What is your gender?
2. What is your age?
3. Where did you receive your undergraduate training?
4. What imaging services are available at your center? (Kindly tick as appropriate)
    a. Ultrasound
    b. Radiography
    c. Mammography
    d. CT scan
    e. MRI
    f. Fluoroscopy
    g. Nuclear Medicine
    h. Interventional Radiology
5. Are there radiology subspecialty services offered at your center? (kindly specify)

**Residents**:

6. Where are you undertaking postgraduate training in Radiology?
7. What is your current Post Graduate Year (PGY) level? (options: PGY1, 2, 3 and 4?)

**Consultant Radiologist**:

8. Where did you receive residency training in Radiology?

9. Practice setting (May chose more than one)
    a. Currently in training
    b. Solo private practice
    c. Group private practice
    d. Primarily academic
    e. Government
    f. Private multispecialty
    g. Locum

    Other practice type

10. Location of practice
    a. Urban
    b. Rural

Other (specify)

**FELLOWSHIP PREFERENCES**

13. Do you plan to pursue fellowship training?
    a) Always wanted and planned to do a fellowship
    b) Do not want to, but likely necessary to get a job
    c) Do not want to but encouraged by residency program
    d) Unsure
    e) I already have a fellowship (indicate)

14. What would be your preferred fellowship?
    a) Musculoskeletal imaging
    b) General body cross sectional imaging
    c) Vascular or interventional imaging
    d) Abdominal/body/ chest cross sectional imaging
    e) Mammography/breast/women imaging
    f) Neuroradiology
    g) Nuclear medicine
    h) Thoracic imaging
    i) Pediatric imaging
    j) Ultrasound
    k) Other
    l) Undecided

15. Where have you/Did you received information for fellowship training?
    a) Peers (residents or fellows)
    b) Staff radiologists
    c) University websites
    d) Society websites
    e) Ads in publications and journals
    f) Other (specify)

16. Where are you planning to pursue fellowship training? / Where did you receive your fellowship training? (indicate appropriately)

a) What is/was the reason for the above choice?

b) Will you be/were you being self-sponsored?

**FACTORS INFLUENCING FELLOWSHIP PREFERENCE**

17. What factors influence/influenced your choice fellowship training? for each point indicate the numerical value that corresponds to your response

| Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

| Personal factors | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|
| Successful/enjoyable rotation during training | | | | | |
| Personal interest | | | | | |
| Influential mentor or program director | | | | | |
| Social or family considerations | | | | | |
| Financial constraints | | | | | |
| Exclusion of other specialties | | | | | |

Work related factors

| Work related factors | Strongly disagree | Disagree | Undecided | Agree | Strongly agree |
|---|---|---|---|---|---|

| |
|---|
| Direct impact on patient care |
| Availability of advanced or a variety of imaging modalities |
| Direct patient contact |
| Flexibility of working hours |
| Research and teaching opportunities |
| Increased employability |
| Better income |
| Research opportunities |

**PERCEIVED BARRIERS TO SET UP LOCAL FELLOWSHIP PROGRAMS**

In your opinion;

(Indicate yes, No or I don't know and reasons for your response where applicable)

a) Is there adequate required equipment locally for training of subspecialties?
b) Are the staff adequate to commence subspecialty training?
c) Are case volumes adequate for subspecialty training?
d) Are international partnerships necessary for assistance in training an initial critical mass of fellows locally?
e) Is there is enough support from the regulatory framework (medical schools, referral hospitals, medical board and the government) for the set-up of radiology subspecialty?

**BENEFITS OF LOCAL FELLOWSHIP PROGRAMS**

Indicate yes, No or I don't know and reasons for your response where applicable

a) Would you be in favor of local fellowship training?
b) Would local fellowship training improve patient management?
c) Would local fellowship training improve research output?
d) Would local fellowship programs benefit postgraduate radiology training?
e) Would local fellowships increase the interest in subspecialty training?

## Appendix 3: Semi structured interview

1. What are the local trends in radiology residency training?
2. What is the emerging market needs for radiologists?
3. Is the current radiology residency training sufficient to meet local and international clinical, research and academic needs?
4. Would you be in favor of local fellowship training?
5. Is the current radiology departmental clinical set up sufficient to support fellowship training?
6. Would local fellowship training improve patient management?
7. Would local fellowship training improve research output?
8. Would local fellowship programs benefit postgraduate radiology training?
9. Would local fellowships increase the interest in subspecialty training?
10. Is there adequate required equipment locally for training of subspecialties?
11. Are the staff adequate to commence subspecialty training?
12. Are case volumes adequate for subspecialty training?
13. Are international partnerships necessary for assistance in training an initial critical mass of fellows locally?
14. Is there is enough support from the regulatory framework (medical schools, referral hospitals, medical board and the government) for the set-up of radiology subspecialty?

## Appendix 4; Sample study results

## Table 1; Resident demographic details

| **GENDER** | PERCENTAGE |
|---|---|
| MALE | 40 |
| FEMALE | 60 |
| **CURRENT YEAR OF TRAINING** | |
| PGY1 | 20 |
| PGY2 | 25 |
| PGY3 | 25 |
| PGY4 | 30 |

## Table 2; Consultant demographic details

| **GENDER** | PERCENTAGE |
|---|---|
| MALE | 45 |
| FEMALE | 55 |
| **PRACTICE LOCATION** | PERCENTAGE |
| URBAN | 70 |
| RURAL | 30 |
| **PRACTICE SETTING** | |
| CURRENTLY IN TRAINING | 15 |
| SOLO PRIVATE PRACTICE | 10 |
| GROUP PRIVATE PRACTICE | 20 |
| PRIMARILY ACADEMIC | 10 |
| LOCUM | 5 |
| GOVERNMENT EMPLOYED | 20 |

| | |
|---|---|
| EMPLOYED IN A PRIVTATE FACILITY | 15 |
| OTHER | 5 |
| **FELLOWSHIP TRAINING** | |
| NONE | 95 |
| INTERVENTIONAL RADIOLOGY | 2 |
| NEURORADIOLOGY | 1 |
| ABDOMINAL IMAGING | 0 |
| GENITOURINARY IMAGING | 0 |
| MUSCULOSKELETAL IMAGING | 0 |
| CARDIOTHORACIC IMAGING | 0 |
| CHEST IMAGING | 0 |
| NUCLEAR MEDICINE IMAGING | 0 |
| BREAST IMAGING | 1 |
| GYNECOLOGY | 0 |
| PEDIATRIC | 0 |
| ONCOLOGY | 0 |
| ULTRASOUND | 1 |
| CT | 0 |
| MRI | 0 |

Table 3; Plans to pursue fellowship

| | PERCENTAGE | |
|---|---|---|
| | RESIDENT | RADIOLOGIST |
| ALWAYS WANTED AND PLAN TO DO FELLOWSHIP | 60 | 40 |

| | | |
|---|---|---|
| DO NOT WANT TO BUT LIKELY TO IN ORDER TO GET A JOB | 20 | 30 |
| DO NOT WANT TO BUT ENCOURAGED BY RESIDENCY PROGRAM\MENTOR\SUPERVISOR | 10 | 20 |
| UNSURE | 10 | 10 |

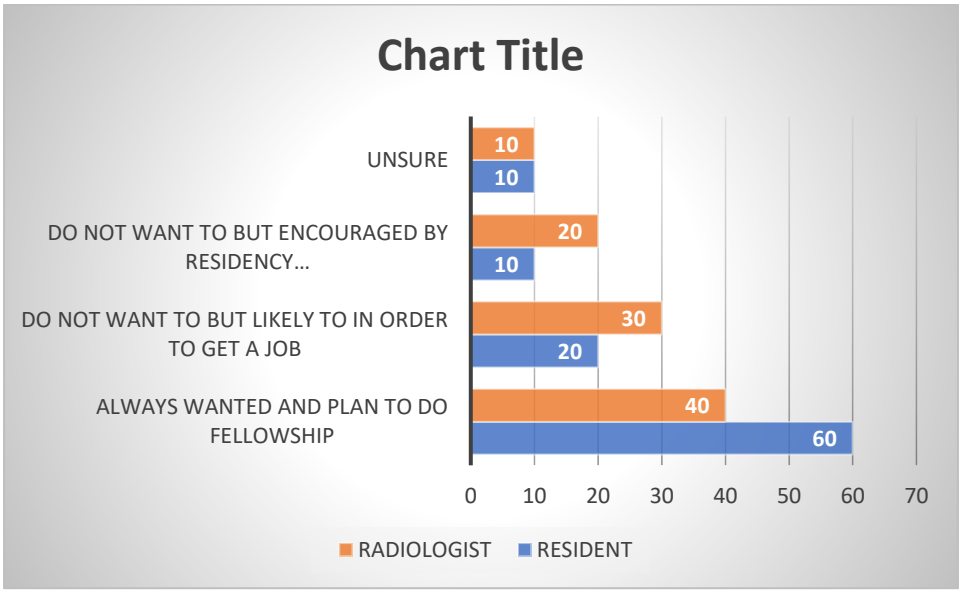


Table 4; Fellowship tract preference

| **FELLOWSHIP PREFERENCE** | **PERCENTAGE** | |
|---|---|---|
| NONE | RESIDENTS | GENERAL RADIOLOGISTS |
| INTERVENTIONAL RADIOLOGY | 5 | 10 |
| NEURORADIOLOGY | 5 | 3 |
| ABDOMINAL IMAGING | 5 | 5 |
| GENITOURINARY IMAGING | 2 | 0 |

| | | |
|---|---|---|
| MUSCULOSKELETAL IMAGING | 10 | 15 |
| CARDIOTHORACIC IMAGING | 7 | 15 |
| CHEST IMAGING | 3 | 10 |
| NUCLEAR MEDICINE IMAGING | 10 | 15 |
| BREAST IMAGING | 5 | 2 |
| GYNECOLOGY | 0 | 0 |
| PEDIATRIC | 5 | 0 |
| ONCOLOGY | 20 | 20 |
| ULTRASOUND | 10 | 0 |
| CT | 10 | 0 |
| MRI | 3 | 0 |
| OTHER | 0 | 0 |

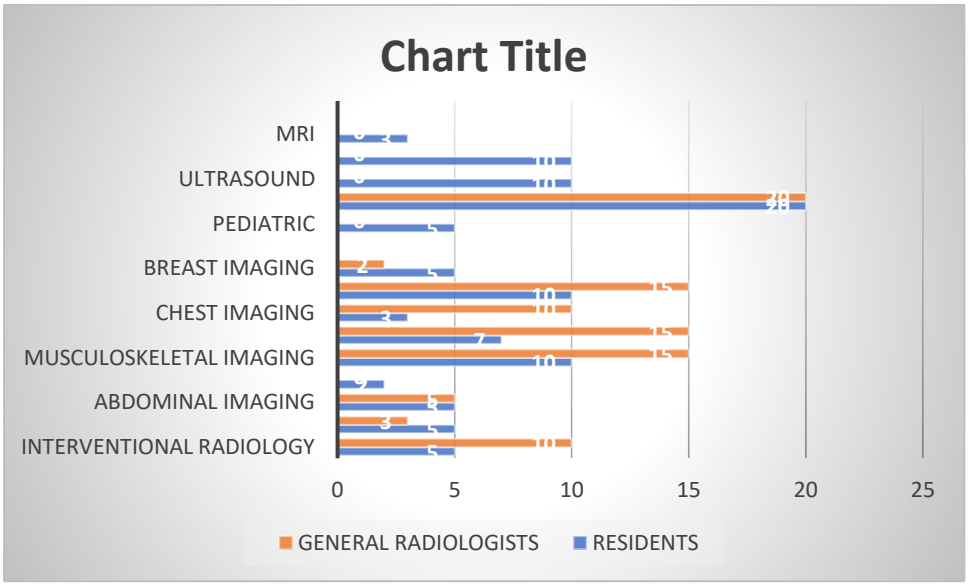

Table 5; Influence of personal factors on the choice of subspeciality

| Personal factors | Interventional Radiology N 21 | Neuro Radiology N 20 | Abdominal N 16 | MSK N 15 | CARDIO THORACIC N 10 | Nuclear medicine N 30 | Gynecology, breast N 15 |
|---|---|---|---|---|---|---|---|
| Successful/enjoyable rotation during training | 88% | 69% | 78% | 71% | 89% | 67% | 61% |
| Personal interest | 77% | 79% | 74% | 76% | 56% | 90% | 89% |
| Influential mentor or program director | 83% | 88% | 79% | 93% | 78% | 98% | 98% |
| Social or family considerations | 82% | 54% | 46% | 75% | 98% | 90% | 67% |
| Financial constraints | 74% | 60% | 85% | 91% | 67% | 70% | 98% |
| Exclusion of other specialties | 88% | 12% | 78% | 84% | 45% | 60% | 45% |

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7th May 2021

APPROVED
07 MAY 2021
KNH/UoN-ERC

Dr. Anisha G. Onchong'a
Reg. No. H58/11316/2018
Dept. of Diagnostic Imaging and Radiation Medicine
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Onchong'a,

**RESEARCH PROPOSAL – DEMAND AND BARRIERS TO DEVELOPING RADIOLOGY FELLOWSHIP TRAINING IN KENYA (P39/01/2021)**

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 7th May 2021 – 6th May 2022.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website **http://www.erc.uonbi.ac.ke**

Yours sincerely,

**PROF. M. L. CHINDIA**
**SECRETARY, KNH-UoN ERC**

c.c. The Principal, College of Health Sciences, UoN
The Senior Director, CS, KNH
The Chairperson, KNH- UoN ERC
The Assistant Director, Health Information Dept, KNH
The Dean, School of Medicine, UoN
The Chair, Dept. of Diagnostic Imaging and Radiation Medicine, UoN
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