

**TITLE**

**AN AUDIT OF THE PATTERN OF RADIOLOGICAL  
EXAMINATIONS DONE IN THE DEPARTMENT OF  
DIAGNOSTIC RADIOLOGY OF THE UNIVERSITY OF  
NAIROBI FROM JUNE 1998 TO NOVEMBER 2000.**

**DESSERTATION SUBMITTED IN PART FULLFILMENT**

**FOR THE DEGREE OF MASTER OF MEDICINE**

**(DIAGNOSTIC RADIOLOGY) OF**

**THE UNIVERSITY OF NAIROBI**

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**BY: DR/MKUMBO E.N MD UNIVERSITY OF LENINGRAD FIRST**

**MEDICAL INSTITUTE, AUGUST 1988.**



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**DR MKUMBO E.N MD UNIVERSITY OF LENINGRAD FIRST**

**MEDICAL INSTITUTE, AUGUST 1988.**

**SUPERVISOR:** This dissertation has been submitted for examination with my approval as the university supervisor.

**SIGNED:**



**DR. G.K. IKUNDU ;RADIOLOGIST, SENIOR LECTURER  
DDR-U.O.N**



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## ABBREVIATIONS

AJR; American Journal of Roentgenology

BJR; The British Journal of Radiology

BRS; Basic Radiological System

DDR; Department of Diagnostic Radiology

EAC; East African Community

IGU; Income Generating Unit

KNH; Kenyatta National Hospital

Kshs; Kenya Shillings

MRI; Magnetic Resonant Imaging

WHO; World Health Organization

## SUMMARY

A retrospective study of radiological examinations was carried out in the Department of Diagnostic Radiology in the last 2½ years. A total of 28133 cases were reviewed, of these 10830(38.5%) were females, 5743 (20.4%) were males and 11560 (41%) had no sex indicated. 9769 (34.7%) had no age indicated, 11519(40.9%) noted adults, 258 (0.9%) noted child, 7% was between 21 and 30 years.

1837 (65.3%) patients had referral forms written Kenyatta national hospital, 4980 (17.7%) University of Nairobi, 113 (0.4%) Aghakhan hospital and 4642 (16.5%) from other centers.

14629 (52%) the referral diagnosis did not tie with the radiological diagnosis, while 12294 (43.7%) the referral diagnosis tied with the radiological diagnosis and 1210 (4.3%) had no referral diagnosis.

Plain films were the majority and accounted for 51.4%, followed by gray scale ultrasound, which accounted for 44.8% and color Doppler was the least accounting for 1.1%. The commonest examinations were Chest radiographs 6244(37.5 %) followed by lower limbs 3913 (23.5%) while plain abdomen was the least 126(0.8%).

Abdominal ultrasound examinations were top on the list of ultrasound examination accounting for (36.6% 4540 (36.6%) followed by pelvic ultrasounds 4526 (36.5%) while cranial ultrasound were least accounting for 19 (0.1%) only. 250 color Doppler's ultrasound were done. Lower limb Doppler accounted for 92.0% (230), carotid 6% (15) and upper limbs 5(2%).

## INTRODUCTION

The launching of the Department of Diagnostic Radiology (DDR) as a fully fledged imaging center was conceived and implemented by the teaching staff as a self supporting unit generating its own funds and proudly contributing to the budget of various organs of the University.

The chairman of DDR took this brave first step in June, 1998 with the help and encouragement from the UNES (University of Nairobi Enterprises Services, the commercial wing of the university that manages all the income generating units of the university), who at that time advanced a small soft loan of Kshs. 200,000.00 that was required to buy the consumables including films and chemicals which were required to start the department running.

The DDR already had an old GE mobile X-Ray unit, an automatic film processor and a small portable ultrasound unit, all of which were collecting dirt due to disuse in the store. So with these equipments and a very enthusiastic staff of 5 radiologists, 2 technicians, 2 secretaries and two messengers the project was launched. From this humble beginning with dedication and determination of the staff an irreversible process was started.

## LITERATURE REVIEW

The discovery of roentgen rays (X-rays) by Wilhelm Conrad Roentgen, professor of physics at the University of Wurzburg, German on November 8, 1895, marked the beginning of a new era in Medical Science. For the first time it became possible to see through the intact skin and superficial tissues and visualize the bones and deeper structures of the body. Improvement on the crude equipment of the early days followed and with the tremendous interest generated throughout the world by news of discovery, it was only a short time before the methods became available for the study of the body cavities and visceral structures (1).

The DDR is a teaching unit at the University of Nairobi, at Kenyatta National Hospital (KNH). It teaches postgraduate radiology and undergraduate doctor trainees. It is currently providing complementary imaging services alongside the X-ray department KNH for the wards, outpatients, and referrals from outside KNH. The concept for primary health care cannot be successfully implemented without support of diagnostic service (2).

As the population grows, more aware of the magnitude involved in extending adequate medical care to all citizens, it is unfortunate that radiology is showing both signs of maturing and signs of rapid growth since 1980s starting with ultrasound. Radiology has emerged as a major influence in medicine (3,4). Diagnostic Imaging Services are,

however, not universally available. In fact, 2/3 of humanity has no access to diagnostic imaging and the bulk of these are in less developed countries like Kenya and its neighbors in the East African Community. The use of radiographic imaging is becoming wide rapidly as newer imaging modalities and improvement on older ones occurs with technological advances. Ultrasound for instance is an almost indispensable tool in good antenatal care of pregnant mothers, so are plain films in the management of fractures. Diagnostic imaging should therefore not be a privilege, but should be the right of the patient when his or her doctor believes that it will assist in accurate diagnosis and result in better management (5).

WHO states that in developing countries every first referral hospital or center should have an imaging service, providing diagnostic radiography and an ultrasound machine, should exclusively be a hospital service. There should be a dedicated X-ray room, a dark room, an office, a store and if possible an ultrasound available in a dedicated ultrasound room (6,7). The DDR at the University of Nairobi has met this basic criterion. The department is mainly performing conventional radiographic imaging and ultrasound examinations. The WHO summarizes the possible indication for diagnostic imaging as follows:

1. Trauma

- X-rays used for the skeleton and chest.
- Ultrasound is used for soft tissues (spleen, Liver etc).

2. Chest diseases

- X-rays used for infections and heart diseases.

- Ultrasound is used for pleural effusions.

### 3. Abdominal diseases

- X-rays used for calculi; obstruction, perforation.
- Ultrasound is used for calculi, jaundice, perforation and Pelvic Inflammations.

### 4. Pregnancy

- X-rays no longer used
- Ultrasound is used for obstetric examination (8).

These basic imaging procedures are performed at the DDR.

Conventional radiological procedures today in the Western world and Japan are being performed on expensive equipment that is often more sophisticated than necessary and too complex to use and maintain. Ultrasound is facing an important dilemma, should the equipment become more sophisticated with the use of computers and automation thus increasing its price or should the benefit that have been traditionally, derived from its simplicity be continued? The relatively low cost of the present ultrasonic equipment, the speed of examination and the close contact with the patient are great advantages of the procedure. The necessity to develop operator skills has been an obstacle and has been responsible for creating the call for automation (9).

Color Doppler ultrasound is a useful technique for rapid, non-invasive evaluation of venous disease in the upper and lower extremities. It has been used successfully to evaluate thrombosis. In addition Doppler sonography shows promise for monitoring thrombotic therapy and detecting intermittent venous compression

related to thoracic inlet syndrome. The examination is best accomplished with high-resolution sonographic equipment for example phased gray scale imaging and a 6 MHz for color Doppler imaging. For larger patients, use of lower frequency probe such as 5MHz, sector or phased array transducer with 4 MHz Doppler capabilities may be necessary.

The role of the radiologist may be considered as three pronged.

- (a) Clinical care
- (b) Teaching and
- (c) Research

These roles feature significantly in every radiology practice whether in an office, in a community hospital or in an academic setting. Every one of our many daily interactions carries with it an element of each role. It is important at a time when a radiologist seem to be set by conflicts with their clinical colleagues and with governments to reflect on these and to acknowledge with appreciation the efforts of those in leadership positions who as they vigorously pursue the goals of radiology, deserve active support and participation. (15,16).

The relationship of the diagnostic radiologist as a consultant to other physicians has been in a state of constant flux since radiology has become one of the new specialties in the early part of the 20<sup>th</sup> century. S. Roskoff et al did a survey on physician's attitude towards the competence of general diagnostic radiology. Responses to a questionnaire were obtained from 1539 physicians in 15 medical specialties to measure the attitude towards general diagnostic radiology with regard to their medical knowledge and professional

competence as consultants. Among the detailed results obtained, it was determined that only 8.1% of all physicians believe general diagnostic radiologists are poorly informed about disease processes, but 25% believed these radiologists needed more subspecialty training to be valuable as consultants. Physicians who also do their own radiographic and sonographic examinations believe general diagnostic radiologists to be unimportant twice as often as do physicians who refer their patients to radiologist (28.2%) vs. (14.5%). Most physicians (78%) believe that diagnostic radiologists perform unique function in hospitals. Orthopaedic surgeons, neurosurgeons, cardiologists had lowest opinion of general radiologists as consultants. (17,18).

Health services are generally expensive. Recent trends in technological advances have greatly impacted on the practice of radiology and tremendously increased our understanding of an anatomical basis of various disease processes and thereby resulting in better health care. Virtually all branches of diagnostic radiology have undergone a technological evolution. In recent years great advances have been seen in ultrasound, CT, MRI and nuclear medicine. Infact these fields are in constant change .As we advance in technology, the costs of patient service are also becoming more expensive. Efforts to regulate these costs should be emphasized not only in radiological services but also in other services. On the other hand, however, radiological examinations are highly visible to regulators and the public (19,20). The DDR is offering radiological services to the public at very competitive rates

Radiologists and non-radiologists are investing in free standing imaging centers often in partnership. Venture capital group may run them and have them as partners, radiologists and referring doctors. Occasionally they are owned by non-radiologists and employ radiologists to perform radiological services. All these arrangements suffer from the lack of professional control. In this arrangement who serves as a patients advocate? The law (21,22).

What is wrong with radiology? Not that many things are wrong with radiology in this century. On the contrary the discipline is thriving and medical imaging will obviously continue to have an essential place in medical and health care. Radiologists however, must recognize that their discipline is once again going through a rapid phase of mutation. The many changes will not necessarily damage their position but they may on contrary benefit from them if they adapt timely to the modifying environment by an active process of engagement in the new developments and if they give up resistance to the inevitable evolution (23).

## **STUDY RATIONALE**

- 1. To assess the frequencies of examinations carried out in the DDR-UON.**
- 2. To determine whether the system taken by the DDR-UON can be applied in other places (like in Tanzania) where such a system is not in place.**
- 3. Self evaluation test that will help to refocus the stated goals of the DDR as a center of excellence in Medical Imaging and also provision of better health care as we enter the third millennium.**

**OBJECTIVES:****A. Broad Objective**

Radiological requisition. Diagnosis and outcome of examinations carried out by income generating unit (IGU). Department of Diagnostic Radiology.

**B. Specific Objectives:**

1. Analyze provisional and clinical diagnosis as stated on radiology, requests, (radiological request forms).
2. Analyze frequency types of examinations requested.
3. Analyze diagnosis entered on radiological reports
4. Evaluate patient's sources and demographic characteristics of all the cases requiring radiological imaging.

## HYPOTHESIS

The DDR has improved the patient service at KNH. Patients are not given appointment for investigations; they are investigated the time they come and results are given in time (The same day, or few minutes after being investigated).

Consultants are spending more time in the department dealing with patients and students both postgraduates and undergraduates. Students are benefiting more with the teaching facilities and so they spend more time in the department learning.

## **METHODOLOGY**

### **1. STUDY AREA**

DDR – UON at KNH. During the study period the unit had:

- ◆ Two X-Ray machines: A general radiography unit and a mobile unit.
- ◆ Two Ultrasound machines.
- ◆ Two processing machines.
- ◆ Radiography and ultrasound accessories and consumables.

Data was collected from the work done in the DDR, reviewed and then analyzed.

### **2. STUDY DESIGN**

Descriptive retrospective.

### **3. SAMPLE SIZE**

All records of cases attended from June 1998 to November 2000. The DDR handles about 950 patients on average per month and carries out large number of examinations. So, in the period of 2½ years (30 months) about 28,133 cases were studied.

#### **4. DATA COLLECTION**

Data was collected from the unit records section using the data collection forms and transferred to specially designed charts.

## RELEVANT ETHICAL ISSUES

This is a retrospective study, so, no consent will be needed, as no patient will be irradiated. No patient's name will be used; instead, numbers will be used. And patient's confidentiality will be preserved.

Table 1: Frequency distribution

Category	Frequency	Percent
...	...	2.4
...	...	5.5
...	...	41.3
Total	28722	100

Table 2: Age distribution

Age Group	Frequency	Percent
0	732	0.0
10	1172	2.4
20	2018	7.1
30	1857	5.5
40	2822	9.1
50	3882	23.3
60	421	1.5
70	102	0.5
80	44	0.2
90	22	0.0
100	14676	48.9
102	5708	24.7
Total	28722	100

## RESULTS

During the period June 1998 to November 2000, a total of 28,133 records of patients who underwent radiological examinations were reviewed. The sex and age distribution is shown in Tables 1 and 2 below.

**Table 1: Sex distribution**

<b>Sex</b>	<b>Frequency</b>	<b>Percent</b>
Males	5743	20.4
Females	10830	38.5
Sex not indicated	11560	41.1
<b>Total</b>	<b>28133</b>	<b>100</b>

**Table 2: Age distribution**

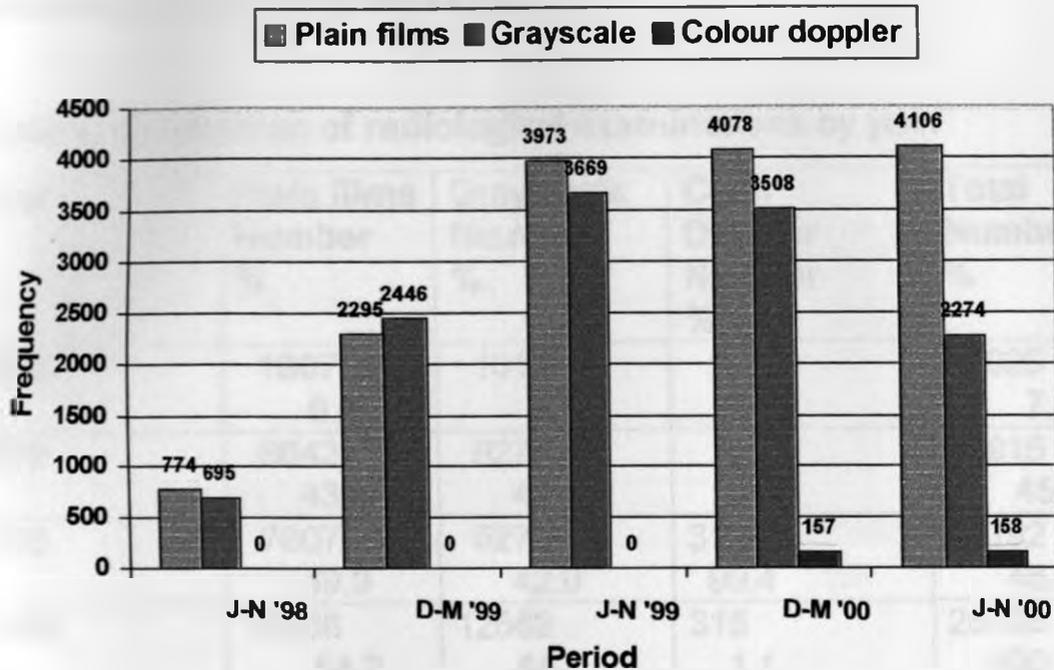
<b>Age in years</b>	<b>Frequency</b>	<b>Percent</b>
0-10	232	0.8
11-20	679	2.4
21-30	2008	7.1
31-40	1557	5.5
41-50	862	3.1
51-60	656	2.3
61-70	421	1.5
71-80	128	0.5
Over 80	44	0.2
Indicated as child	258	0.9
Indicated as adult	11519	40.9
Age not indicated	9769	34.7
<b>Total</b>	<b>28133</b>	<b>100</b>

Plain films were the majority accounting for 54.1% of all radiological examinations (Table 3). Color Doppler examinations were done in year 2000 only and accounted for 1.1% of the radiological examinations.

Table 3: Distribution of radiological examinations obtained from records for the period June 1998 – November 2000.

<b>Period</b>	<b>Plain films Number %</b>	<b>Gray scale Number %</b>	<b>Color Doppler Number %</b>	<b>Total Number %</b>
June – Nov. 1998	774 5.1	695 5.5	0 0	1469 5.2
Dec. 98 – May 99	2295 15.1	2446 19.4	0 0	4741 16.9
June 99 – Nov. 99	3973 26.1	3669 29.1	0 0	7642 27.2
Dec. 99 – May '00	4078 26.8	3508 27.9	157 49.8	7743 27.5
June – Nov. 2000	4106 26.9	2274 18.1	158 50.2	6538 23.2
<b>Total N %</b>	15226 54.1	12592 44.8	315 1.1	28133 100

## Distribution of radiological examinations for the period June 1998 to November 2000



Key: J-N '98 = June – November 1998; D-M '99 = December '98 – May '99

J-N '99 = June – November 1999; D-M '00 = December '99 – May 2000;

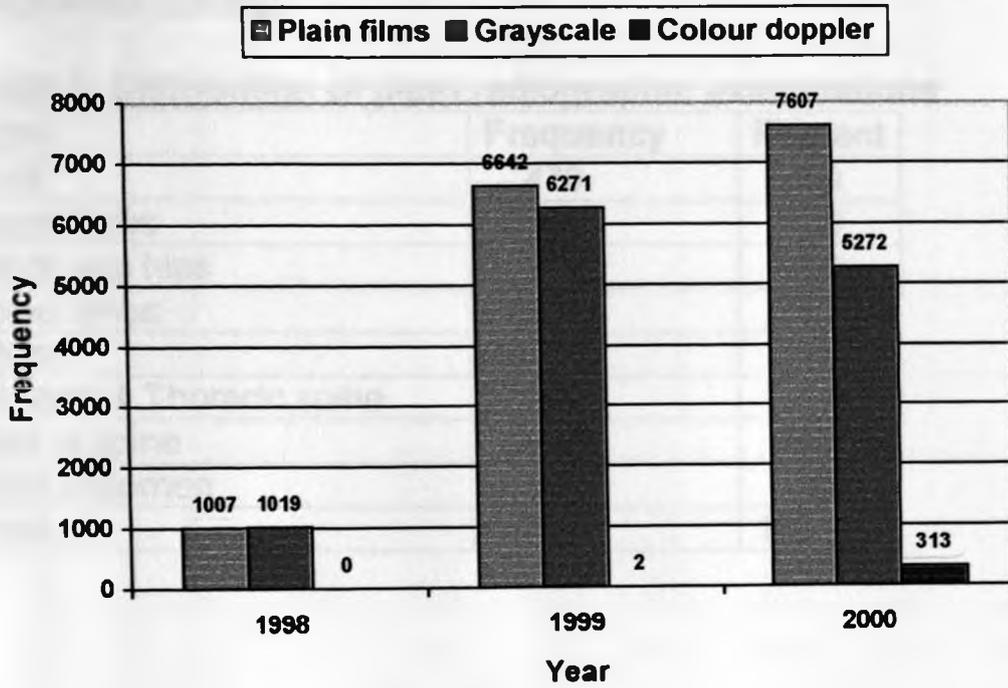
J-N '00 = June – November 2000

Majority of radiological examinations were plain films, which accounted for 54.2% of all examinations followed by gray scale examinations accounting for 44.7%.

**Table 4: Distribution of radiological examinations by year**

<b>Year</b>	<b>Plain films Number %</b>	<b>Gray scale Number %</b>	<b>Color Doppler Number %</b>	<b>Total Number %</b>
1998	1007 6.6	1019 8.1	0 0	2026 7.2
1999	6642 43.5	6271 49.9	2 0.6	12915 45.9
2000	7607 49.9	5272 42.0	313 99.4	13192 46.9
<b>Total %</b>	15256 54.2	12562 44.7	315 1.1	28133 100

### Distribution of radiological examinations

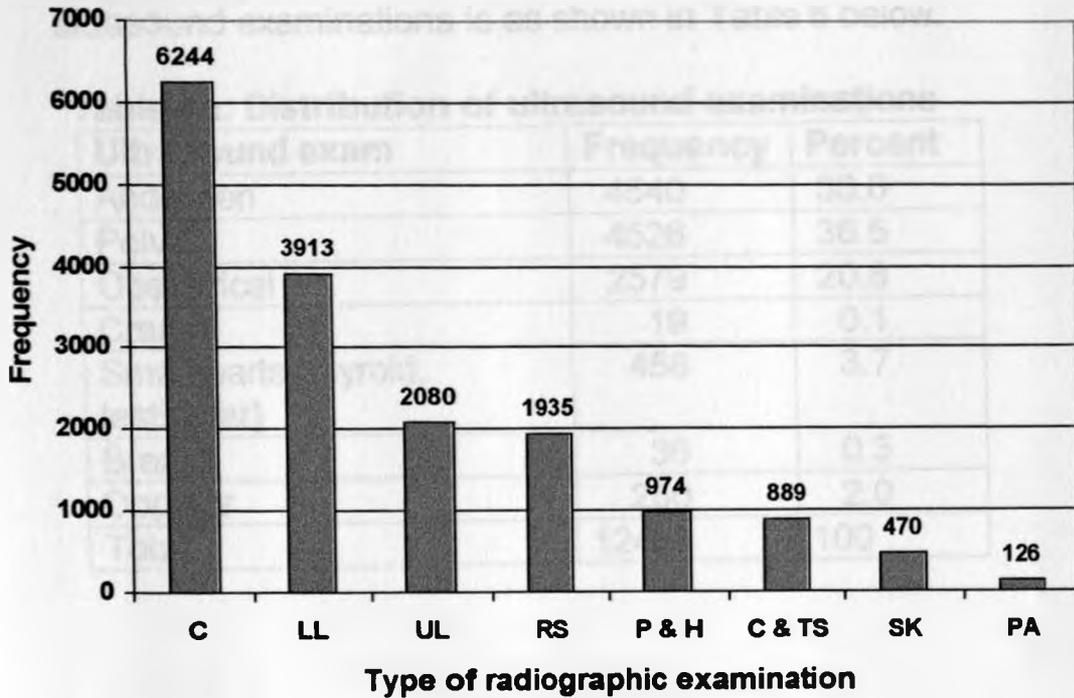


The distribution of plain radiographic examinations is shown in Table 5 and chest X-rays were majority (37.5%), followed by X-rays of the lower limbs (23.5%).

**Table 5: Distribution of plain radiographic examinations**

Type	Frequency	Percent
Skull	478	2.9
Upper limbs	2080	12.5
Pelvis and hips	974	5.9
Lower limbs	3913	23.5
Chest	6244	37.5
Cervical & Thoracic spine	889	5.3
Rest of spine	1935	11.6
Plain abdomen	126	0.8
Total	16639	100

### Distribution of plain radiographic examinations



Key: C = Chest; LL = Lower limbs; UL = Upper limbs; RS = rest of spine  
 P & H = Pelvis & hips; C & TS = cervical & thoracic spine; SK = Skull;  
 PA = plain abdomen

Ultrasound examinations of both abdomen and pelvic were the most common each accounting for 36.6% and 36.5% respectively of all ultrasound examinations. Distribution of ultrasound examinations is as shown in Table 6 below.

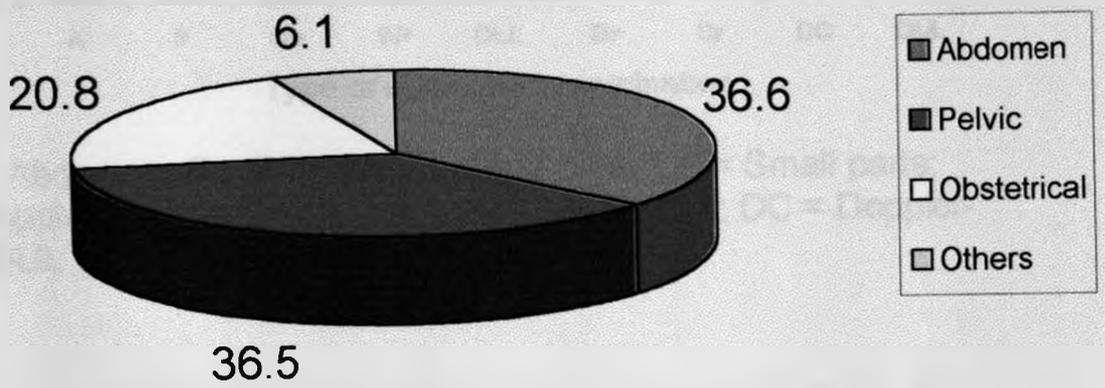
**Table 6a: Distribution of ultrasound examinations**

<b>Ultrasound exam</b>	<b>Frequency</b>	<b>Percent</b>
Abdomen	4540	36.6
Pelvic	4526	36.5
Obstetrical	2579	20.8
Cranial	19	0.1
Small parts (thyroid, testicular)	458	3.7
Breast	36	0.3
Doppler	250	2.0
Total	12408	100

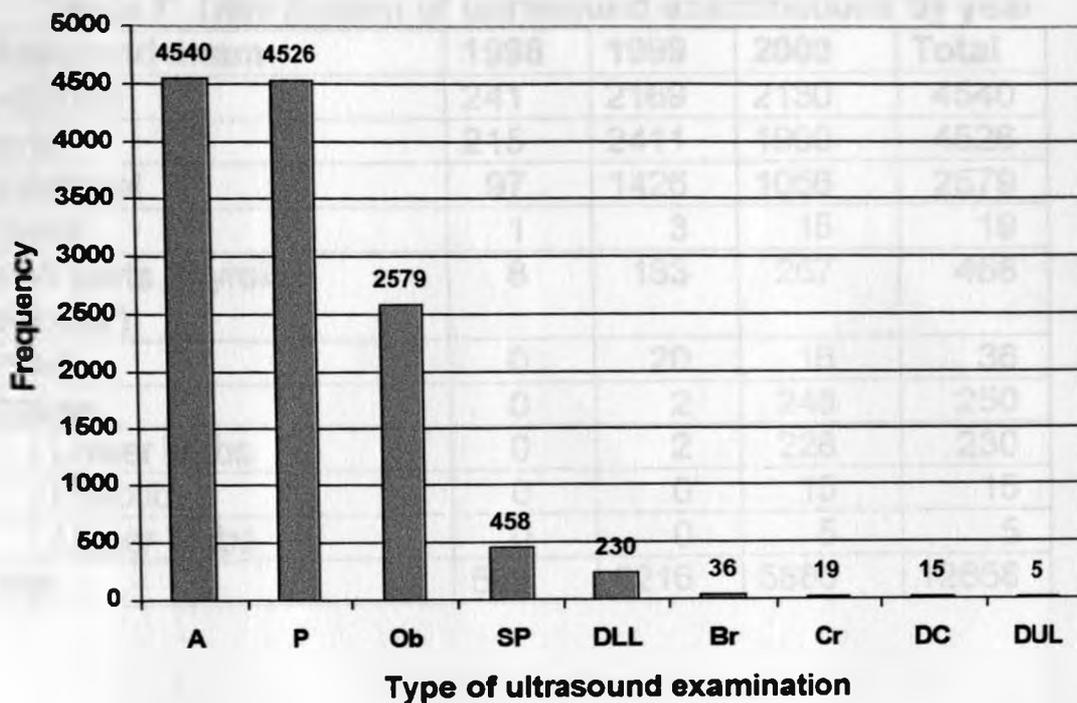
**Table 6b: Distribution of Color Doppler Examinations**

<b>Color Doppler examination</b>	<b>Frequency</b>	<b>Percent</b>
Lower limbs	230	92.0
Carotid	15	6.0
Upper limbs	5	2.0
Total	250	100

## Distribution of ultra sound examinations (%)



### Distribution of ultrasound examinations



Key: A = Abdomen; P = Pelvis; Ob = Obstetrics; SP = Small parts; DLL = Doppler-lower limbs; Br = Breast; Cr = Cranial; DC = Doppler-carotid; DUL = Doppler-upper limbs

Table 8: Distribution of plain radiograph examinations by year

Examination	1998	1999	2000	Total
Chest	24	180	204	478
Abdomen	173	302	1015	2090
Spine & hips	73	370	551	974
Other	304	1814	1300	3418
Total	574	2566	3170	6310
Head & paranasal sinuses	27	315	547	889
Hand/wrist	100	500	1175	1775
Other	4	63	119	186
Total	1035	2553	3056	6644

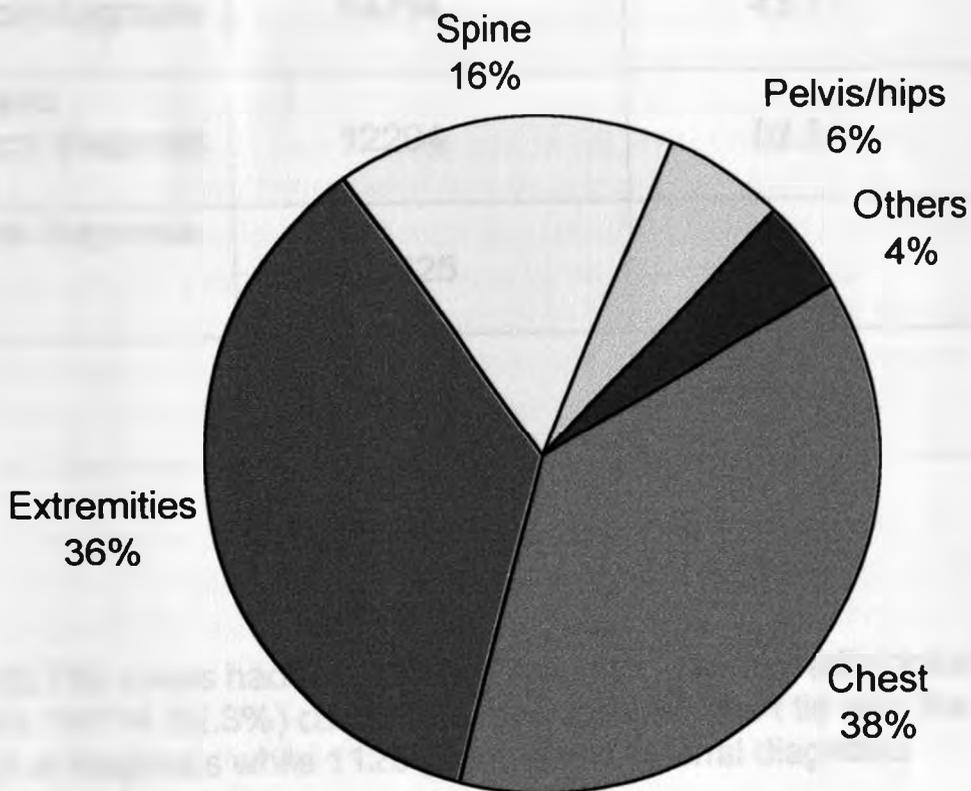
**Table 7: Distribution of ultrasound examinations by year**

<b>Ultrasound exam</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>Total</b>
Abdomen	241	2169	2130	4540
Pelvic	215	2411	1900	4526
Obstetrical	97	1426	1056	2579
Cranial	1	3	15	19
Small parts (thyroid, testicular)	8	183	267	458
Breast	0	20	16	36
Doppler:	0	2	248	250
: Lower limbs	0	2	228	230
: Carotid	0	0	15	15
: Upper limbs	0	0	5	5
<b>Total</b>	<b>562</b>	<b>6216</b>	<b>5880</b>	<b>12658</b>

**Table 8: Distribution of plain radiographic examinations by year**

<b>Plain examination</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>Total</b>
Skull & facial bones	24	160	294	478
Upper limbs	172	893	1015	2080
Pelvis & hips	73	370	531	974
Lower limbs	334	1614	1965	3913
Chest	302	2587	3355	6244
Cervical & thoracic spine	27	315	547	889
Rest of spine	102	663	1170	935
Plain abdomen	4	63	59	126
<b>Total</b>	<b>1038</b>	<b>6665</b>	<b>8936</b>	<b>16639</b>

### Distribution of plain radiographs



**Table 9: Referral and radiological diagnosis**

	<b>Frequency</b>	<b>Percentage</b>
Referral and radiological diagnosis tied	14714	43.7
Referral and radiological diagnosis didn't tie	12294	52.3
No referral diagnosis	1125	4.0
<b>Total</b>	<b>28133</b>	<b>100</b>

12294 (42.7%) cases had referral diagnosis tied with the radiological diagnosis, 14714 (52.3%) cases referral diagnosis didn't tie with the radiological diagnosis while 1125 (4%) had no referral diagnosis

## DISCUSSION

An audit of the pattern of radiological examinations done in the DDR\_UON between June and 1998 and November 2000 was done. A total of 28133 request forms and radiological reports from the records was analyzed where by 10830(38.5%) were females, 5743 (20.4%) males while 11560 (14%) had no sex indicated. Most of these cases 21546(76.5) had no age indicated; only 6587 (23.5%) had their age indicated. This is a common finding as it has been shown through experience (25) which showed 59.9% of all cases had no sex indicated in their request forms and 39.3% had no age indicated. Age and sex are very important in narrowing the list of your differential diagnosis especially when reporting the images, as some diseases are more common in certain age groups while others have sex preponderance.

Most of the cases 18370(65.3%) were referred with KNH request forms, 4980 (17%) with UON request forms, 113 (4%) from Aghakhan hospital and 4642 (16.5%) from other centers. This can be explained by the fact that at KNH there is many patients in the booking list and also they have bureaucracy in their mode of delivering the results. You may take 3days to more than a week before one gets his or her results, while this is not the case at IGU-UON where patients are examined as they come and the results are usually given on the same day within 20 to 30 min or sometimes earlier. This is possible because the staffs at the IGU-UON are hard working; well organized they have good leadership and are highly motivated. Motivation is good at IGU-UON because this unit acts as a source of income to them. The lower percentage are coming from the Aghakhan hospital and this is most likely due to the high cost of consultation, imaging as well as treatment offered at that hospital. So these are those few who cannot afford and decide to go to a place, which is relatively cheap, but with good quality service.

Plain films were found to be the most common type of investigation requested and it accounted for 51.4% which is lower compared to other studies done previously in Kenya and Tanzania in the years 1987 and 1988 respectively where it was found to be more than 97.7%(26). This is explained by the fact that during that time availability of other imaging modalities like ultrasound was not there.

Of the plain films chest radiographs were the commonest investigation requested accounting for 37.5%, which correlate well with findings from studies done previously in the same region where it was 46% and 35% in Kenya and Tanzania respectively (26). Plain abdominal radiographs were the least accounting for only 0.8%, which is much lower, compared to previous data obtained in the same region where it was found to be 4% and 11% in Kenya and Tanzania respectively (26). Availability of ultrasound facility and its easy accessibility has changed the pattern of examinations requested as it has been shown above. Currently abdominal, pelvic and obstetric examination are done using ultrasound which is free of ionizing radiation and has not shown any side effect or hazard when used in diagnostic quality range.

In this study gray scale ultrasound was top on the list accounting for 44.8%. Among gray scale examination done abdominal ultrasound and pelvic examination were top on the list with almost equal frequency accounting for 36.6% and 36.5% respectively. Obstetric ultrasound was 20.8% and cranial ultrasound was at the bottom accounted for only 0.1%.

Color Doppler ultrasound examination is a non-invasive technique of examining the blood vessels. It is becoming very popular nowadays for investigating or detecting thrombi.

Most of the referral diagnosis 52.3% did not tie with the radiological diagnosis while 43.7% the referral diagnosis tied with the radiological diagnosis and 4.0% had no referral diagnosis.

DDR provides a wide spectrum of medical services for the KNH hospital as well as other centers both within Nairobi and outside. Except for her end examination CT and MRI, which are still in the pipeline.

IGU-UON has been of great help for both undergraduate and postgraduate students as consultants are spending more time with the patients and the students. Also students are benefiting more with the teaching facility as they spend more time in the department leaning.

## CONCLUSION

Patient's care is good in the department of diagnostic radiology. There is no time wasted for the patient as they are recognized on arrival and attended in time. Results are given on the same day just a few minutes after being examined. Serious patients are given first priority for example patients with vaginal bleeding are attended first. The clerks, technicians, radiographers, secretaries and the radiologist are always at their place to fulfill their part.

This study is a baseline. The arrangements taken by the department of diagnostic radiology U.O.N at K.N.H can be used in other hospitals in both Kenya and outside to improve patient's care.

## RECOMMENDATIONS

1. Referring clinicians should realize the importance of documenting age and sex of the patients as most of the time the radiologist did not see the patient, only the images.
2. The staff at the reception desk at I.G.U-U.O.N must make sure that there is sex and age documented before the patient is examined, and the radiologist who is reporting should ask for the patient's age and or sex if it is not documented in the form as always the patient is around waiting for the results. .

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**DATA COLLECTION FORM**

Date, month and year of examination	
Patients number	
Patients age	
Patients sex	
Clinical diagnosis	
Radiological examination requested	
Clinical diagnosis on referral	
Radiological diagnosis	

## DATA COLLECTION FORM

Distribution of radiological examination obtained from Records:	TYPE OF EXAMINATION			
	Plain films	Gray scale U/S	Color Doppler U/S	Total
June 98-Aug. 98				
Sept. 98-Nov 98				
Dec 98-Feb. 99				
March. 99-May 99				
June 99-Aug. 99				
Sept99- Nov 99				
Dec 99-Feb 2000				
March 2000- May 2000				
June 200-Aug 2000				
Sept 2000- Nov 2000				