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Research Article

Knowledge, Attitudes and Practices of Referring Medical Practitioners Regarding the Justification of Radiological Examinations at the Ndola Teaching Hospital of Zambia

Osward Bwanga

Midland Regional Hospital at Tullamore, Radiology Department, Co. Offlay, Ireland

*Corresponding Author
Osward Bwanga

Abstract: The use of X-radiation in the diagnosis of diseases and injuries is a fundamental part of medical practice. In recent years, medical exposure of patients has increased globally and is becoming a public health concern due to adverse biological effects ionising radiation has on the human body. Medical practitioners have a responsibility to justify each medical exposure. In order to do this optimally, they should have knowledge in radiation protection. The aim of this study was therefore to assess the existing knowledge, attitudes and practices of medical doctors and clinical officers in relation to the delivery of medical exposures at the Ndola Teaching Hospital of Zambia. This study was conducted using a survey approach and data were collected using a questionnaire. All medical doctors and clinical officers working at the Ndola Teaching Hospital were invited to take part. The overall level of knowledge of the majority (55.2%) of the medical practitioners was judged unsatisfactory (<50%), (74.6%) had positive attitude towards medical exposures and 61.3% indicated adherence to the justification process. The Spearman's rank correlation coefficient and Mann Whitney U tests were conducted. The results showed that there was no relationship between the knowledge of medical practitioners and their attitudes and practices regarding the justification of medical exposures. Furthermore, there were no differences in the knowledge, attitudes and practices between medical doctors and clinical officers regarding the justification of radiological examinations. It was suggested that introduction of radiation protection programmes, referral guidelines and audits would further improve the justification process.

Keywords: referring medical practitioner, medical doctor, clinical officer, knowledge, attitudes, practices, radiation protection, justification, radiological examination.

INTRODUCTION

Since the discovery of X-radiation in 1895, radiological examinations have become an integral part of patient management in medicine. It is estimated that about 50% of the critical decisions in medicine is based on radiological examinations (Tavakoli *et al*., 2003). In the recent years, there has been an increase in global demand for radiology services following the introduction of modern imaging modalities. There is reason to assume that the use of radiation for medical purposes is going to continue to increase. According to the UNSCEAR Report (2008) the total number of diagnostic imaging examinations worldwide was estimated to have risen from 1.9 billion to 3.1 billion between 2000 and 2008. This has resulted in major improvements in the diagnosis and treatment of many diseases and injuries.

The global demand for radiological services has also resulted in an increased exposure of patients to ionising radiation. This is becoming a public health concern because it has been proven that ionising radiation has adverse biological effects on the human body (WHO, 2008). Exposure to ionising radiation could damage the cells of the living organisms, which may affect the functioning of the organs or lead to cancer. According to the World Health Organisation (2009), cancer has been identified as the biggest long-term risk of significant and repeated exposure to ionising radiation. Limited studies detailing the harmful effects of ionising radiation have been conducted in the

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United States of America (USA) and United Kingdom (UK). Some direct epidemiological data suggest that low doses of radiation as low as 10-50 mSv might be associated with a small risk of cancer induction (Brenner *et al.,* 2003). Additionally, Brenner (2004) estimated that of 600,000 patients exposed to CT examinations annually in the USA, about 500 might die from cancer attributed to radiation. In the UK, it is estimated that 700 radiation-induced cancer cases develop each year (Uri, 2012), and 250 people die annually as a result of cancer secondary to medical exposures (Arslanoğlu *et al.,* 2007). This calls for action to reduce unnecessary exposure of patients to radiation.

The radiation protection system for patients are governed by the principles of justification and optimisation. However, optimisation is outside the cope of this study. A radiological examination is justified if the benefits to the patient will do better than harm. Traditionally, the role of the justification of radiological examinations was largely delegated to imaging professionals. However, the referring medical practitioners have a joint responsibility in the justification process (IAEA, 2013). This is because the referring medical practitioners usually have the most complete picture of the patient's condition to guide the patient in undergoing only necessary examinations. In order to do this optimally, referring medical practitioners should have adequate radiation protection knowledge. This should be acquired whilst in medical school and supported by continuing professional development (CPD). Unfortunately, there is a global concern that less compliance exists for the justification of radiological examinations due to a lack of radiation protection knowledge among medical doctors (Soye & Paterson, 2008; Zewdneh et al., 2012; Famurewa et al., 2013)).

Zambia is also sharing the benefits of advances in diagnostic imaging and radiotherapy technology that make it possible for medical practitioners to quickly make a diagnosis and treat various diseases. Computed tomography, nuclear medicine and radiotherapy services have recently become readily available in teaching hospitals. Unfortunately, these modalities are a source of high radiation doses for the patients. Under the Ionising Radiation Protection Act of Zambia (2011), medical doctors and clinical officers have a legal responsibility as referrers to justify each radiological examination by:

- Communicating the benefits and risks of the examination to their patients.
- Clinically examining a patient before deciding to request any examination.
- Providing all relevant information on the radiology request form to allow the radiologist/radiographer to confirm the justification for the examination.
- Paying special attention to high dose examinations, such as CT scans.
- Considering non-ionising diagnostic imaging examinations, such as ultrasound (US).
- Making efforts in retrieving any previous X-ray images or reports before deciding to request another investigation.
- Consulting radiologists and radiographers when in doubt of the appropriate diagnostic imaging examination to request for a particular patient's condition.

The medical use of ionising radiation is the largest single contributor to world population exposure from artificial sources (WHO, 2008). In Zambia, it is estimated that approximately 70% of patients visiting hospitals are referred for radiology services (Ministry of Health, 2007). Despite this huge number of patients being exposed to medical exposures, there is no published research conducted to assess the knowledge, attitudes and practices of medical doctors and clinical officers regarding the justification of radiological examinations in Zambia. It is in light of this problem that this research was initiated.

METHODOLOGY

A quantitative research design using a cross-sectional survey was utilised in conducting this study. Polit and Beck (2013) defines a quantitative research as the systematic empirical investigation of phenomena that lend themselves to precise measurements and quantification. This design helped the researcher in assessing the existing knowledge, attitudes and practices of referring medical practitioners regarding the justification of radiological examinations. Furthermore, the cross-sectional survey approach helped the researcher in getting a picture of what was happening in a study population at a particular time (Maltby *et al.,* 2010).

Population and ampling

In this study the targeted population were medical doctors and clinical officers working at Ndola Teaching Hospital of Zambia. At the time of this study, the Ndola Teaching Hospital constituted of the Ndola Central Hospital and Arthur Davidson Children Hospital of Ndola. Radiologists and medical students were excluded from this study, since they do not refer patients for radiological examinations. In this study, the entire population of interest was included (N=120) due to the small size that was involved.

Data Collection Instrument

A self-completion questionnaire was chosen as the method of data collection. The questionnaire was chosen for this study because questions can easily be arranged and standardised (Denscombe, 2010). The questionnaire was divided into four sections: respondents' demographics, knowledge, attitudes and practices. The first section on demographics contained

five multiple choice questions on occupation, workplace, experiences, and education. The second section contained 16 multiple choice questions to test the knowledge of medical practitioners on radiation safety and risks. The third section contained 12 statements on attitudes, beliefs and misconception of medical practitioners regarding the justification of radiological examinations. The respondents were asked to indicate how they agreed or disagreed with each statement using 5-point Likert scale. The last section also contained 12 questions on practices of medical practitioners with regards to the justification of medical exposures. Respondents rated their practices on a 5-point rating scale with options of 'never', 'rarely', 'sometimes', 'very often', and 'always'.

After developing the questionnaire, a pilot study was conducted on 12 participants within the study population. The main purpose of the pilot study was to test the validity and reliability of the questionnaire. Polit and Beck (2013) defines the validity of a questionnaire as the extent to which it addresses the research question. Therefore, the face validity of the questionnaire was checked by 3 medical and diagnostic imaging experts. On the other hand, the reliability of a questionnaire refers to the consistency with which respondents understand and respond to all the questions (Maltby *et al.,* 2010). To ensure reliability, a test-retest statistical technique was employed to assess the knowledge questions, while Cronbach's alpha technique was employed to assess the attitudes and practice statements. The reliability analysis of the knowledge score yielded the test-retest value of 0.95, and Cronbach Alpha values of 0.70 and 0.80 for attitudes and practice scores respectively. The results were considered acceptable (Maltby *et al.,* 2010; Polit & Beck, 2013). Pilot study respondents were asked not to take part in the main study to avoid contamination of the final results.

Data Collection and Analysis

After determining that the validity and reliability of the questionnaire were acceptable, the recruitment flyers were then posted on the hospitals' notice boards. Furthermore, a list of medical doctors and clinical officers were obtained from the human resources department and the questionnaires were distributed to all 95 eligible respondents (excluding pilot study participants), via the hospitals' internal mail system. The respondents were asked to return completed questionnaire within three weeks, using self-addressed envelopes. The researcher had chosen to distribute the questionnaires by internal mail in order to reduce the cost, improve the anonymity and increase the response rate (Denscombe, 2010). However, there was an initial low response rate and a reminder was sent to respondents two weeks after the original administration date as a measure to maximise the response rate.

A quota of 16 points was allocated to the knowledge section. A correct answer was awarded one mark, whereas an incorrect answer, not sure, or omission received a zero mark. The total correct answers scored was used to classify the level of knowledge of respondents as 'satisfactory' if a total of 8/16 (≥50%) was reached and 'unsatisfactory' if lower than 8/16 (<50%). The fifty-percentage being a middle score was considered to be a suitable pass mark. Secondly, attitude statements that displayed favourable views were scored highly, while those that reflected an unfavourable opinion were scored lowly. This means that the positive statements scored as 5,4,3,2 or 1 of the responses of 'strongly agree', 'agree', 'undecided', 'disagree' and 'strongly disagree', while the direction of items scores was reversed for negative statements. Thirdly, items in the practice section were scored 1,2,3,4 or 5 for the responses 'never', 'rarely', 'sometimes', 'very often', and 'always', while the direction of items scores was reversed for negatively worded questions.

Data were analysed using both descriptive and inferential methods using SPSS Version 22 software. Non-parametric statistical tests were used to analyse attitude and practices of respondents. Spearman's rank correlation coefficient was used to determine if a relationship existed between knowledge, attitudes and practices of respondents. Furthermore, Mann Whitney U test was used to find out if differences between medical doctors and clinical officers existed. Statistical results were considered significant at $p < 0.05$.

Ethical Considerations

Permission to conduct this research was sought and obtained from the University of Dundee and Tropical Diseases Research Centre (TDRC) Research Ethics Committees. The information sheet was attached to each questionnaire explaining the aim and details of the study. To maintain confidentiality, all completed questionnaires were kept in locked locations, and only the researcher had access to this data. The completion and return of the questionnaire constituted consent to taking part in the study (Polit & Beck, 2013).

RESULTS

Out of 95 questionnaires distributed to medical doctors and clinical officers, 68 were completed and returned, giving a response rate of approximately 72%. There were no incomplete questionnaires among the returns. The majority 53 (77.9%), of the respondents were from Ndola Central Hospital. Of the respondents, the majority 53 (77.9%) were medical doctors, while 15 (22.1%) were clinical officers. The years of referral practice ranged from less than a year to more than 11 years. Amongst the 68 respondents, the majority, 64 (91.2%), had studied radiology and a third, 24 (35.3%), had received radiation protection education and training. Table 1 presents demographic characteristics of the respondents.

Table 1: Demographic characteristics of study respondents

Characteristics	Number	Percentage (%)
Occupation		
Medical Doctors	53	77.90%
Clinical Officers	15	22.10%
Total	**68**	**100.00%**
Work Place		
Ndola Central Hospital	53	77.90%
Arthur Davidson Children Hospital	15	22.10%
Total	**68**	**100.00%**
Years of referral practice		
<1 year	15	22.10%
1-2 years	10	14.70%
3-5 years	14	20.60%
6-10 years	14	20.60%
>11 years	15	22.10%
Total	**68**	**100.00%**
Radiology study at undergraduate		
Yes	62	91.20%
No	06	08.80%
Total	**68**	**100.00%**

Knowledge about Radiation Safety and Risks

The knowledge of 31 (44.8%) respondents regarding radiation safety and risks associated with radiological examinations was judged satisfactory (score ≥50%). Figure 1 represents the knowledge scores.

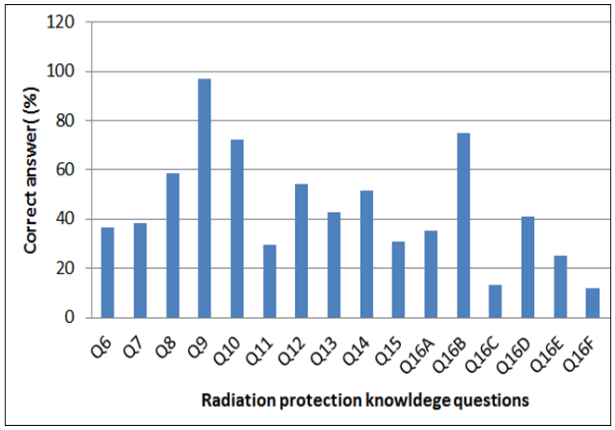

Figure 1: Showing knowledge scores on radiation safety and risks

Respondents were asked whether they were aware of any risk from radiological examinations and 66 (97.1%) declared that they were aware. To further test the levels of knowledge, respondents were asked to select the major source of radiation doses. Only a third 25 (36.8%), of respondents selected the correct answer, the natural radiation sources. When asked the meaning of the justification principle, only a few, 26 (38.2%), of respondents defined, it correctly as, medical exposure should do more good than harm. As for the question of who is responsible for the justification of examinations, over half, 40 (58.8%), of the respondents answered it correctly that it involves both the imaging professionals and referring medical practitioners. Respondents were also asked about the organisation responsible for enforcing radiation safety standards in Zambia. About 29 (57.4%), of the respondents did not know that the Radiation Protection Authority of Zambia is the responsible body.

Regarding the questions on clinical examples of deterministic and stochastic effects of ionising radiation, 20 (29.4%) and 37 (54.4%), of the respondents correctly selected all of the above choice (cataract, hair loss and infertility) and cancer respectively. With regard to the question on individual age groups most sensitive to ionising radiation, the majority, 49 (72.1%), of respondents correctly answered the unborn foetus. Respondents were also asked to select a true statement regarding the 10-day rule for females of childbearing age. Half, 35 (51.5%), of the respondents correctly selected 'only in the first 10 days after the beginning of the monthly menstrual period should a radiological examination be allowed' as the true statement. The question regarding the control of external radiation using time factor, a third, 21 (30.9%), of respondents answered it correctly, that barium enema examinations exposes patients to longer screening times.

Respondents were assessed on ionising and non-ionising diagnostic imaging examinations. In the list of six modalities, namely: MRI, plain film radiography, ultrasound, nuclear medicine, CT and

mammography, respondents were asked to tick examinations with a high radiation dose or low dose or no dose or not sure. The scores are presented in Table 2.

Table 2: Radiation dose scores associated with different types of imaging modalities

Modality	High dose	Low dose	No dose	Not sure	Total
Magnetic resonance imaging (MRI)	25.0%	19.1%	35.3%	20.6%	100.0%
Plain film (general radiography)	10.3%	75.0%	5.9%	7.4%	98.5%
Ultrasound	14.7%	72.1%	13.2%	-	100.0%
Nuclear medicine	41.2%	13.2%	8.8%	36.8%	100.0%
Computed tomography (CT)	25.0%	14.7%	20.6%	39.7%	100.0
Mammography	29.4%	11.8%	41.2%	17.6%	100.0%

Note: There was one missing value on plain film (general radiography) of 1.5%

As indicated in Table 2, MRI and US were correctly ticked as no dose examinations by 24 (35.3%) and 9 (13.2%), of the respondents respectively. Nuclear medicine and CT were correctly ticked as high dose examinations by 28 (41.2%) and 17 (25.0%) respondents respectively. Plain film and mammography were correctly ticked as low dose examinations by 51 (75.0%) and 8 (11.8%), the respondents respectively.

Attitudes of RMP towards Medical Exposures

Figure 2 shows, a large majority (74.6%), of respondents had positive attitudes towards the justification of medical exposures, 9.9% were undecided and 15.5% had negative attitude towards the justification of medical exposures.

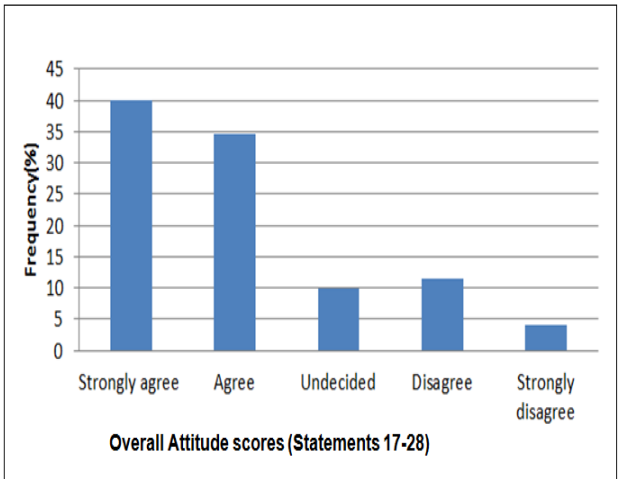

Figure 2: Attitudes towards medical exposures

The majority, 65 (95.6%), of respondents were of the opinion that awareness about radiation protection is important in reducing unnecessary medical exposures. On the statements on whether the integration of radiation protection into medical programmes and the inclusion of radiation protection topics during conferences could improve awareness levels, the majority, 62 (91.2%) and 66 (97.0%), of the respondents reported 'strongly agree' or 'agree' categories respectively. For the statements on whether low confidence of medical practitioners in the diagnosis and requesting for a radiological examination when results are unlikely to affect patient management could cause unnecessary medical exposures, more than half, 51(75.0%) and 62 (92.0%), of the respondents were in the 'strongly agree' or 'agree' categories respectively. For statements on whether CT for screening purposes and chest X-ray for medical examinations causes unnecessary exposures, the majority fell in the middle categories of 'agree' 'undecided' and 'disagree' with equal scores (n=16; 23.5% for each mentioned category), and less than half 20 (29.4%) of the respondents reported 'strongly disagree' or 'disagree' categories respectively.

For statement on whether a pregnancy test should be mandatory to all females of childbearing age undergoing radiological examinations, less than half 22 (32.4%) of the respondents reported 'strongly disagree' or 'disagree' categories respectively. On the issues of obtaining formal consent from patients undergoing radiological examinations, the majority, 41 (60.3%), of the respondents reported 'strongly agree' or 'agree' categories. For the statement on whether dialogue between medical practitioners and imaging professionals could help in reducing unnecessary examinations, 60 (88.2%), of respondents reported 'strongly agree' or 'agree' categories. The last two statements were on the introduction of referral guidelines and clinical audits and how these programmes could help reduce unnecessary medical exposures, many, 48 (70.6%) and 59 (86.8%), of the respondents were in the 'strongly agree' or 'agree' .

5.4.3 Practices of RMP Regarding Justification of Radiological Examinations

The results revealed that, most (61.3%), of the respondents indicated good adherence to the justification process of radiological examinations, while (38.7%) indicated poor adherence. The frequency at which respondents operationalised the justification principle of radiation protection is presented in Figure 3.

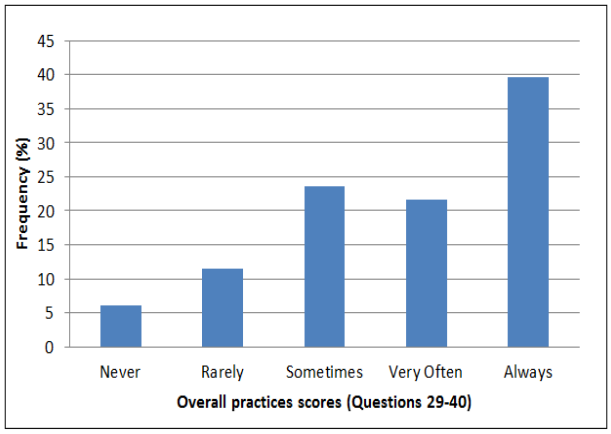

Figure 3: Showing practices of referring medical practitioners

About half, 37 (54.4%), of the respondents reported that they always balance the benefits and risks for each patient, while 5 (7.4%) never discuss the radiation risks with their patients. More than three quarters, 52 (76.5%), of the respondents always examine a patient before deciding to request an examination. Only 40 (58.9%), of the respondents indicated that they 'always' or 'very often' try in retrieving previous X-ray films before deciding to request a new examination. When asked if they provide information on the request forms, the choice 'always' was opted for by a large number, 49 (72.1%), of the respondents. Another question asked was whether they first consider non-ionising examinations during the justification process. Only less than half, 27 (39.7%), of the respondents selected the 'always' category.

In this study, about 25 (36.8%) and 27 (39.7%), of the respondents answered that they always put into consideration the age of the patient and pay special attention in justifying examinations with longer exposure times respectively. On the question, "how often you consult a radiographer /radiologist when unsure of which examination to request in a given clinical situation?" the choice 'always' was opted by 17 (25.0%) respondents. With regards to the question about self-presentation patients, 19 (27.9%) respondents stated that they 'never' refer patients who appeal for radiological examinations. Another issue examined was on female patients of childbearing age; more than half 40 (58.8%), of the respondents indicated that they 'always' ask their female patients of childbearing age about the possibility of being pregnant. When asked how often they request a repeat examination if not satisfied with the interpretation of an examination, few 14 (20.6), of the respondents were in the 'never' category.

Relationship between the Knowledge of RMP'S and their Attitudes and Practices

A Spearman correlation coefficient test was conducted to establish whether the knowledge of respondents relates to their attitudes and practices regarding the justification of radiological examinations. The test was conducted at a significant level of 0.05. The results are presented in Table 3.

Table 3: Correlation coefficient test results between knowledge, attitudes and practices of referring medical practitioners

		Knowledge	Attitudes	Practice
Knowledge (N=67)	Correlation Coefficient	1.000	.	.
	Sig. (2-tailed)	.	.	.
Attitudes (N=68)	Correlation Coefficient	.043	1.000	.
	Sig. (2-tailed)	.732	.	.
Practices (N=68)	Correlation Coefficient	.183	.011	1.000
	Sig. (2-tailed)	.138	.931	.

The results were not significant in all three cases: knowledge and attitudes (rho=-.043; p=.732); knowledge and practices (rho=-.183; p=.138); and attitudes and practices (rho=.011, p=.931). In other words, there was no relationship between the knowledge of medical practitioners and their attitudes and practices regarding the justification of medical exposures.

Comparison of the Knowledge, Attitudes and Practices between Medical Doctors and Clinical Officers

To determine whether the knowledge, attitudes and practices regarding the justification of radiological examinations differed between medical doctors and clinical officers, a Mann Whitney U test was conducted at a significance level of 0.05. The results in Table 4 indicate that there were no statistically significant differences in knowledge, attitudes and practices (U = 265, p = .099; U = 391, p = .923 and U = 354, p = .524, respectively). This means that medical doctors and clinical officers, had the same knowledge, attitudes and practices regarding the justification of radiological examinations.

Table 4: Mann Whitney U test results of the comparison of the knowledge, attitudes and practices between medical doctors and clinical officers

IV variables	Occupation	N	Mean Rank	Sum of Ranks	Mann-Whitney U	P value
knowledge (N=67)	Medical doctor	53	36.00	1908.00	265.000	.099
	Clinical officer	14	26.43	370.00		
Attitudes (N=68)	Medical doctor	53	34.62	1835.00	391.000	.923
	Clinical officer	15	34.07	511.00		
Practices (N=68)	Medical doctor	53	35.31	1871.50	354.500	.524
	Clinical officer	15	31.63	474.50		

DISCUSSION

Knowledge of Radiation Safety and Risks

This study found that 62 (91.2%), of respondents had studied radiology, but only 24 (35%) had received education and training in radiation protection. This finding is similar to previous studies that reported less than one in three medical doctors having received training in radiation protection (Almen *et al.*, 2009; Hamarsheh & Ahmead, 2012). However, a study by O'Sullivan *et al.* (2010) shown that education in radiation protection represents a good instrument for improving practitioners' knowledge on the justification of medical exposures.

Throughout world history, human beings have been exposed to natural background radiation. In this study, about 25 (36.8%), of respondents correctly identified natural radiation sources as the major source of the world population dose. This finding is similar to a previous study performed by Tavakoli *et al.* (2003) who reported that 34.6% of medical doctors in their study knew that natural sources expose patients to more radiation than other sources. It is estimated that 85% of the world population doses comes from natural sources, while the remaining 15% arises from man-made sources (WHO, 2008). Medical practitioners should remember that when exposing their patients to ionising radiation, they are further adding to the natural exposures.

In this study, almost all 66 (97.1%), of the respondents were aware of the risks from radiological examinations. The risk of medical exposure can only be minimised by justifying each examination, but the majority, 42 (61.8%), did not know the meaning of the justification principle. Essentially, it means that medical exposures should do more good than harm. The lack of knowledge of the justification principle may lead to unnecessary exposure of patients to radiation. One of the overriding principles applicable to patients that minimises external radiation exposure is restrictedness to the time during which an individual is exposed. Fluoroscopic studies such as barium enemas expose patients to longer screening times. Therefore, patients receive high doses of radiation from such procedures. According to International Atomic Energy Agency (2013) such procedures carry the risk of causing erythema to patients that have received high doses in a single or repeated procedure. Unfortunately, only 21 (30.9%), of the respondents answered this question correctly.

Respondents' knowledge on radiosensitivity is another important aspect of the justification process. Groups of individuals (elderly, adolescents, infants, and unborn foetus) have got different radiosensitivity, with the unborn foetus being the most radiosensitive (WHO, 2009). The biological effect of radiation depends on the age of an individual and the radiosensitivity of the tissue exposed. The majority 49, (72.1%), of respondents identified the unborn foetus as the most radiosensitive age group. Lack of knowledge may lead to exposing pregnant patients and children to unnecessary medical exposures. Medical practitioners should also be knowledgeable on the biological effects of radiation as some patients might present to them with a history and signs of deterministic and stochastic effects. According to the UNSCEAR Report (2006), the deterministic effects occur when a large number of cells have been damaged and as a result of that, the tissue structure or function is affected, while stochastic effects occur when cells are not killed, but are modified. Unfortunately, only 20 (29.4%), of respondents correctly identified all clinical examples of deterministic effects (cataract, hair loss and infertility) and 37 (54.4%), of the respondents correctly identified radiation induced cancer as a clinical example of the stochastic effects.

Medical practitioners' knowledge of the ways of protecting an unborn foetus is another aspect of the justification process. More than half, 35 (51.5%), of respondents knew the meaning of the 10-day rule. Tavakoli *et al.* (2003) also reported that the majority (65.9%) of medical doctors in their study correctly defined the 10-day rule. Under this rule, the radiological examination involving the pelvis may only be performed if the women's menstrual period commenced in the previous ten days. This is because the chances of being pregnant up to this time are minimal, since fertilisation takes place between the 11-14th day. However, in case of urgency an examination can be performed under the benefit versus risk consideration.

Referring medical practitioners should have the ability to compare the radiation doses that are associated with the various imaging modalities. Only 24

(35.3%) and 9 (13.2%), of the respondents identified MRI and US as no dose examinations respectively. The poor knowledge of MRI could be due to the absence of this modality at the Ndola Teaching Hospital. On the other hand, CT and nuclear medicine expose patients to relatively high doses in comparison to other diagnostic imaging modalities, such as general radiography. However, only 17 (25.0%) and 28 (41.2%), of the respondents answered correctly that CT and nuclear medicine are high dose examinations respectively. CT has just been introduced at the Ndola Teaching Hospital and most of the respondents might not be familiar with this modality, while nuclear medicine is not available. The lack of discrimination between ionising and non-ionising radiation examinations may lead to the poor justification of medical exposures.

Attitudes of RMP towards Medical Exposures

Radiation experts have inferred that the introduction of radiation awareness programmes could help in improving awareness among medical practitioners (ICRP, 2009; Malone *et al.,* 2012). A fairly high percentage 62 (91.1%) of respondents were in support of the integration of radiation protection topics into medical programmes and the inclusion of such topics during conferences to help in improving their knowledge regarding the justification of radiological examinations. In addition, 51 (75.0%) of respondents agreed with the statement that low confidence among medical practitioners in diagnosis could cause unnecessary medical exposures. Malone *et al.* (2012) points out that medical practitioners with low confidence in clinical assessment over rely on radiological examinations, thereby exposing their patients to unnecessary radiation. The majority, 62(92.0%), of the respondents also had an opinion that requesting for an examination when results are unlikely to affect patient management could cause unnecessary medical exposures. This is true (Royal College of Radiologists, 2012).

Another issue investigated related to the requesting of examinations for screening purposes. About 30 (44.2%), of respondents had a view that pre-employment chest X-rays do not cause unnecessary exposure to radiation. The main purpose of pre-employment screening is to avoid hiring an employee who could have a contagious disease such as pulmonary tuberculosis (TB) which could endanger other employees. Different views have been reported in the literature on this matter. Studies (Ladd *et al.,* 2006; Lohiya *et al.,* 2006) conducted in Europe have revealed low levels of discovery of TB by chest radiographs and is only conducted if there are special reasons pertaining to a particular employment. However, a review of chest radiographs conducted in Ivory Coast, a tropical region, country with prominent TB, identified about 7% chest pathologies likely to constitute a risk to the working community (Kouamé *at al.,* 2012). It was recommended that a chest X-ray is useful in pre-employment check-ups in the tropical environment, such as Zambia. However, the use of whole-body CT for screening purposes does not justify the high radiation dose received by patients from such a procedure (IAEA, 2013). Unfortunately, half, 34 (50.0%), of the respondents supported this unsafe practice.

Less than a quarter, 14 (20.6%), of respondents did not support the idea of obtaining formal consent from patients. The International Atomic Energy Agency (2013) states that in order for any patient to undergo a radiological examination, the patient or patient's legally authorised representative should be informed of the expected benefits as well as the risks. About 22 (32.3%), of the respondents did not support the notion of conducting a mandatory pregnant test on all females of childbearing age undergoing radiological examination. The ICRP (2003) recommends a pregnancy check for all females between the ages of 12 to 55 undergoing examinations involving the pelvic areas. These include performing a pregnancy test, where appropriate. However, a pregnant test may be necessary if the patient has missed the monthly menstrual period.

In this study, the majority 60 (88.2%), of respondents supported the view that dialogue between the referring medical practitioners and imaging professionals may help in reducing unnecessary examinations, as it can iron out issues without subjecting patients to further imaging. About (57%) of medical doctors had also a similar view in the study conducted by Moifo *et al.,* (2014). Another aspect of the medical practice is the use of guidelines. The referral guideline is the most useful tool in the justification process. Unfortunately, there are no radiology referral guidelines at the Ndola Teaching Hospital, but 48 (70.6%), of respondents supported the idea of introducing radiology referral guidelines. The World Health Organisation (2009) has estimated that radiation dose could be reduced by 30% by applying referral criteria. Once referral guidelines are in place, audits may be used for monitoring the use and compliance with such tools (Remedios, 2011). Again, the majority, 59 (86.8%), of respondents supported the idea of introducing audits relating to the justification process in meeting professional standards.

Practices of Referring Medical Practitioners

Although a great majority, 53 (77.9%), of respondents indicated that they always or very often balance the benefits and risks for each examination, it was noted that only 26 (38.2%) of them knew the meaning of the justification principle. One could wonder how they balance the benefits and risks if only a few understand the justification principle. On communication, the ICRP (2007) has recommended that medical practitioners should always inform their patients of the risks from radiological examination. However, more than half, 37 (55.4%), of respondents

indicated that they sometimes or rarely or never discuss the radiation risks with their patients. This finding supports the literature that there is poor communication between doctors and patients regarding the risks of medical exposures (Lee *at al.,* 2005; Malone *et al.,* 2012). In order to improve the communication, fact sheets on imaging examinations may be provided to the patients bearing the information on the benefits and risks.

In this study 4 (5.9%), of respondents reported that they 'sometimes' or 'rarely' clinically examine their patients before requesting an examination. This number is lower than the one found in the literature. Bosanguest *et al.* (2013) found that in a third (30%) of radiology requests, doctors do not clinically examine their patients. This practice could potentially expose patients to unnecessary radiation. However, 27 (39.7%) of respondents reported that they 'always 'or 'very often' consult the imaging professionals when unsure of which radiological examination to request. The consultation prevents requesting inappropriate examinations. In addition, 31 (45.6%) of respondents indicated that they 'always' or 'very often 'retrieve previous X-ray films before deciding to request for a new examination. This best practice prevents repeating investigations which have already been performed.

In this study 62 (91.2%), of respondents reported that they 'always' or 'very often' provide the necessary information on the X-ray request form, but audits conducted outside Zambia revealed that half (50%) of the request forms are often inadequately filled by referring medical practitioners (Akinola *et al.,* 2009; Afolabi *et al.,* 2012). It is important to adequately complete the request forms to avoid any misunderstandings, which might lead to radiographers performing a wrong technique and repeating the examination. Another cause of unnecessary medical exposures is self-presentation patients, who appeal to have a radiological examination undertaken. In this study, 58 (85.3%), of respondents reported that they 'never' or 'rarely' or 'sometimes' refer self-presentation patients for imaging. It should be mentioned that patients may only be referred for imaging if the medical practitioners are satisfied of the need for such a procedure after the clinical evaluation.

Relationship between the Knowledge of RMP'S and their Attitudes and Practices

This study found that there was no relationship between the knowledge of referring medical practitioners and their attitudes and practices regarding the justification of medical exposures. This finding does not agree with Contento (2010) who described that there is a linear relationship between knowledge, attitudes and practices. This means that as medical practitioners acquire knowledge through education and experience, their attitudes change, leading to changes in their practices. This unexpected result may be due to social desirability bias. Denscombe (2010) defined a social desirability bias as a systematic error in self-report measures that results from the desire of respondents to project a favourable answer. This means that some respondents may have exaggerated responses affecting the results.

Comparison of Knowledge, Attitudes and Practices between the Medical Doctors and Clinical Officers

This study found that there were no differences in the knowledge, attitudes and practices between medical doctors and clinical officers regarding the justification of medical exposures. A clinical officer is a mid-level practitioner of medicine who is qualified and licensed to perform general medical duties, such as diagnosis and treatment of diseases. However, one expects that medical doctors should have better knowledge, attitudes and practices than clinical officers. This may be due to the same education and training in radiation protection offered to both medical doctors and clinical officers.

CONCLUSION

This study addressed several gaps in the literature by investigating the knowledge, attitudes and practices of referring medical practitioners regarding the justification of radiological examinations. The knowledge was judged (<50%) unsatisfactory for the majority (55.2%) of medical doctors and clinical officers, but most (74.6%) had a positive attitude towards medical exposures and 61.3% reported adhering to the justification principle. In order to improve the knowledge base of medical practitioners, radiation protection CPD's programmes may be set up locally in the form of seminars and workshops. There may be a need to introduce locally produced referral guidelines based on local diseases and resources. These guidelines may be produced in collaboration with medical practitioners. Clinical audits of the justification process may also be established in order to improve the quality of radiology services. The implementation of these recommendations may facilitate and enhance the justification of radiological examinations at the Ndola Teaching Hospital.

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REFERENCES

1. Tavakoli, M.R., Toosi, S. & Saadatjou, S.A. (2003). Knowledge of medical students on hazards of ionising radiation. *Journal of Medical Education Spring* 3(1), 3-6.
2. UNSCEAR Report. (2008). Sources and effects of ionising radiation, volume 1: sources, annex D:

medical radiation exposures. Retrieved October 12, 2015, http://www.unscear.org /unscear /en/ publications.html.
3. World Health Organization. (2008). Global initiative on radiation safety in healthcare settings. Geneva: World Health Organisation.
4. Brenner, J.D., Doll, R., Goodhead, D.T. & Hall, E.J. (2003). Cancer risks attributable to low doses of ionizing radiation: Assessing what we really know. *Proceedings of the National Academy of Science.* 100 (24), 13761-13766.
5. Uri, I.F. (2012). Lack of radiation awareness among referrers: implications and possible solutions. *International Journal of Clinical Practice*, 66 (6), 574-581.
6. Arslanoğlu, A., Bilgin, S., Kubal, Z., Ceyhan, M.N., Ilhan, M.N., & Maral, I. (2007). Doctors' and intern doctors' knowledge about patients' ionizing radiation exposure doses during common radiological examinations. *Diagnostic and Interventional Radiology*, 13(2), 53-55.
7. International Atomic Energy Agency (2013). Referring medical practitioners. Retrieved July 10, 2015, from https://rpop.iaea.org/RPOP/RPoP/Content/Information For/HealthProfessionals/6_OtherClinicalSpecialities/referring-medical-practitioners/.
8. Soye, J. A. & Paterson, A. (2008). A survey of awareness of radiation dose among health professionals in Northern Ireland. *British Journal of Radiology*, 81 (969), 725-729.
9. Zewdneh, D., Dellie, S.T., & Ayele, T. (2012). A study of knowledge and awareness of medical doctors towards radiation exposure risk at Tikur Anbessa Specialized Referral and Teaching Hospital, Addis Ababa, Ethiopia. *Journal of Pharmacy and Biological Science*, 2(4), 01-05.
10. Famurewa, O.C., Ayoola, O.O., Ogunsemoyin, A.O., & Onayade, A.A. (2013). Radiation protection and dose awareness among doctors in a Nigerian Teaching Hospital: A preliminary study. *West African Journal of Radiology*, 20 (1), 37-40.
11. Ionising Radiation Protection Act of 2011 of Zambia, Lusaka: Government printers.
12. Ministry of Health (2007). Mapping of health links in the Zambian health services and associated academic institution under the Ministry of Health. Lusaka: Ministry of Health.
13. Polit, D. F., & Beck, C.T. (2013). Essentials of nursing research: appraising evidence for Nursing Practice (8th edition). Philadelphia: Lippincott Williams and Wilkins Ltd.
14. Maltby, J., Williams, G., McGarry, J., & Day, L. (2010). Research methods for nursing and healthcare. Essex: Pearson Education Limited.
15. Denscombe, M. (2010). The good research guide: for small-scale social research projects (4th edition). Berkshire: Open University press.
16. Almen, A., Leitz., & Richter, S. (2009). Report on national survey on justification of CT examinations in Sweden. Stockholm: SSM publishers.
17. Hamarsheh, A., & Ahmead, M. (2012). Assessment of physicians' knowledge and awareness about the hazards of radiological examinations on the health of their patients. *Eastern Mediterranean Health Journal*, 18 (8), 875-881.
18. O'Sullivan, J., O'Connor, O.J., O'Regan, K., Clarke, B., Burgoyne, L.N., Ryan, M.F., & Maher, M.M. (2010). An assessment of medical students' awareness of radiation exposures associated with diagnostic imaging investigations. *Insights into Imaging*, 1(2), 86-92.
19. World Health Organization. (2009). Children and radiation-WHO training package for the health sector. Retrieved February 10, 2015, from http://www.who.int/ceh/ capacity/ radiation.pdf.
20. UNSCEAR. (2006). Sources, effects and risks of ionizing radiation. New York: United Nations Scientific Committee on the Effects of Atomic Radiation.
21. International Commission on Radiation Protection. (2009). Education and training in radiological protection for diagnostic and interventional procedures. London: SAGE Publication Ltd.
22. Malone, J., Guleria, R., Craven. C., Horton, P., Rvinen, J.A., Mayo.J., Oreilly, G., Picano, E., Remedios, D., Heron, J., Rehani, M., Holmberg, O., & Czarwinski, R. (2012). Justification of diagnostic medical exposures: some practical issues. *The British Journal of Radiology*, 85(1013), 523-538.
23. Royal College of Radiologists. (2012). Making the best use of clinical radiology services: referral guidelines (iRefer). London: The Royal College of Radiologists.
24. Ladd, S. C., Krause, U., & Ladd, M. E. (2006). Are chest radiographs justified in pre-employment examination? Presentation of legal position and medical evidence based on 1760 cases. *Radiology journal*, 46(7), 567-573.
25. Lohiya, G. S., Tan-Figueroa, L., Lohjiya, P., & Bui, D. (2006). The futility of universal pre-employment chest radiographs. *Journal National Medical Association*, 98(12), 2019-2023.
26. Kouamé, N., Ngoan-Domoua, A.M., & Konan, A.N. (2012). Systematic chest radiography during pre-employment check-up. *African Journal of Respiratory Medicine*, 15(7), 15-17.
27. International Commission on Radiation Protection. (2003). Biological effects after prenatal irradiation (embryo and fetus). London: SAGE Publication Ltd.
28. Moifo, B., Edzimbi, A.L., Tebere, H., Tambe, J., Samba, R.N., & Fotsin, J.G. (2014). Referring physicians' knowledge on justification of medical Exposure in diagnostic imaging in a Sub-Saharan African Country, Cameroon. *Open Journal of Radiology*, 4, 60-68.

29. Remedios, D. (2011). Justification: How to get referring physicians involved. *Radiation Protection Dosimetry*, 147(2), 47-51.
30. International Commission on Radiation Protection. (2007). Recommendations of the International Commission on Radiological Protection. London: SAGE Publication Ltd.
31. Lee, C. I., Haims, A. H., Monico, E. P., Brink, J. A., & Forman, H. P. (2004). Diagnostic CT scans: assessment of patient, physician, and radiologist awareness of radiation dose and possible risks. *Journal of Radiology*, 231(2), 393-398.
32. Bosanguest, K.G., Cho, J.S., Williams, N., Gower, D., Thomas, K.G., & Lewis, M.H. (2013). Requesting radiological investigations-Do junior doctors know their patients? A cross sectional survey. *Journal of the Royal Society of Medicine*, 4 (1), 3-7.
33. Akinola, R., Akinkunmi, M., Wright, K., & Orogbemi, O. (2009). Radiology request forms: are they adequately filled by clinicians?. *The Internet Journal of Radiology*, 2(1), 41-44.
34. Afolabi, O. A., Fadare, J.O., & Essien, E. M (2012). Audit of completion of radiology request form in a Nigerian Specialist Hospital. Annals *of Ibadan Postgraduate Medicine*, 10(2), 48-52.
35. Contento, I. (2010). Nutrition education: linking research, theory, and practice. London: Jones and Bartlett Publishing international.