

Patients Experience in X-ray Exposures in Some Hospitals in Southern Ghana

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Abstract

The use of X-ray and other ionizing radiations for diagnostic, interventional and treatment purposes requires strict guidelines and restrictions in order not to put patients, operators of the equipment and the public at risk either directly or indirectly. This study was to independently ascertain if patients exposed to X-ray for either diagnostic or interventional purposes are taken through the appropriate safety protocol before and during the procedures as per the recommendations of International Commission on Radiological Protection (ICRP) under auspices of the International Atomic Energy Agency (IAEA) of the United Nations (UN). One thousand, four hundred patients from five regional capitals including the capital city were involved in the study. It was observed that most of the key guidelines were not strictly being followed. In some instances, women of childbearing age (11-55 years) were not asked any question about possible pregnancy before exposure, previous X-ray exposure histories were not considered and some patients were exposed to the X-ray without any protective gear. However, the findings also showed that there is a low probability of equipment malfunctioning or multiple shots being taken on a single visit. This observation makes X-ray exposure unsafe for many in a developing country like Ghana and the Radiation Protection Institute (RPI) must be resourced to enforce the required guidelines.

Keywords: x-ray, radiation protection, patient, guidelines

1. Introduction

Though X-ray exposure (radiology, CT scan, fluoroscopy) are considered safe and the dosage involved considered minimal with respect to background radiation from the environment (earth & space), the history of x-ray injuries provides contrary evidence (Lee *et al.*, 2004). There are no published studies that prove the direct causality between medical imaging and increased cancer risk. Current data on radiation exposure and cancer risk is based on data from survivors of atomic bombs, nuclear accidents and the early use of X-rays. The assumed increased risk of cancer from low dose medical exposure (CT scans and x-rays) is based on individuals exposed to high doses (atomic bombs and nuclear accidents). The theory that the increased risk holds true at these lower doses is called the linear no threshold model and is the currently adopted model for calculating radiation risk (Berrington de Gonzalez & Darby, 2004).

Apart from the x-ray protocols in setting x-ray equipment, the basic routines that a patient should be taken through should not be ignored in the name of "safe levels" and "risks are negligible"

1.1 History of X-ray injuries

The use of X-ray as a diagnostic imaging tool resulted in physicians and other medical radiation workers developing skin carcinomas, leukemia, dermatitis, cataracts, and other adverse health effects (Friebe, 1902; Rollins, 1904; Scott, 1911). Though recommendations were made to decrease stray radiation to the patient and restrict the x-ray beam (Rollins, 1904; Seibert, 1995), it took many years before the recommendations were implemented and radiation protection committees established (Walker, 1989). With the development and evolution of radiation dose measurement devices and general radiation protection equipment (Linet *et al.*, 2010), occupational doses declined dramatically (Linet *et al.*, 2010; UNSCEAR 2000), and the excesses of leukemia, skin cancer, and female breast cancer in medical radiation workers employed before 1950 were no longer apparent in subsequent medical radiation workers (Linet *et al.*, 2010).

From 1956 to the present, epidemiologic studies have also linked diagnostic x-rays with cancer increases in patients, including modest excesses of pediatric leukemia in the offspring of mothers undergoing diagnostic X-rays during pregnancy (Stewart *et al.*, 1956; Stewart *et al.*, 1958; MacMahon, 1962; Wakeford, 2008; Linet *et al.*, 2009). Increased breast cancer risks in women with tuberculosis were monitored using fluoroscopy (Boice Jr *et al.*, 1991; Howe & McLaughlin, 1996; Ron, 2003), and in women with scoliosis evaluated with repeated X-rays (Doody *et al.*, 2000).

1.2 Education and Regulation

While the need for education is very important, there are no widely available resources that provide information to both patients and health care providers about the increased risk of cancer from medical imaging (Lee *et al.*, 2004). Some of the safety guidelines for X-ray exposures include:

Unless prevented by the prescribed procedure, shielding of the gonads of all patients are to be provided, regardless of their age or childbearing capacity. -Specific area gonad shielding, that is gonad shielding that covers and is slightly larger than the region of the gonads, is used when the gonads will lie within the primary x-

ray field, or within close proximity (about 5 cm), despite proper collimation of the x-ray beam.

Specific area gonad shielding is not to be used as a substitute for careful patient positioning, proper beam limitation, correct technique factors and proper film processing. -Specific area ovarian shielding is used on female patients after having determined that she is not pregnant.

X-ray examinations must not be performed if there has been no prior clinical examination of the patient. It should be determined whether there have been any previous X-ray examinations, which would make further examination unnecessary, or allow for the ordering of an abbreviated examination. Relevant previous radiographs or reports should be examined along with a clinical evaluation of the patient.

When a patient is transferred from one physician or hospital to another any relevant radiographs or reports accompanying the patient should be reviewed by the consulting physician. When prescribing a radiological examination, the physician should specify precisely the clinical indications and information required.

The number of radiographic views, required in an examination, should be kept to the minimum practicable, consistent with the clinical objectives of the examination.

Before performing X-ray examinations on females of childbearing age (11-55 years), the patient must be asked whether there is any chance that they may be pregnant. Care must be taken to protect the fetus from radiation when the X-ray examination is not avoidable. Radiological examinations of the pelvic area in women of childbearing age should be undertaken in the ten-day period following the onset of menstruation, since the risk of pregnancy is very small during this period.

If a radiograph contains the required information, repeat procedures should not be prescribed simply because the radiograph may not be of the "best" diagnostic quality.

Once justified, the examination should be performed with minimal radiation dose. This requires achieving adequate image quality while keeping the exposure as low as reasonably achievable (ALARA principle) (IAEA 2001; HSWA 1974).

2. Materials and Method

A total of 1400 patients were interviewed using close-ended questionnaires from two regional capitals including the national capital Accra. The basic demographic information about the patients and part of the body exposed to the radiation was collected. The questionnaire was biased toward the basic routine a patient is expected to go through;- instructions given to the patient, enquiry of previous X-ray history, possible pregnancy enquiry in the case of females, protective gear provided during the procedure; multiple shots as a result of malfunctioning of X-ray equipment or wrong settings: The response to each of these critical questions/provisions was weighted as follows: 3 for yes; 2 for no; and 1 for no response. A cumulative weighted mean score of each question falling below 2.4 indicates a routine question or service not being provided and a cumulative weighted mean score greater than 2.4 implies adherence to a particular requirement. It must however be noted that the weighted mean score of each respondent was not used in the evaluation. The cumulative weighted mean score for each of the five critical questions was further used to obtain the Poisson's probability for a patient being taken through any of the five questions/provisions. The result is presented in figures 1 & 2 and table 1.

3. Results and Discussions

A total of 1400 patients aged between 19 and 69 years (450 in Accra, 450 in Kumasi, 200 in Koforidua, 150 in Takoradi, and 150 in Cape Coast) participated in the exercise after having undergone X-ray imaging procedure. In all 47.7% (45.8% from Accra, 41.1% from Kumasi, 42.5% from Koforidua, 65.3% from Takoradi, and 62.7% from Cape Coast) were females and 52.3% (54.2% from Accra, 58.9% from Kumasi, 57.5% from Koforidua, 34.7% from Takoradi, and 37.3% from Cape Coast) were males.

3.1 Previous history enquiry

On the overall 57.6% of the respondents indicated that their previous record was not considered. 71.8% from Accra, with 42% from Koforidua, 42.2% from Kumasi, 72.7% from Takoradi and 66.7% from Cape Coast. While those who responded in the affirmative had an overall of 31.4% (19.1% from Accra, 39.1% from Kumasi, 50.5% from Koforidua, 27.3% from Takoradi, 23.3%, and from Cape Coast).

The radiographers in Koforidua appears to be adhering to the guidelines of considering previous X-ray exposure history of patients before prescribing a new exposure (IAEA 2001 & HSWA 1974). This enquiry is meant to prevent unnecessary dose to the patient, especially if the information required can be obtained from the previous X-ray images of the patient. A mean weighted score of 2.10 to 2.43 implied the required provisions were not being followed. The probability that a patient's previous x-ray history will be considered before a new x-ray exposure is prescribed ranges from 18.9% to 21.1%. The importance of this critical question cannot be over emphasized especially in the light that every radiation dose counts in the well of the patient, and also that dose effects may vary for individuals, hence a standard dose for may not be safe.

3.2 Instructions provided

Instructions provided to patients vary with procedures required. Procedures requiring contrast in soft tissues requires the ingestion of certain drugs (like barium) may require instructions relating to diet or medication restrictions. Considering all the respondents, 36% indicated that instructions were provided to them, while 48.8% claim they were not given any instruction. 15.2% gave no response. In each of the regional capitals those who were given instructions ranges from 23.3% in Cape Coast to 40.5% in Koforidua. It is possible that the 48.8% of the respondents were those whose imaging procedures do not require diet or medication restrictions. A mean weighted score of 2.10 to 2.30 was obtained for this provision. The probability that a patient would be provided with instructions prior to the X-ray imaging procedure ranges from 18.9% in Cape Coast to 20.3% in Takoradi.

3.3 Enquiry about possible pregnancy

The concern for the health of fetuses in relation to radiation exposure is a major concern to health physicists and oncologists. Though some claim that the radiation impact during x-ray for a fetus is negligible, others are of the view that extreme care is required to protect all pregnancies and hence the need for this information from females of child bearing age (11-55 years), (IAEA, 2001; HSWA, 1974). The overall response indicated that out of the 668 female respondents, 35.2% were asked 'if they were pregnant?' 50.2% indicated that the issue was not raised. Enquiry about possible pregnancy had a weighted mean score ranging from 2.06 in Accra to 2.39 in Cape Coast, with the overall score of 2.21. The probability that a woman of childbearing age scheduled for an x-ray imaging procedure would be asked of the possibility of being pregnant ranges from 18.6% in Accra to 20.8% in Takoradi and Cape Coast.

3.4 Provision of protective gear

Both patients and X-ray machine operators are at risk due to ionizing radiation, necessitating the need of protective gears to reduce and prevent latter health complications. The exposures could be either from the primary (direct) or secondary (scatter) beams of X-ray. While the direct or primary implies being in the direct path of the X-ray beam, the scatter is a result of X-ray interaction with objects within the enclosure. The use of protection gears like gonad shields, thyroid shields, lead aprons, etc is important especially if these organs are not in the direct beam but close to the target organ (IAEA 2001 & HSWA 1974).

The weighted mean score for this provision ranges from 2.10 in Cape Coast to 2.34 in Koforidua, which implies that this provision is not being satisfied. In all 55.6% indicated that they were not provided any protective gears, while 30.4% indicated they were provided with protective gears. There is an 18.6% to 20.1% probability that a patient schedule for an X-ray imaging procedure will be provided with the required protective gear.

3.5 Equipment failure/malfunction

Each part of the body has its own protocols. This is to enable the best possible image quality to be obtained. Negligence on the part of the X-ray technician or equipment failure can or may lead to a poor image quality (under / over exposed). This may then lead to multiple x-ray exposures (more radiation dose) on one visit. 69.9% of the respondents (75.6% from Accra, 54.2% from Kumasi, 74% from Koforidua, 85.3% from Takoradi and 78.7% from Cape Coast) indicated that they were not subjected to multiple x-ray shots. The weighted mean score for equipment failure or malfunction ranges from 2.06 in Kumasi to 2.26 in Koforidua. The probability of an equipment failure or multiple shots on a single visit falls within the range of 18.6% to 20%. This implies that the equipment hardly malfunctions.

4. Conclusions

A low weighted mean score was obtained for the five issues relating to X-ray imaging procedures in the five regional capitals, including the national capital. The resulting low probability for: - previous records being checked; instructions being provided; possible pregnancy enquiry (females) and provision of protective gears implies non-adherence to the basic radiation protection guidelines, thereby putting patients at risk. The low probability for possible equipment malfunction, which could result in multiple X-ray exposures on a single visit, implies the equipment and its settings for respective procedures are reliable. The observations made stresses the need for vigorous education and regulation for both the public and radiologists with information on what to expect during X-ray diagnostic imaging and also provide the public with a platform to provide a feedback if the required routines are not being followed

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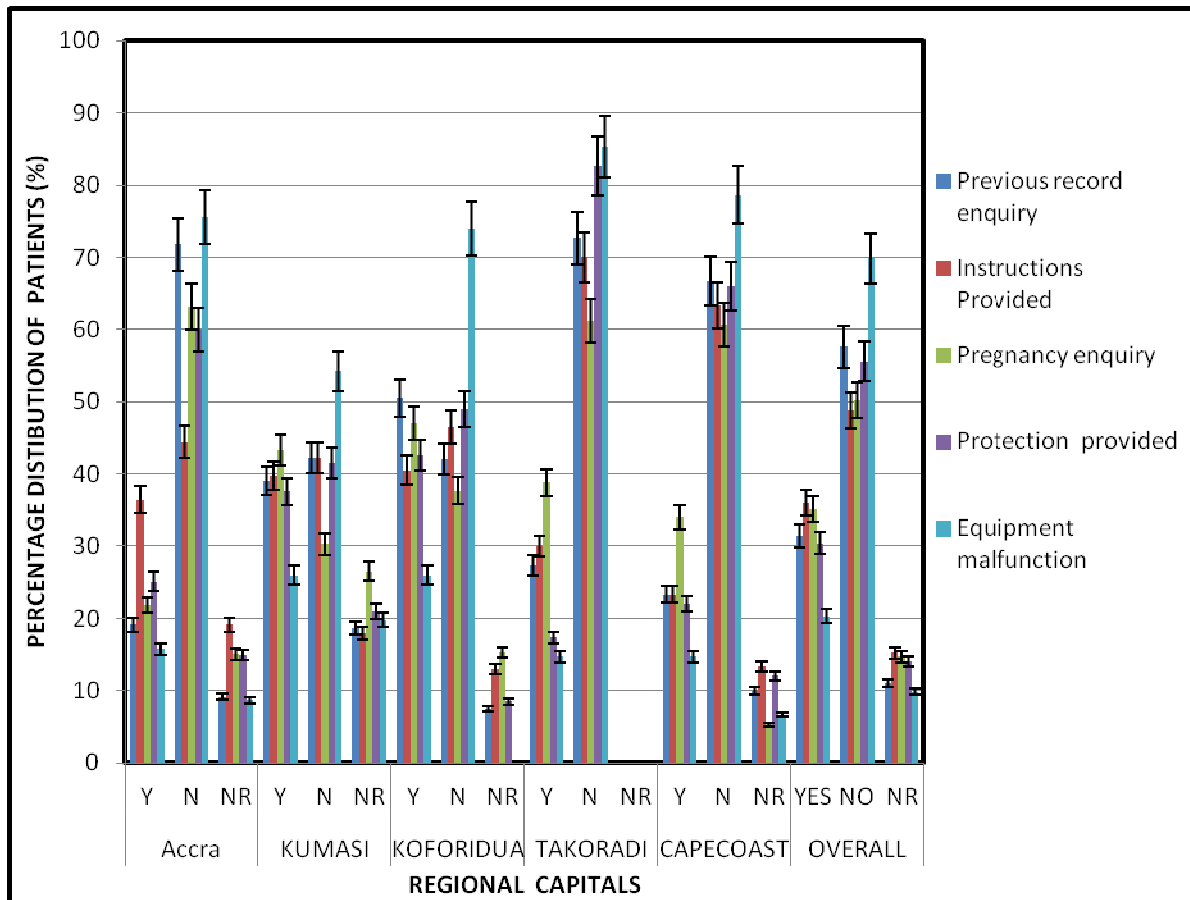


Figure 1: Percentage distribution of patients exposed to X-ray from five regional capitals Accra, Kumasi, Takoradi, Koforidua and Cape coast in Ghana, with 5% error

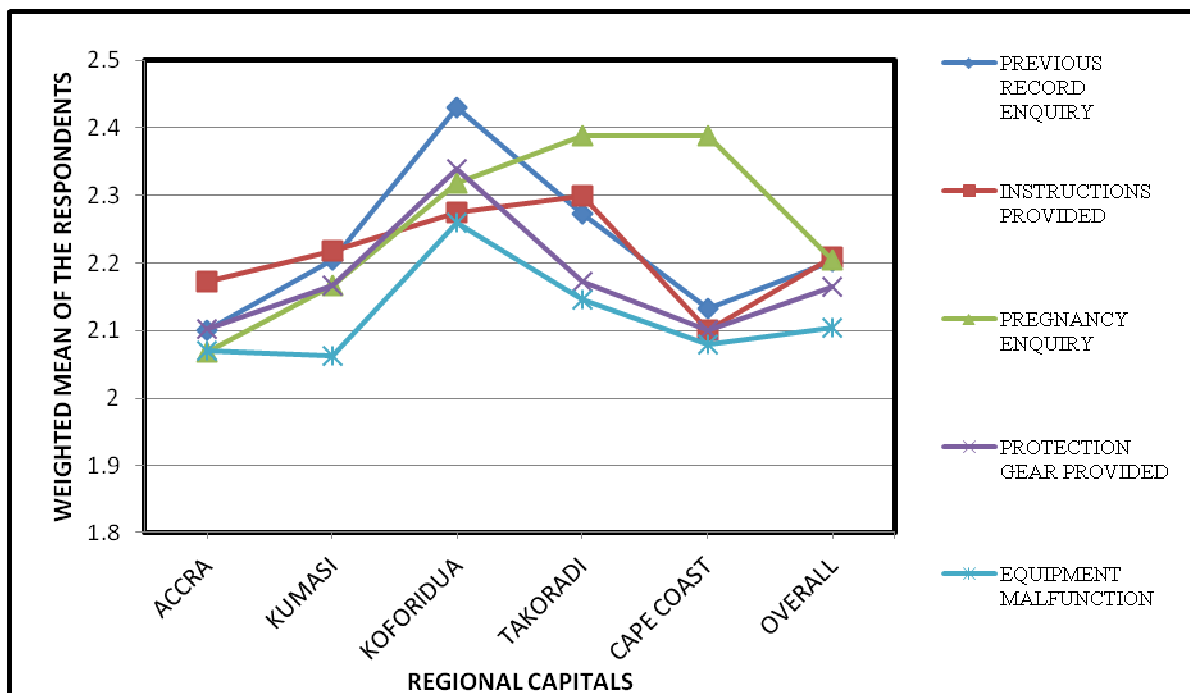


Figure 2: The Cumulative Weighted Mean Score for each critical question/provisions before X-ray an imaging procedure of patients.

Table 1: The Poisson's probability distribution for the five critical questions/provisions that a weighted mean score of 3.0 can be obtained.

	ACCRA	KUMASI	KOFORIDUA	TAKORADI	CAPE COAST	OVERALL
	Pr (3.0)	Pr (3.0)	Pr (3.0)	Pr (3.0)	Pr (3.0)	Pr (3.0)
Previous record enquiry	2.100	2.204	2.430	2.273	2.133	2.203
Instructions Provided	2.173	2.218	2.275	2.300	2.100	2.208
Pregnancy enquiry	2.068	2.168	2.318	2.388	2.389	2.205
Protection provided	2.102	2.167	2.340	2.173	2.100	2.164
Equipment malfunction	2.071	2.062	2.260	2.147	2.080	2.104

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