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# The Need for Good Radiation Protection in Diagnostic Imaging in Ghana

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**Abstract:** The need to re-examine radiation protection and safety measures to protect the people in Ghana is therefore essential. This is because medical X-ray diagnosis in the country continues to increase. It is the responsibility of the radiation worker to protect patients, self, staff and the members of the public against unnecessary exposure to ionizing radiation. Medical radiation protection is an important aspect of quality care that X-ray departments are expected to provide for their patients. Following increasing concern about radiation hazards from medical diagnostic x-ray, radiation dose assessment of patients undergoing medical diagnostic x-ray examinations has been suggested. However, to implement them requires an effective infrastructure which includes adequate laws and regulations, efficient regulatory system, experts on radiation protection and operational provisions.

**Keywords:** Radiation Protection, Diagnostic Imaging, Regulation, Implementation

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## 1. Introduction

Medical X-rays a low dose ionizing radiation for diagnostic purposes provides potential benefits to the health care of patients and therefore basically an accepted part of medical practice (Department of Health, 2001; Shiralkar, et al, 2003). However, its application has been regulated in several countries because of its potential hazards beside the benefits in patient care. In Ghana, regulations for the use of ionizing radiation for both medical and industrial purposes were introduced quite recently (Schandorf and Tetteh, 1998). Meanwhile, radiological services have been provided in the country for several years (Schandorf et al, 1995).

Also medical X-rays are the largest source of man-made ionizing radiation exposure to the Ghanaian population. To date no study has been done regarding the knowledge, beliefs, attitudes and behaviours of diagnostic radiographers and radiological technicians in the country towards radiation protection. Asmundsdottir and Kaplan, (2000) stated that bringing out the attitudes of professionals towards an issue of their practice will help determine the state of that condition. As a professional concern, Dowed and Tilson (1999) are of the view that a profession like radiography which is seeking to attain autonomy should exhibit professionalism by practicing radiation protection. An investigation by

Schandorf and Tetteh (1998) showed that radiation dose levels in Ghana from the most routine X-ray examinations, are far above the levels set by the International commission on Radiological protection (ICRP) 60 (1990) and that of the Committee of the European Commission (CEC) 1990 on radiation protection. Their investigation did not comment on the attitude or behaviour of the radiographers and the radiological technicians as a factor contributing to this high dose levels.

However, high absorbed dose levels of radiation irrespective of the cause, poses radiation risk to the population. Evidence in recent years shows that low dose ionizing radiation which include diagnostic X-rays carries with it some degree of risk (Benke, 1995; Department of Health, 2001; Picano, 2004). Cohen (1991) in a study found that energy deposited by ionizing radiation in the human tissue has a greater health effects than any other form of tissue trauma. Based on this and other available evidence both past and current, the Department of health UK suggests the need to give attention to the potential harm, however small, arising from the lowest levels of absorbed dose of ionizing radiation and also avoid exposures which are unhelpful.

The need to re-examine radiation protection and safety measures to protect the people in Ghana is therefore essential.

This is because medical X-ray diagnosis in the country continues to increase (Schandorf and Tetteh, 1998). It is the responsibility of the radiation worker to protect patients, self, staff and the members of the public (Dowed and Tilson, 1999) against unnecessary exposure to ionizing radiation. Medical radiation protection is an important aspect of quality care that X-ray departments are expected to provide for their patients.

## 2. Background

Radiation protection is a term applied to concepts, requirements, technologies and activities that tend to protect the people (radiation workers, members of the public, and patients undergoing radiation diagnosis and therapy) against the hazards of ionizing radiation (Cunningham et al, 2004). In recent times discussions on risk posed by various conditions, such as technology and environment has been a matter of great concern to the society (Osei et al, 1997). Among the factors that can cause risk to the health and activities of the population of any country is the exposure to ionizing radiation (Walker, 1989). Medical X-rays being ionizing radiation for diagnostic purposes provides potential benefits to the health care of patients (Department of Health, 2001; Shiralkar, et al 2003).

However, a long term malignant disease in those irradiated has been found to be an associated risk of exposure to ionizing radiation (Department of Health, 2001). Also the Department of Health further states that there is low risk of hereditary disease in the offspring of those who have been exposed. Additionally there is the assumption that the chances of having these adverse effects are directly proportional to the level of exposure without any threshold (Department of Health, 2001). Based on this the Department of Health suggests the need to give attention to the potential harm, however small, arising from the lowest levels of absorbed radiation dose and also avoid exposures which are unhelpful. Although the application of ionizing radiation for medical purposes is not in a large scale in Ghana (Schandorf et al, 1995) as compared to industrialized countries, there is the need to establish a strong radiation protection and safety culture to protect the population against unnecessary radiation exposures. This is because 60% of personnel exposure working in hospital x-ray departments in the country are being monitored (Schandorf et al, 1996) due to large diagnostic x-ray facilities compared to industry, research and teaching.

By the amendment of the Ghana Atomic Energy Commission (GAEC) Act 204, 1963, the Radiation Protection Board (RPB) 1993 was established through the Provisional National Defence Council Law 308. The RPB was charged with the responsibility of seeing to all forms of ionizing radiation and safety issues of the country (Schandorf et al, 1995). Medical and industrial importation and use of ionizing radiation or devices emitting them became regulated by the power vested on the RPB. The current regulations for radiation protection in Ghana depend almost exclusively on the recommendations of the International Commission on

Radiological Protection (ICRP).

A study by Schandorf et al (1998) provides a representative dose data in Ghana which hitherto, was not available. It served as a baseline for comparison of measurements in individual X-ray departments in the country. Their investigation assessed the radiation doses to patients in selected and most frequent x-ray examinations. These were chest, skull, abdomen, pelvis and lumbar spine. In terms of frequency, Chest x-ray accounted for (46.5%), skull (8.0%), lumbar spine (9.0%) whilst pelvis and abdomen together were (7.8%). The mean entrance (skin) dose during the survey for patients close to the standard 70kg weight and 20cm AP trunk thickness were compared with the Commission of European Communities' (CEC) guideline values for the same selected anatomy. The findings showed higher mean dose greater than that set by the CEC and the International Commission on Radiological Protection (ICRP), (1990). This is an indication that doses being received in Ghana are high. A recent report from the National Radiological Protection Board (NRPB) (2004), indicate that although benefits of medical exposures might exceed the risk a review of current studies gives a different picture. The National Radiation Protection Board (NRPB) (2004), indicate that although benefits of medical exposures might exceed the risk a review of current studies gives a different picture.

According to the NRPB revised radiation effects models used to predict dose to patients shows that one out of a few hundred or more could get fatal cancer after undergoing extensive x-ray examinations. In particular, when the patient is young, have a long-standing illness or severe injury (NRPB 2004). The need to justify, optimize and limit x-ray exposures has been recommended by the ICRP 60 (1991).

Until coming out with this recommendation the widely held view was that clinical benefits of diagnostic radiography procedure to the patient far out-weigh the risk and so all examinations were justified (Wootton, 1993). As much as this assumption still holds valid, there is still the need to optimize the application of ionizing radiation within the concept of a reference level of exposure. The theoretical background for radiation protection recommended by ICRP provides the basis for all activities and guidance applicable to specific situations of the use of ionizing radiation. It is difficult to state that justification and dose optimization are being adhered to as there is no current data in the hospitals to prove it. Because of the unpredictable nature of effects of ionizing radiation from medical X-rays, several countries are putting up all forms of measures to control its application without compromising patient management.

One such controls is the guidelines that have been published by the Royal College of Radiologist (RCR) (2003), "Making the best use of a department of clinical radiology" and the "Referral guidelines for imaging" by the European Commission (2000). These developments heightens the need to develop radiation protection and safety culture in developing countries such as Ghana where radiation protection infrastructure might not be in the same level as in

most developed worlds.

### 3. Biological Aspects of Ionizing Radiation

Epidemiological investigations have established with enough data that there is risk of cancer in man following exposure to ionizing radiation (Cox et al, 2004). Also several studies provided evidence that risk of childhood cancer after mother's exposure during pregnancy is real (Cox et al, 2004). Radioactive materials or devices that emit particles or electromagnetic waves are able to break atoms into smaller particles called ions. The emission of the particles is called radiation and the disintegration of the atoms into ions is called ionization hence the name ionizing radiation (Dowed and Tilson, 1999). Because the body contains a lot of water, radiation is capable of breaking the water molecules into ions called free radicals which are very reactive and can subsequently lead to chemical changes in the organic molecules in the cell of the body with dangerous effects (Dendy et al, 1998).

The deoxyribonucleic acid (DNA) is a vital organic molecule which is highly susceptible to the potential risk ionizing radiation poses to cell tissues (Dixon and Dendy, 2003). The DNA carries several vital life processes in man and therefore these permanent changes that occur as a result of the exposure to radiation may manifest itself as inherited genetic effects or as a cancer (Myers, 1993). Studies conducted shows that radiation has the capability of killing cells and usually it is the DNA which has always been the target for both cell death and long term adverse effects (Deny et al, 1998). The linear no-threshold (LNT) model of radiation protection indicates that risk to noising radiation will not be different in relative magnitude when large doses are given to a small number of persons or smaller doses are administered to large number of people provided the collective dose are the same (Dendy et al, 1998). The collective dose according them is the product of the number of persons multiplied by the dose. As mentioned above, radiation use in Ghana is not in a wider scale, however, dose levels are high (Schandorf, et al, 1995). However, the Schandorf et al study failed to provide the reasons for these high dose levels. Their study neither described the equipments nor the problems leading to this higher levels of dose.

### 4. Conclusion

Following increasing concern about radiation hazards from medical diagnostic x-ray, radiation dose assessment of patients undergoing medical diagnostic x-ray examinations has been suggested (Johnston and Brennan, 2000). This is because radiation dose assessment can reveal differences in patient dose and the cause of these variations. This can assist in investigating areas that require dose reduction (Shrimpton, et al, 1986). The concepts of radiation protection in all

countries essentially integrate the ICRP recommendations (Cunningham et al, 2004). However, to implement them requires an effective infrastructure which includes adequate laws and regulations, efficient regulatory system, experts on radiation protection and operational provisions (Cunningham et al, 2004). They further suggest that it is vital to establish an attitude and behaviors shared by all those involved with protection responsibilities. This according to them should include, workers through management levels which ensures that protection and safety matters are given high priorities.

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