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KNOWLEDGE, ATTITUDE AND PERCEPTION OF RADIATION IMAGING AMONG MEDICAL STUDENTS IN LIBYAN HOSPITALS

MASTER THESIS

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ABSTRACT

KNOWLEDGE, ATTITUDE AND PERCEPTION OF RADIATION IMAGING AMONG MEDICAL STUDENTS IN LIBYAN HOSPITALS

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The study which focuses on knowledge, attitude and perception of radiation imaging among medical students in Libyan Hospitals uses a quantitative method for the research by considering 300 questionnaires to address the targeted aim of the study in order to describe the demographic characteristics of the students and answering the research questions. The results shows that the study was dominated by males between the ages of 31 to 40 and are single working in radiography department as doctors with a monthly income of less than 500 USD.

Regarding the knowledge of radiation hazards, the workers know of acute radiation sickness such as nausea and vomiting and skin injuries such as erythema, skin pigmentation, dermatitis, hair loss and skin desquamation, the workers perception regarding protective devices for reducing radiation exposure, they perceived that the use of lead apron, lead goggles and thyroid shields is best protective device for reducing radiation exposure. In terms of consistent use of PPDs and dosimeter, the medical workers consistently make use of lead goggles, lead apron, thyroid shield and dosimeter (TLD) badge and they are aware that film-badge normally used as protective device, there is no periodical examination of workers who work with radiation equipment, and the radiology department is aware that thyroid shield, and lead goggle are also used as protective devices from radiation exposure.

The medical students have knowledge of the SI unit of absorbed dose equivalent and the SI unit for measurement of radioactivity, but they are not aware that CT scan and ultrasound involves the usage of x-rays though they know that mammography and MRI involves the usage of x-rays. The research question; “What do radiographers and dental professionals know about ionizing radiation exposure?" indicates that in the radiography department, there is a tendency that 49% know about ionizing radiation exposure in relation to all the harm it might cause. The question, "What is the healthcare workers level of awareness of radiation?" shows that administrative staff has the lowest awareness of radiation. The answer to the question, "What is the healthcare workers' perception of radiation?" indicates that the relative proportions of health-care workers are not independent of the perception of radiation.

Keywords: radiation exposure, perception, X-ray, awareness, attitude.

ÖZET

LİBYA HASTANELERİNDEKİ TIP ÖĞRENCİLERİNİN RADYASYON GÖRÜNTÜLEME KONUSUNDA BİLGİ, TUTUM VE ALGI DÜZEYLERİ

Mohamed ELTAHER ALI EHMAIDA

Yüksek Lisans, Çevre Eğitimi ve Yönetimi
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Libya Hastanelerindeki tıp öğrencilerinin radyasyon görüntüleme ile ilgili bilgi, tutum ve algılarını belirlemeye üzerine odaklanan çalışma, öğrencilerin demografik özelliklerini tanımlamak ve cevap vermek amacıyla araştırmada 300 kişiye anket uygulanmıştır ve araştırma sorularına cevap aranmıştır. Sonuçlar, çalışmanın, 31 ile 40 yaş arasında radyoloji bölümünde tek çalışan ve aylık gelirlerinin 500 USD'nin altında olan erkek doktorlar tarafından domine edildiğini göstermektedir.

Radyasyon tehlikeleri ile ilgili olarak, işçiler; bulantı ve kusma gibi, deri pigmentasyönü, dermatit, saç dökülmesi ve cilt deskuamasyonu / pul pul dökülmesi gibi cilt rahatsızlıklarını biliyorlar, ve işçilerin, radyasyon maruziyetini azaltmak için koruyucu cihazla ilgili algıları ile ilgili olarak, kurşun önlük, kurşun gözlük ve tiroid zırhlarının / kalkanlarının kullanılmasının, radyasyon maruziyetini azaltmak için, en iyi koruyucu cihaz olduklarını algılamışlardır. Kişisel koruyucu donanımların (kkd) ve dozölçerin/damlalığın tutarlı kullanımı açısından, tıp çalışanları sürekli olarak kurşun gözlüğü, kurşun önlük, tiroid siperi/kalkanı ve termolüminesant dozimetre (TLD)/ dozölçer işareti / rozeti kullanırlar ve onlar, film rozetinin normalde koruyucu cihaz olarak kullanıldığının farkındadırlar. Radyasyon cihazları ile çalışan işçiler için periyodik muayene yoktur ve radyoloji departmanında çalışan işçilerin, tiroid kalkanının/siperinin ve koruyucu gözlüklerin radyasyona maruz kalmadan önce koruyucu cihaz olarak kullanıldıklarının farkındadırlar.

Tıp çalışanı öğrenciler, absorbe edilmiş doz eşdeğeri Uluslararası Birimler Sistemi (SI) birimi ve radyoaktivitewnin ölçülmesi için (SI) birimi hakkında bilgilidirler; ve mamaografi ile emarın (MRI) X-ray ışınlarını içerdiğini bilmelerine rağmen, Bilgisayarlı Tomografi (BT) taraması ve ultrasonun X-ray ışınlarının kullanımının X-ray içerdiğinin farkında değildirler. Araştırma sorusu olan “radyologlar ve diş hekimleri, iyonize radyasyon maruziyeti hakkında ne biliyorlar?” sorusunda, neden olabileceği tüm zararlara bağlı olarak iyonize edici radyasyonun maruziyetini radyografi bölümünün %49’unun bildiği hususunda eğilim vardır; “radyasyona karşı sağlık hizmeti çalışanlarının farkındalık seviyesinin ne olduğu” ile ilgili soruda, idari personelin radyasyona karşı en düşük düzeyde farkındalığa sahip olduğu ortaya çıkmaktadır. Sağlık hizmeti çalışanlarının farkındalığının ne olduğu sorusunda, sağlık hizmeti çalışanlarının, göreceli oranlarda, radyasyona karşı bağımsız olduklarına işaret edilmektedir.

Anahtar kelimeler: radyasyona maruz kalma, algılama, x-ray, farkındalık, tutum

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ABBREVIATIONS

ALARA	As-low-as sensibly achievable
ANOVA	Analysis of variance
CBCT	Cone-beam computerized tomography
CT	Computed Tomography
DNA	Deoxyribonucleic acid
GD	Government Decrees
GPs	General practitioners
Gy	Gray
HBM	Health Belief Model
LNT	Linear-no-threshold
MRI	Magnetic resonance imaging
mSv	Millisieverts
NRO	Nuclear Regulatory Office
PPDs	Personal Protective Devices
SI	System International
SPSS	Statistical package for social sciences
Sv	Sievert
TLD	Thermoluminescent Dosimeter
TNRC	Tehran Nuclear Research Center
H_T	Dose equivalent to organ T
W_T	Specific weighting factor for organ T
%	Percentage

INTRODUCTION

Ionizing radiation from medical applications represents the majority of radiation doses from artificial sources to which the general population is exposed. This is the consequence of a steadily increasing demand for radiological examinations with particular reference to multi-detector computed tomography (MDCT), which alone accounts for about 50 % of the overall medical radiation exposure (Hricak et al., 2011). Though this has been paralleled by a dramatic evolution of imaging technology over the last decade, it is often worsened by a lack of appropriateness and optimization criteria by both referring physicians and radiological staff (Brenner and Hall, 2007; Mettler et al., 2008; Lauer, 2009; Costello et al., 2013). Recently, efforts by both vendors and societies were carried out to reduce radiation doses and sensitize users and patients to the issues of radiological protection (Mahesh and Durand, 2013).

Radiation is a component of man's physical environment, and is broadly classified into ionizing and non-ionizing radiation. The most energetic form and of major public health significance is ionizing radiation. In normal circumstances 80% of our exposure to ionizing radiation comes from natural sources of which radon gas is by far the most significant, while the other 20% comes from man-made sources, primarily medical X-rays. Radiation can be ionizing or non-ionizing, the first of which is critical. Exposure to ionizing radiation is not only related to medical and occupational use, but also to the natural radiation in the environment, usually about 88% (Walden & Farzeneh, 1990). We are all exposed to radiant energy, which turns the sun into a source of radiation that can penetrate into the cells (Nias, 1998).

Even the harmful effects of radiation were recognized before the discovery of the x-ray, which showed that any amount of radiation could pose a risk of cancer and genetic disorders. The acute dose is also chronic dosed to the body, but the chronic exposure at low doses is dangerous, as the body is at any given time (Hinwood, 1993), a smaller percentage of the cells take up time. This is a low chronic dose taken via occupational exposure to radiation. These effects are not directly measurable on the populations of workers exposed to risks, so risk estimates in occupational levels are based on risk factors measured at high doses (Hinwood, 1993). It was caused by the advent of radiation technology and the recent catastrophic public interest. The nuclear catastrophe severity in Japan in March 2011 initially described as bad compared to the previous nuclear catastrophes, such as Chernobyl in 1986, when concluded.

All the measures taken to evacuate people to prevent the cooling system from running and the leakage of electromagnetic materials were done to protect the environment and especially to avoid the surrounding communities from the effect of the radiation (Tromp et al., 2011). Radiation in the United States has not direct effects, which can take years to be fully implemented in terms of environmental impact and human health.

1.1 Problem

Attitude, knowledge and how radiation imaging is perceived among Libyan medical students due to radiation effects.

1.1.1 Sub problem

1. What do medical students know about ionizing radiation exposure?
2. Does gender affect the knowledge of medical students regarding x-ray radiation?
3. Do personal protective devices affect the risk perception of x-ray radiation?
4. What is the healthcare workers perception of radiation?
5. What is the healthcare workers level of awareness of radiation?

1.2 Aim of the Research

The evidence from the literature is insufficient on the education of radiation safety, specifically in pediatric population, thus highlighting the importance of communication between health care professionals and parents. Many studies have confirmed a lack of patient awareness of the potential risks of ionizing radiation.

The purpose of this study is

- To assess knowledge of medical students associated with dose, benefit and risk.

- To improve understanding and/attitude so as to allow individuals to undergo necessary x-ray examinations, through a cross-sectional study.

1.3 Importance of this research

The rationale of this study was the increase in the number of radiologists, dentists and professionals involved in the study. It is important to note that these protocols are taken into account.

1.4 Assumptions

- The knowledge given by students that participated in this research from medical schools in Libya expresses their perception and awareness of radiation.
- The group chosen for this study is approved to be qualified and appropriate.
- The answers by the participants were not influenced nor biased.
- Data obtained from related literature is believed to be sufficient.
- Lack of awareness and knowledge of radiation will affect or influence the outcome of the research study negatively.

1.5 Limitations

- This research is limited to medical students in Libya
- It was limited to only 300 students studying in Libya.
- There was restriction in resources used in this research.

1.6 Definitions

Awareness is defined as the ability to make forced-choice decisions above a chance level of performance. The second definition, proposed by Henley (1984), is subjective and simply equates awareness with self-reports indicating that an observer "consciously sees" a stimulus.

According to James, (2007) perception is defined as "the consciousness of particular material things present to sense." Radiation is the flow of energy or passing out of energy from a medium or a vacuum.

CHAPTER II
LITERATURE REVIEW

Use of ionizing radiation in medical imaging for diagnostic and interventional purposes has risen dramatically in recent years with a concomitant increase in exposure of patients and health workers to radiation hazards. Medical and dental X-rays now constitute the major man-made sources of radiation exposure (Charles, 2001). Reports from studies demonstrated a dramatic rise in the prevalence of adverse health effects following exposure to ionizing radiation over the past two decades (Bury, 2004). The documented evidence of poor knowledge of radiation safety among various cadres of health workers at risk of occupational exposure shows the enormity of the problem at hand (Shiralkar, 2003; Lee, 2004). Various studies have shown that any amount of radiation is associated with cancer and genetic defect risk (Nias, 1998, Walden and Farzaneh, 1990). Although there is a large amount of radiation, chronic exposure to low-level doses in the industry, doses taken as occupational exposures for a certain period of time are also dangerous. Radiation is an important concept in medical faculties. The beneficial effects of radiation include the use of X-rays in the diagnosis, but are harmful if patients or health workers are repeatedly exposed to radiation. It involves the therapeutic use of radiation that can cause unacceptable effect.

2.0 Radiation Policy in Libya

Libya's concern about radiation and control of radioactive sources began about 30 years ago in 1982. The law was concerned with the use of ionizing radiation and protection against hazards (Act No. 2). In 1982, the National Radiological Protection Board was established according to the Act No. 2. Regulatory activities such as registration, licensing and inspection have been granted to the Tajoura Nuclear Research Center for Radiation Protection and Physical Health.

The office of nuclear and radiation safety was established in 2001. In 2005 the office became "The Nuclear Safety and Security section", one of the national Bureau for scientific research. In 2008 the Nuclear Safety and Security section became one of the

Libyan Atomic Energy Establishment offices named "The Nuclear Regulatory Office" (NRO).

2.1 National Legal Framework

1- Act #2, 1982, “The use of Radiation Sources, and protection against Ionizing radiation”. This law sets the principal rules and regulations for radiation protection, and use of radioactive sources and devices.

2- National Safety Regulations. These regulations specify the general requirements for safety of practices, and the implementation procedures for Act #2.

3- Act #15 2003 “Protection of the Environment” This law sets the rules and regulations for environmental protection.

4- Act #4, 2005, “Transportation of dangerous goods on national roads”. This law sets the principle rules and regulations for transporting dangerous materials on national rods. • Classifies DMs in 8 categories, (Class #7, Radioactive Materials).

5- Government Decrees; GD #31, Establishing the NRO within the AEE, and stating its main roles and responsibilities. GD #80, AEE to provide regulatory control of facilities and activities.

Medical Applications: There are many hospitals and medical centers that use radiation sources and radiotherapy radiation sources. There are five medical centers that use radiation sources for diagnosis and treatment, three in Tripoli, the other in Benghazi and one in Sabha.

2.2 Nuclear Regulatory Office (NRO) Regulation

According to the national regulation, it is necessary to use radioactive sources and devices to re-export all resources. In some cases where resources are found to be out-of-use or orphaned, the radiation protection department and the sources in radioactive sources are addressed through TNRC storage.

2.3 Trends in Medical Imaging

The use of medical imaging continues to grow steadily in the world. An example of such is seen in the United States (United States) with an increase from 1950 to 2007 (Mettler et al., 2009, NCRP, 2009). The greatest increase in exposure to ionizing radiation in the United States compared to background radiation is from intensive medical procedures (Bolus, 2013). In the 1980s the medical report accounted for 15% of the total exposure. However, it increased to 48% of all exposures in 2006 (Bolus, 2013, NCRP, 2009). This is a dramatic increase in the number of annual medical imaging procedures performed on patients (Bolus, 2013).

Simultaneously, there is growing concern about potential health effects associated with current levels of exposure to radioactivity. Childhood exposure is particularly worrying because children's organ development status is more sensitive than adult radiation (NRCNA, 2006). UNSCEAR found out that between 1997 and 2007 the total number of diagnostic examinations was more than 3.6 billion and that children under the age of 15 had about 350 million examinations (UNSCEAR, 2000, 2010). 40% of all imaging facilities around the world are thoracic radiographs and 9% are performed with children (UNSCEAR, 2010). This shows that a significant portion of the medical imaging in the United States is made for children.

In particular, the use of IT increased from 239% in 1993 (Bolus, 2013, Brenner et al., 2001, Donnelly, 2005, NCRP, 2009). It is important to note that the mean dose per CT scan (1.47 mSv) is much higher than conventional X-ray and radioscopy (0.33 mSv) (Mettler et al, 2008 and NCRP, 2009). In the US patent, the number of annual CT procedures increased from 3 million in 1980 to 62 million in 2006 (Bolus, 2013, NCRP, 2009). Approximately 11% of all CT examinations in the United States are on children (Linton & Mettler, 2003). In a study conducted by Dorfman et al., (2011), an examination of health insurance records revealed that 42.5% of children received at least (Dorfman et al., 2011). On average, it is estimated that a child will have 7 medical radiographs until the age of 18 (Fahey et al., 2011).

2.4 Dosimetry of Radiation

In a study carried out by Fahey et al., (2011) on investigating the effect of radiation dose of radiation dosimeter development. The amount of energy absorbed per unit body mass of tissue exposed is defined as radiation dose (WHO, 2016). absorbed dose is a gray (Gy) absorbance of 1 Joule (J), where unit is the amount of energy stored in tissue or organs per unit mass measured in gray (Gy) (Brody et al., 2007). It is used for all types of ionizing radiation (Picano et al., 2012).

The *effective dose* (E) is defined by a weighted sum of the equivalent dose to the other body tissue or organ where H_T is the dose equivalent to organ T , and W_T is the specific weighting factor for organ T (McCollough and Schueler, 2000; Treves and Taylor, 2007; WHO, 2016)

$$E = \sum H_T W_T$$

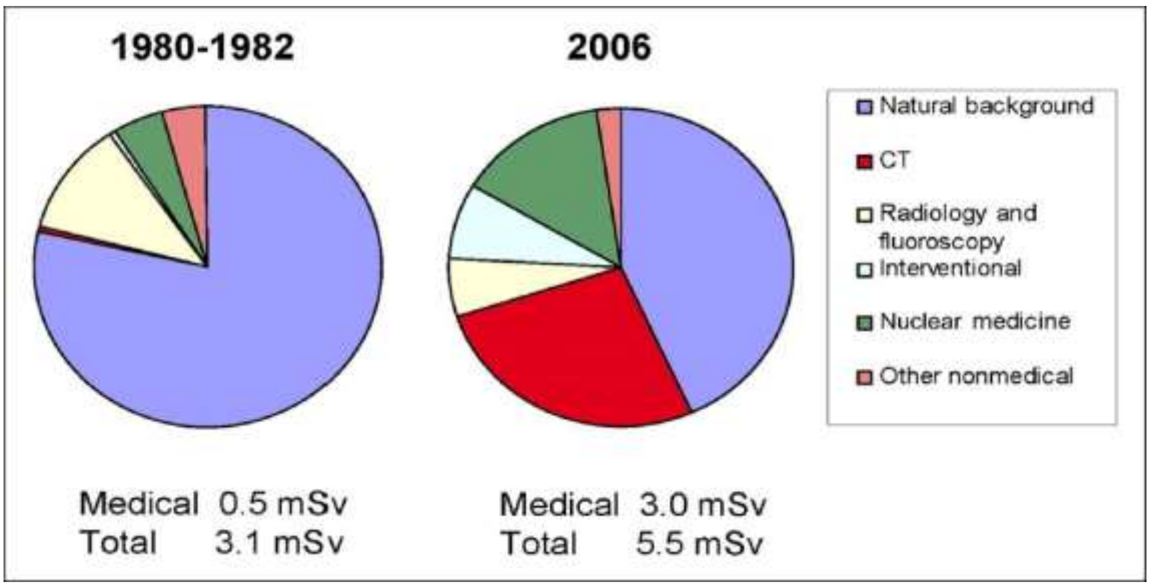
The unit for both equivalent and effective dose in the System International (SI) nomenclature is the Sievert (Sv). For diagnostic imaging, it is often used in terms of millisieverts (mSv). Also, the effective dose considers the biological effects of radiation by multiplying the gray (Gy) by a quality factor (Brody et al., 2007).

2.5 Sources of Radiation Exposure

Low exposure to radiation is a natural and permanent part of living around the world (WHO, 2016). The annual average radiation exposure for the world population is about 3mSv / year per person (UNSCEAR, 2010). Radon and other naturally occurring sources of radiation in homes are the main source of radionuclide, which constitutes 80% of the annual dose (Bolus, 2013; WHO, 2016), with natural background radiation levels being different depending on geological differences. On average, 20% of annual doses are due to the use of radiation (WHO, 2016).

The average annual radiation exposure in the US is about 5.5mSv / yr per person (Mettler Jr et al., 2008). Figure 1 shows an exponential increase in US exposure to medical imaging in the population. Scans were, on average, 0.86 CT scans (Dorfman et al., 2011). In this study population up to the age of 18 years. The primary background represents 33% of radon (2.4 mSv), (Mettler Jr et al., 2008). In 2006, human exposure has become the most unnatural contribution (Mettler Jr et al., 2009, NCRP 2009), representing 50% of the total exposure to radiation exposure in medical imaging (3.0 mSv). Specifically, the total exposure to radiation from the CT (NCRP 2009) contributes only 49%. Also, Dorfman et al., (2011) in a study of 5.8 million children under the age of 18 are expected to pass at least one medical CT scan of 2.6 million in two or more years of CT with almost three years period

Figure 1.
Average annual radiation exposure of U.S. population.

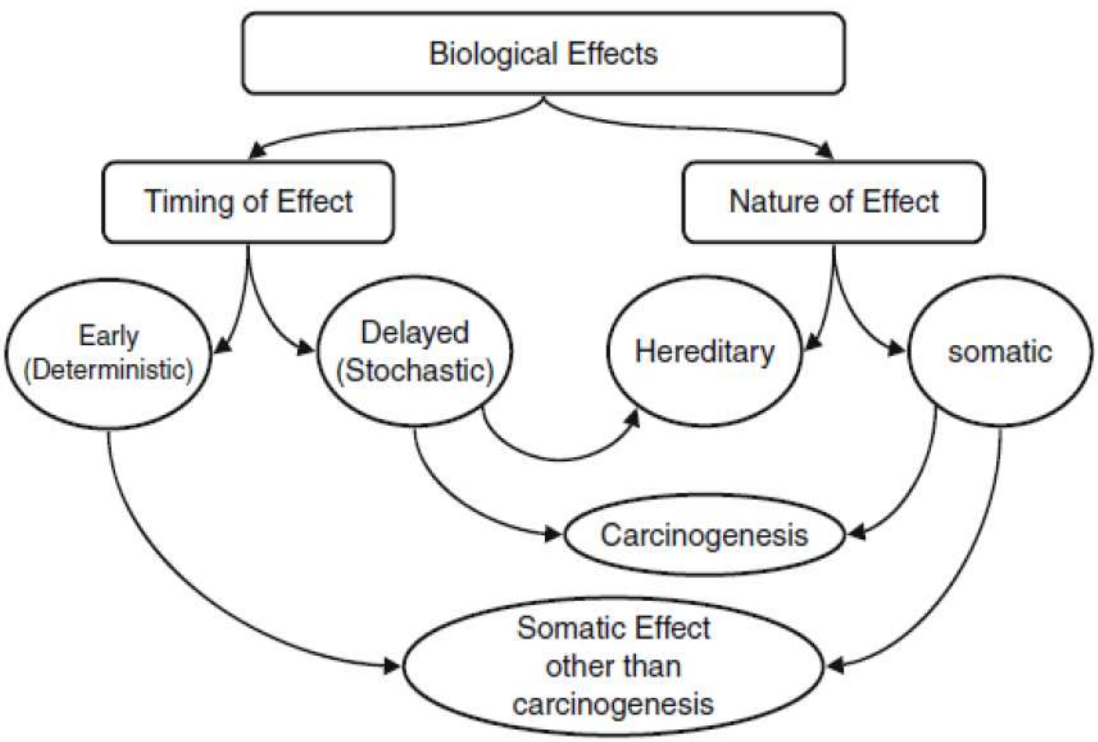


Estimated annual per capita adult effective dose in United States. Chart on left illustrates the distribution of effective dose in 1980–1982. The chart on right shows the distribution in 2006 (Fahey et al., 2011; Mettler Jr et al., 2009). Thornton et al. (2004) reported that radiation doses and risks associated with imaging procedures are similar to those reported in the literature. Estimates of possible increases in future cancer risk were estimated due to the rapid expansion of CT use. However, no study of cancer risk has been performed in the underlying CT patients (Frush et al., 2003, Pearce et al., 2012). Lee et al. (2004), the risk of malignancy was increased in only 3% of adult patients receiving abdominal CT. In a study conducted by Larson et al. (2007), only 13% of parents understood that there was a risk associated with CT. Some researchers believe that the potential risks of parental desire for rapid diagnosis (Linton and Mettler Jr, 2003) contribute significantly to the increased use of CT in children (WHO, 2016). It is important to understand the benefits and risks of medical imaging methods.

2.6 Health Effects of Radiation Exposure

Humans are exposed to ionizing radiation from both natural and man-made sources. According to UNSCEAR, two different effects occur in organs and tissues exposed to radiation (UNSCEAR, 2012). These effects are classified according to their latency time (Figure 2) and their characteristics after exposure to radiation (Elgazzar and Kazem, 2015).

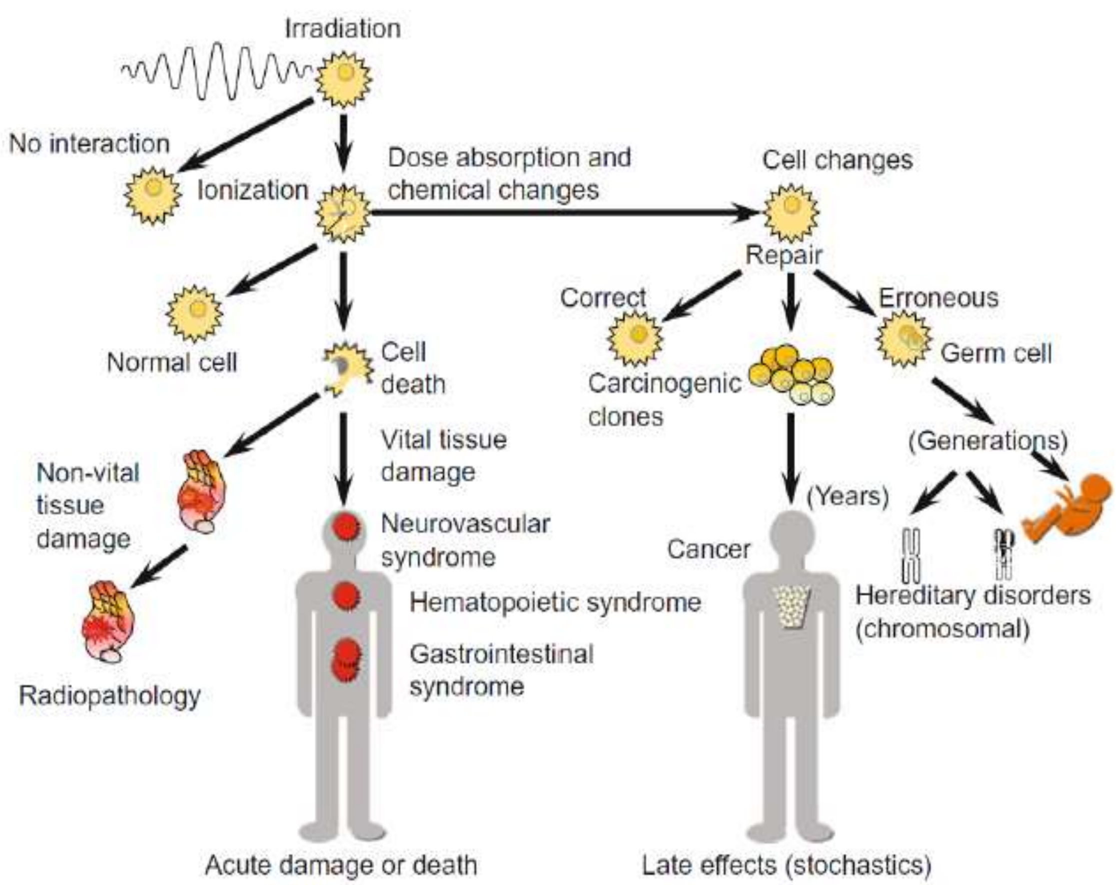
Figure 2.
Biological effects of radiation exposure (Elgazzar & Kazem, 2015).



The deterministic effects are health effects from cell death (Elgazzar & Kazem, 2015, ICRP, 2012, UNSCEAR, 2012). Acute Radiation Syndrome, Skin Flare, Hair

Loss and Cataract (WHO, 2016) are examples. Instead, the stochastic effects start with a change, especially in the cells of DNA. If the mutant cell is a somatic cell, the mutation can lead to a malignant tumor. If the mutant cell is a stem cell, it may cause hereditary effect (Domenech, 2017). Compared to pre-defined results, there is no threshold value with stochastic results (Okano & Sur, 2010). The effects of the stochastic effects were observed after a long delay (IAEA, 2004, WHO, 2016). Hereditary diseases are caused by DNA modification (Figure 3). The BEIR VII report (2006) concluded that low radiation doses are very small when compared to the fundamental frequency of genetic diseases in the population of genetic risk.

Figure 3.
Radiation effect on the whole body system.



Both deterministic and stochastic pathways affect the body due to the radiation exposure (Domenech, 2017).

2.7 Radiation and Health Problems

2.7.1 Chronic Low Dose Radiation

Even therapeutic use of ionizing radiation for therapeutic and diagnostic purposes has long-term low doses, but these are carcinogenic and mutagenic effects on human health that are considered "peaceful". This area has not been thoroughly researched. However, it is widely accepted that radiation is a danger that any amount can cause cancer and genetic defects. As a result, regulatory agencies have concluded strict measures to regulate exposure to radiation and only very high doses of radiation (Nias, 1998) have been investigated while at very low doses of radiation is challenging, which is difficult and far from being measured.

2.7.2 Radiation and Pregnant Women

According to a study by Sternheim and Kane (1991), mothers receive pelvic radiation rays when they have a 30-40% chance of catching pregnant cancers. For this reason, tools and protocols have been developed to protect women from reproductive age or pregnant women on radiations. Employees working with radioactive materials and X-rays should wear a ribbon badge (Jaros and Breuer, 1982).

2.7.3 Radiation Workforce

In the early days of diagnostic radiology, the doctors were not as careful as they are today and were left in their hands. In 1969, the Soviet Socialist Republic adopted a law that brought safety standards for the production, processing, storage and transport of natural or man-made radioactive materials and other ionizing radiation sources. In the United States, the 1968 Radiation Health and Safety Act made it possible to formulate radiation emissions (Benton, 1982).

A thorough survey of writing underpins a "linear-no-threshold" (LNT) chance model, and radiation protection guidelines are based off this hypothesis. This model expects that any level of radiation is harmful and that the hazard increments directly even with additions of low dose (Brenner, 2002; Brenner et al., 2001; Brenner and Hall, 2007; Chodick, 2007; Johnson et al., 2014; NRCNA, 2006). There is not a limit underneath which cancer is not prompted; be that as it may, the quantity of radiation-initiated cancer is little at low doses (NRCNA, 2006) Likewise, it might actuate the repair procedure by empowering or hindering the creation of enzymes at low dose (Ernst et al., 1998). Another repair process is radical detoxification by evacuation and inebriation of toxic radicals (Ernst et al., 1998; UNSCEAR, 2012).

In addition to cancer, exposure to radiation has been shown to increase the risk of cardiovascular disease and benign tumors (NRCNA, 2006). However, the data do not allow these risks to be quantified (NRCNA, 2006; Treves and Taylor, 2007). In this study, the efficacy and safety of treatment of patients with acute myeloid leukemia were assessed.

2.8 Medical X-Rays: A World Perspective

90% of the diagnostic problems can be solved using the basic radiological examination - although the World Health Organization has around two-thirds of the world's population, about 80%, it has no access to basic radiology services, and X-ray technological progress does not stop. Unfortunately, despite the advancement of technology in radiographic equipment, most of the developing countries still depend on traditional radiography and in such processes (Muhogora, et al., 2008). A simple radiological examination is performed on the conventional radiograph. Although Libya is a middle-income country, radiographic equipment differences are found in rural and urban hospitals, in developing countries.

The research has shown that the availability and use of x-ray imaging is different from one country to another (Regulla & Eder, 2005). Further evidence of geographic diversity in the use of radiology in the United States has been documented (Lysdahl & Børretzen, 2007). In addition, the US radiology survey shows that almost half of all diagnostic procedures involve conventional X-rays (Bhargavan & Sunshine 2005). Norwegian trends in diagnostic radiology tests show that conventional radiography 2002 represents about 60% of all imaging procedures (Børretzen et al., 2007).

2.9 The Value of X-Rays in Medicine

Despite the radiation hazards mentioned above, there is no doubt that the use of the familiar diagnostic X-rays is of many benefits. We do not want to undermine the possible effect of medical radiography on the diagnostic medicine as an integral part of patient care and management. X-rays provide an opportunity for health personnel, especially physicians, to see the inside of the patient without functioning physically. This is consistent with the view of Manning, (2004) X-rays. Although exposure to the world's population radiation is the single most important factor, it provides benefits to these caregivers because it still writes diagnostic fluoroscopy. From Gunderman (2005) point of view, medical radiographs have changed the way health and illnesses of patients and doctors see.

Medical X-rays are therefore a valuable diagnostic tool when reasonable precautions are taken to expose the patient to radiation. The decision of the radiological examination must be made collectively by the patient and the doctor. And when an X-ray beam is justified, the gain will certainly compensate for these risks. In this way, positive ionizing radiation with favorable X-rays (Gofman, 1999) is predictable and contributes to health and benefits and knowledge.

2.10 Radiation Protection and Resource Allocation

Respect for the autonomy of patients is one of the cornerstones of modern medical ethics. However, according to autonomy, this is not the only important moral obligation, according to Rogers (2002). It is equally important to be able to work with the patient and at the same time to consider the resource distribution. Regardless of the patient's clinical benefit, x-ray examination requests result in unnecessary exposure to radiation and improper use of radiographic sources (Mendelson & Murray, 2007). Indeed, in some countries, such as the United States, the proportion of the resources allocated to health care has been significantly discussed (Moskowitz et al., 2000).

Considering the increasing cost of diagnostic imaging and its associated risks, many health authorities in the United States have accepted X-ray regulations. However, in most cases, these efforts achieved little success. And this failure, according to Wilson, et al., (2001), may be attributed to the fact that not enough is known about the determinants of radiological use and in particular little is known about factors that influence patient demand for x-ray examination.

2.11 Factors that Could Influence Patient Demand for X-Ray Examinations

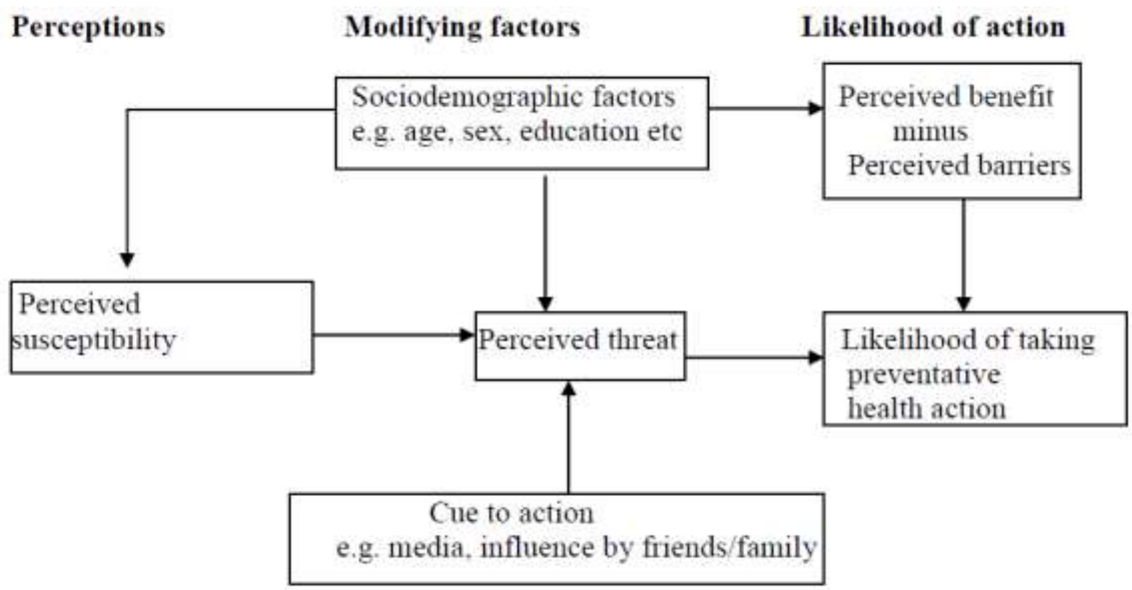
It is important to note that there is no evidence that patients are under-risk x-rays for radiographic examination. X-rays are very important and special patient preferences are required for the patient. And since some of the reasons for the unavailability of sick patient demand is the examination of the requirements with X rays clinical care (Lysdahl & Hofmann, 2009), it is important to determine the factors that affect the patient. Determining the factors that affect patient demand for x-ray examination will be vital to eliminate the tension.

2.11.1 Factors included in the Health Belief Model

Most of the interventions aimed at individuals' health-related behavior, according to Lyon and Reeves (2006) rely on health theories. This is consistent with Conn's (2009) beliefs that many researchers write that one wants to change specific individual health behaviors. The theoretical framework widely used to change health behaviors is the Health Belief Model (HBM). This model focuses on individual compatibility, effectiveness, cost and benefits of any proposed action.

Desire to prevent disease: Under the health of Matsuda, (2002) defines two important variables. A diagram of the HBM is presented below in Figure 4.

Figure 4.
Diagrammatic representation of the HBM (Source: Rosenstock et al., 1994).



The model attempts to justify the assertion that the patient's threat sense's perception of health problems and expected benefits from modeling measures justifies the claim that such health problems reduce health-seeking behavior that affects a particular patient (Figure 4).

At the same time, HBM anticipates that health-related behavior is influenced by the perception of the threatened patient that constitutes a health problem and associated value is echoed by Petro-Nastus and Michael (2002), or any one that will mitigate this threat. Kibar and Hung (1999) studied HBM to identify the main components including perceived benefits and costs, perceived susceptibility, perceived severity, motivation and modification factor. HBM provides behavioral health-related assessments that factor in the beliefs of individuals about the likelihood will prevent behavioral illnesses and obstacles that prohibit action, among other things.

Some researchers claim that NGLs use this explanation using risk assessment techniques for health benefits in deterrence that may encourage patients to follow a positive social practice. In this case, there may be a demand for x-rays (Koch, 2005). In this community, it is often seen to find a patient who insists on an X-ray because of the pressure of family members. Although the HBM has been used widely by researchers in an attempt to predict health behaviour, it is not without criticism. Some researchers have argued that the model is flawed for several reasons (Chin, 2000). Among the many reasons identified by these researchers are that the model places excessive responsibility for health on the individual while social factors are neglected. Another limitation of the HBM is the failure to consider factors such as environment, economic, social norms and peer pressure. All of these may influence a patients health-related behaviour such as the demand for x-ray examination (Denison 1996).

2.11.2 Patients' perceived benefits of having an x-ray examination

Acquired benefit is defined as the effectiveness of the strategy designed to reduce disease risk (Denison, 1996). Benefit is usually a function of health behaviors. For example, HBM assumes one of its benefits (Ludwig & Turner, 2002). For this reason, the patient's perceived benefits from a particular health care activity; the radiographic examination request is understandable. An X-ray examination and the patient's expectation for the value of the expected activity, reveals the underlying disease, and the capacity of the relevant estimates. This can affect the attitude of the patient. As stated by Lyon and Reeves, (2006) individuals' susceptibility about illness, expenses involved in carrying out patients behavior and even the benefits and due to action are the original core beliefs of individuals. The researcher also added that the probability of patients' quest or demand for x-ray examination is based on the equilibrium and balance involved between their perceived benefit and barriers to preventative action. In the other way round, it's the view of patients that influenced their decisions on the methods of solution to use in order to get the illness treated.

In fact, the opinion of Lyon and Reeves (2006) highlighted that patient illness major role is played by an individuals' perceptions in health behavior. If there is a misconception about radiation risk, patients expectation on benefit can be altered as argued by Ludwig and Turner, (2002).

One of the factors that determine the use of radiology is said to be the individual patient perceived outcome of x-ray examination. According to Cascade et al.,

(1998) on a discussion about the use of radiology it shows a valid clinical indication that patients that go through radiology usually demand the imaging procedures in order to get assurance on it in order to reduce uncertainty providing information of radiographic imaging is crucial (Manning, 2005). Even with this evidence of radiation a lot of patients see x-ray examination to be more crucial than clinical judgment. Despite this, the main reason for radiographic services was actually to support clinical judgment rather than replacing it with x-ray. As it can be seen patient expectation can actually judge whether an intended action is good or bad. Apart from the basic reason regarding patients and clinicians, other researchers have studied and identified another factor that can contribute to the use of radiological imaging and that is therapeutic (Balagué & Cedraschi, 2006). Corso, et al., (2002), states that preference for prevention and treatment may come as a result of some factors that are not just about value which a certain intervention gives for an individual.

2.11.3 The importance of x-ray compared to clinical evaluation

The vast majority of the patients who look for social insurance administrations in Libyan country doctor's facility appears to trust more in the unwavering quality of x-rays than in a specialist's clinical appraisal. An examination done in Norway demonstrated that patients consider plain radiography more dependable than clinical assessment done by a specialist (Espeland et al., 2001). These authors report that a few patients are of the feeling that specialists cannot diagnose anything without the utilization of an x-ray. Despite the fact that patients may request x-ray testing, their expectation ought not to direct clinical care and administration. Patients' belief in the capacity has a tendency to cloud or rather result from their neglecting to perceive the blind side of x-ray imaging. In the long run, one must inquire what the clinical estimations of these x-rays are for singular patients. In this manner, human services specialists should endeavor to react to patients' requests for unwarranted x-ray examinations earnestly in light of the fact that patients' solicitations are a typical piece of clinical experience (Gallagher et al., 1997).

2.11.4 Patients' Perceived Cost of Medical X-Ray Imaging

Cost is one of the few factors that can impact the choice of the individual patient to ask for a specific activity. The HBM hypothesizes financial cost as one of the adjusting factors that make them bear on a patient's capacity to change and keep up a health-related conduct. What's more, on many occasions, it is just when the patient understands that he/she has the ability to defeat this barrier that he/she would have the capacity to make the required move.

2.11.5 The impact of health workers on patient perception of x-rays

Variables identified with medicinal services specialists frame another arrangement of altering components that have been recognized as having an impact on the patient view of medical x-rays. The utilization of therapeutic x-ray imaging is legitimately controlled by clinical elements. From the literature, it turns out to be certain that issues other than clinical criteria can influence general experts' choice about requesting x-ray, for example, plain radiograph for low back pain (Lysdahl and Hofmann, 2009; Espeland and Baerheim, 2003). A portion of the issues distinguished by these analysts are identified with both patient expectation and wishes, and weight from other healthcare service providers, for example, physiotherapists who may require an x-ray before giving further treatment.

It is likewise demonstrated that patients with a low level of trust in the doctor may ask for services, for example, x-ray examination or medication all the more frequently (Thom et al., 2002). Different analysts have recommended that health specialists could rather inspire from patients their expectations (Little, et al., 2004). For example, rather than giving into a patient's demand, the respondents in an investigation on doctor reaction to patients' request for antidepressants saw the request as an insight to take part in advance demonstrative testing or patient training (Tentler, 2007). The same should be possible for patients who request x-ray examinations.

2.11.5.1 Communication Between Health Workers and Patients

In many examples, correspondence is natural to the point that the significance of doing it well is frequently disparaged (Booth, 2007). In any case, attributable to developing enthusiasm for health advancement and diseases counteractive action, health correspondence in creating nations like Libya has been energized (Alali and Jinadu, 2002). Some of the roles that affect health communication between medical services providers can play, as indicated by these authors, incorporate managing powerful human services guaranteeing viable wellbeing advancement encouraging the successful spread of health information. Absence of effective communication between healthcare service workers and patients could be another factor impacting tolerant interest for x-ray examination. Haldeman (2001) explains in another context that patients looking for spinal pain treatment experience trouble in acquiring reliable data from different healthcare workers with regards to the relative dangers and advantages of treatment choices accessible. Picano (2004) states that in spite of the way that a radiological examination conveys a clear long-term danger of cancer, patients experiencing x-ray examinations frequently get no or off base information about these dangers. In addition, Mitchell (2003) reported that information is an imperative factor prompting an informed decision. In this manner, patients can just settle on informed choice about x-ray examination when information is given by healthcare workers. It has been contended that it is the duty of healthcare staff to convey and give direct data about radiation dangers to the patients experiencing a radiological method (Mubeen et al., 2008; Ludwig and Turner, 2002).

However, an examination on what patients think about ultrasound, computerized tomography (CT) and Magnetic Resonance Imaging (MRI) found out that numerous patients (72%) spoke with relatives or companions rather than health workers to pick up information (Chesson et al., 2002). These outcomes cast a shadow in the way healthcare experts convey and give information. The literature demonstrates that a patient’s fulfillment and adherence to social insurance guidelines is connected to better wellbeing laborer quiet correspondence (Tongue et al., 2005). Different studies additionally demonstrate that the level of patient consistency with treatment gives off an impression of being identified with the measure of information given to the patient by healthcare providers (Lyon and Reeves, 2006). Quality patient information is considered as a critical part of the present healthcare (Sheard and Garrud, 2006). Effective and clear correspondence between healthcare providers and patients as to the cost and hazard-related with x-rays may impact the pattern. Along these lines, other than tending to the passionate needs, Ludwig and Turner, (2002) recommend that healthcare specialists ought to give target actualities about x-rays. In any case, little is thought about the extent to which absence of effective communication impacts patients' interest for x-ray examinations.

2.11.5.2 The Advice of Health Workers on X-rays

A qualitative report done in Australia demonstrates that some general practitioners (GPs) utilize techniques, for example, saying the risks of x-ray exposure and the cost of x-rays as a method for preventing patients from requesting x-ray examinations (Rogers, 2002). Absence of deliberate exhortation, rules, and advising by human services suppliers about medicinal x-ray could likewise be a forerunner to a patient's interest for x-ray examinations. Accordingly, the way wellbeing staff exhorts the patient the first occasion when he/she requests an x-ray could have an effect even in situations where x-rays are not asked for by the doctor.

2.12 Radiation Exposure in Children

Limiting radiation dose during imaging kids is a subject that is ceaselessly examined in the pediatric imaging group (Donnelly and Frush, 2001). For the radiopharmaceutical dose, there is a distinction in potential future dangers from radiation exposure to kids from that to adults. The Life Span Study has exhibited that kids have an altogether higher hazard than adults for a few reasons (Preston et al., 2008). Initially, children are more radiosensitive because of the ceaseless development and development of tissues and organs (Brenner, 2002; Preston et al., 2008). Secondly, radiation exposure may build a potential danger of cancer further down the road since kids have a more drawn out future after the time of exposure (Mathews et al., 2013).

For example, children may confront potential cancer dangers at a rehashed low-dosage exposure in routine therapeutic imaging (Mathews et al., 2013). Research has likewise demonstrated that cancer occurrence in kids is more factor than in adults and relies upon tumor sort, kid's sex and age at exposure (WHO, 2016). Contrasted with adults more than 65, representing 60% of cancer, just 35% is related with expanded radiosensitivity in children (Kahana, Deimling, Rose, Bowman, and Miller, 2006; UNSCEAR, 2012). In particular, children who are under 10 and female are especially helpless to radiation (Douple et al., 2011). Likewise, it has been discovered that adolescent girls experiencing breast advancement have higher breast radiosensitivity at higher dosages contrasted with adults. Young people additionally have higher thyroid radiosensitivity at high dosages (UNSCEAR, 2012). Besides, the rate of CT utilizes increases all through pediatric years and is the most astounding in the youthful populace (Dorfman et al., 2011). This information is in accordance with research into demonstrating that creating organs have expanded susceptibility to radiation.

2.13 Dental Radiology

Though singular dose from radiographic methods in dentistry is generally low, it is normal to perform radiographic systems amid dental appointments (Alqerban et al., 2009; Iannucci and Howerton, 2016). Dental radiograph reflects 13% of all imaging systems, be that as it may, this does exclude the utilization of cone-beam CT (CBCT) (UNSCEAR, 2010). Studies have demonstrated that 43% periapical radiographs and 42% all-encompassing radiographs are routinely used to screen new patients without the nearness of clinical side effects (ADA, 2006; Rushton et al., 1999). Besides, the aggregate successful dosage from medical radiography can be lessened around 30% by keeping away from superfluous exposure (Martínez et al., 2007; Schauer and Linton, 2009). However, the extent of parental familiarity with potential future dangers related with imaging methods in a pediatric dental setting remains moderately obscure. In dentistry, CBCT is a moderately new practice bringing about considerably higher measurements contrasted with all-encompassing radiography (European Commission, 2012; NCRP, 2009). In 2006, around 500 million intraoral bite-wing X-rays and full mouth radiographs were performed (Schauer and Linton, 2009). In correlation with therapeutic imaging techniques, the viable measurement in dental radiography is generally low. Table 1 shows the average effective dose (E) of routine medical and dental diagnostic procedures. The average effective dose for medical diagnostic procedures is compared with that of dental imaging methods (Mettler et al., 2008).

Table 1.
Typical effective dose routine medical and dental conventional radiography and computed tomography

Diagnostic procedure	**Average effective dose (mSv)**
Conventional X-ray procedure	
Skull	0.1
Chest	0.02
Abdomen	0.7
Computed tomography	
Head	2
Chest	7
Abdomen	8
Dental examination	
Intraoral radiography	0.005
Panoramic radiography	0.01
Cone-beam CT	0.2

Intra-oral bite-wing X-rays and panoramic radiography are exemplary imaging strategies in the field of dentistry. The normal viable dosages related with intraoral bite-wing x-rays (0.005 mSv) or extraoral panoramic imaging (0.01 mSv) are considerably lower than those regularly gaven by customary head CT (2 msV) (Mettler et al., 2008; White et al., 2014; WHO, 2016). Contrasted with traditional CT, panoramic radiography considers generally bring down radiation exposure, bring down cost, less patient seat time and greater accessibility (Alqerban et al., 2009). Notwithstanding, there has been late worry about dangers related with these strategies in dentistry (Lin et al., 2013). For example, studies demonstrated that excessive exposures to dental imaging methodology is related to intracranial meningioma, salivary organ tumor and thyroid growth (Claus et al., 2012; Longstreth et al., 2004; Memon et al., 2010; Neta et al., 2013). In spite of the fact that these discoveries are uncertain, the commitment of dental exposure to general radiation exposure is expanding in U.S. (NCRP, 2009). The quantity of CBCT use in dentistry has been expanding which brings about altogether higher assimilated measurements contrasted with panoramic radiography (Tsiklakis, et al., 2004). Present day CBCTs permit shorter filtering time than the time required for the traditional CT (Cohnen et al., 2002; Tsiklakis et al., 2004). Additionally, it furnishes a high determination with minimal effort (Scarfe et al., 2006). Despite the fact that the detailed scope of successful dosage for dental imaging led on CBCT (< 1 mSv) is lower than that of customary head CT (2 mSv), there is proof to propose a requirement for the use of as-low-as sensibly achievable standards (ALARA) to maxillofacial volumetric imaging (Ludlow and Ivanovic, 2008; Pauwels et al., 2012; Rottke et al., 2013; WHO, 2016)

2.14 Risk and Benefit Dialogue

Pediatric health experts assume an essential part in imparting health knowledge to children and their guardians. Tragically, patients regularly do not get information on the dangers and advantages of symptomatic imaging examinations that include the utilization of ionizing radiations (Brenner and Hricak, 2010; Lee et al., 2004). As healthcare experts endeavor to better comprehend the health issues of medical radiation, especially in giving information to people with respect to radiation dangers is imperative in enhancing dental practitioner quiet correspondence (Bulas et al.,2009). In an examination by Thornton et al. (2015), it has reasoned that there is a generous hole between tolerant expectations and current practices for giving information about ionizing radiation utilized as a part of medical imaging. It was discovered that patients need essential instruction about which imaging examinations included the utilization of ionizing radiation and how dosages looked at among them. In any case, learning of the dangers would not change their choice to continue with a prescribed test (Thornton et al., 2015).

A major goal of radiation risk communication is to make sure that patients, parents, and caregivers receive the data they have during a manner that they will create familiar choices (Dauer et al., 2011; McCollough & Schueler, 2000). They need ample and simple information to grasp the imaging care being performed (WHO, 2016). Since medicine imaging involves a broad age vary, it's crucial to contemplate these age-related variations whereas developing communication ways (WHO, 2016). An important barrier to acknowledge is that almost all patients wish their own doctors to coach them regarding radiation considerations; nevertheless, they believe this sort of dialogue cannot occur as a result of time pressures within the clinic (Thornton et al., 2015). Insufficient awareness and understanding of radiation protection problems by healthcare professionals present a challenge in communicating the advantages and risks (Puri et al., 2012; Thomas et al., 2006).

As effective communication with patients and caregivers is more and more recognized as crucial to worry. It's vital to make sure that every healthcare professional has ample education and resources to speak clearly and effectively (WHO, 2016). Research has shown that there's widespread estimation of doses and risks (Lee et al., 2004; Thomas et al., 2006). Lee et al. (2004) have indicated that seventy-fifth of physicians underestimated the acceptable vary for the equivalent variety of chest radiographs for a CT examination. Also, a study by Treves et al. (2008) has confirmed an excellent variation of pharmaceutical administered doses among thirteen specialized medical hospitals. These studies emphasize the importance of radiation safety education for each healthcare professional and also the public.

2.15 Ionizing Radiation Hazards/Accidents

A nuclear and radiation accident is outlined by the United Nations International Atomic Agency as an occasion that has led to important consequences to people, the setting and also the facility.

2.15.1 Chernobyl Nuclear Accident

This was one of the greatest nuclear mischances at any point experienced that exposed individuals to ionizing radiation. The Chernobyl atomic power plant mishap happened on the 26th of April 1986 in the Soviet Union and obviously demonstrated the ill-impacts of radiation on human health as distributed in the WHO (1995) report. The report interfaces sharp increment in cancer cases in the Soviet Union with the delayed consequences of the nuclear disaster. International radiation standards, systems for enhancing the nuclear safety, crisis reaction methodology and alleviation of results were reconsidered after the occurrence (Chernobyl Nuclear Accident Report, WHO, 1995). Our general comprehension of the health impacts of ionizing radiation is enhancing because of persistent research and the learning picked up from studies completed on Chernobyl populaces (Health impacts of the Chernobyl mischance, WHO Report, April 2011).

2.15.2 Japan Earthquake and Tsunami

The 2011 Japanese earthquake was alluded to as the Fukushima Daiichi atomic fiasco in light of the annihilation caused by the Tsunami and earthquake to the Japan nuclear plant. It was the biggest earthquake/seismic tremor at any point recorded in Japan's history and just second to the Chernobyl nuclear calamity bringing about a radiation danger. The earthquake/seismic tremor hit the atomic plant and radioactive substances began spilling (Onomitsu and Hirokawa, 2011). A huge operation of cooling the plant was locked in with the expectation of decreasing the radiation levels. Individuals were emptied to stay away from exposure to radiation that could prompt unsafe health impacts (later in life). Japan likewise experienced the Hiroshima bombings towards the end of World War II. A forthcoming partner ponder was done among nuclear bomb survivors, involving children whose guardians were in the proximity of the atomic mischance, the individuals who moved in later and the individuals who were around however a long way from the exposure. It was discovered that 13 years after the fact, aftereffects of baby disfigurements and cancer before the kids turned 20 years were recognized (Young and Yalow, 1995).

2.16 Radioactive Isotopes

As of late the utilization of radioactive isotopes in military atomic weapons at nuclear power stations has stimulated more prominent open intrigue. A Swiss national was captured in South Africa for making uranium parts, which could be utilized for weapons of mass destruction (Mapiloko, 2008). The harm that these atomic weapons can do is a reason for concern around the world. A key South African atomic office (Pelindaba) was promptly shut down when hazardous gases began spilling. The 'Coalition Against Nuclear Energy' in Africa was profoundly worried about the spillage as they presumed iodine spillage, which was in charge of the extreme diseases in the Chernobyl disaster (Swart, 2009). This means that the impact the Chernobyl calamity has had as far as long haul sick impacts of exposure to these radioactive components, which has sharpened governments to the perils of these radioactive isotopes that could expose the populace to radiation exposure.

2.17 Radiation and Health-Care Professionals

It appears to be evident that regardless of the little yet distinct hazard to patients' health, examinations on radiation exposure are satisfactory and are crucial in medical practice. The impacts of radiation exposure and its health safety measures are critical.

Shiralkar et al. (2003), explored health experts' perspectives of radiation dose got by patients when their experience regularly asked for radiological examinations. Maybe a couple of the health experts knew the dose levels of radiation that their patients were exposed to amid radiological examinations. In spite of the fact that the examination included specialists from two doctor's facilities in various districts, it was evident that most specialists had no clue with regards to the measure of radiation got by patients experiencing normally asked for radiological examinations. Most patients entering the hospital will experience one X-ray examination. In spite of the fact that it is recognized by both the medical experts and the overall population, that radiological examinations are important, Shiralkar et al. (2003) found out that regardless they speak to a potential hazard to health through exposure to ionizing radiation.

The above notions were resounded in the UK's initially contemplate ever that attempted to set up whether medical students had adequate learning on radiation insurance before graduation. Singh et al. (2008) utilized experts including radiologists and clinicians to attempt an examination among recently qualified medicinal officers. In spite of the fact that they took cognisance of the way that most exposures to ionizing radiation happen inside Radiology Departments, it was medical officers who ask for these radiological examinations, which at that point ended up plainly basic for both those in radiology divisions and medical officers to have a similar comprehension of legitimate subjection of patients to radiation exposure. In their investigation, they prescribed for the advancement of an undergraduate program or course on radiation insurance for medical officers. They suggested for the proclamation of important enactment that would direct radiation exposure. In an investigation by Chie et al., (2002), intracoronary radiotherapy techniques, radiation exposure levels and health of medical personnel were examined. It was contended that the strategy for intracoronary radiotherapy at present, embraced and which was the premise of their trial, is safe as for radiation security.

In another research by of Zhou et al. (2010) among medical students and assistants, the level of awareness to ionizing radiation in these groups was surveyed. The outcomes recognized that despite the fact that the two groups had gotten some type of education on ionizing radiation, they all demonstrated that constant preparing at work as lectures, tutorials and workshops will be valued. This was a consequence of the disappointment of the two groups in demonstrating the radiation exposure dosages from basic diagnostic imaging methodology and the significance of subjecting their patients to such radiation. The attitude and knowledge of European urology resident doctors concerning ionizing radiation found out that the assurance of staff was inadequately planned with under usage of protective gear. The disappointment of the urology resident doctors in utilizing radiation security measures was of worry to the authors (Soylemez et al.2013). In the investigation of Portuguese students' information on radiation material science, Rego and Peralta (2006) made intriguing discoveries in regards to the absence of learning by students in separating amongst ionizing and non-ionizing radiation.

The nature and qualities of radiation were not obviously shown, with absence of comprehension on the connection between hazard and radiation type additionally observed. Throughout the years a few kinds of research in various nations have explored perceptions, knowledge on radiation and its ill impacts among students, health experts and for the most part point to a poor understanding of radiation issues. The key range of worry as showed in the motivation for this investigation is compliance to radiation safety measures by healthcare experts. The implicit assumption is the basic belief that more profound understanding of radiation-related dangers, will, in some courses, add to expanded care and compliance.

2.18 Risks Associated With Medical X-Rays

Conventional or simple images may include magnetic resonance imaging (MRI) and ultrasound, ionizing radiation from the patient with ray. Conventional X-ray provides enormous benefits to patient management, but this benefit does not pose a risk to radiation. Researchers claim to have small but real risks involving diagnostic imaging and conventional radiology (Lockwood et al., 2007).

Diagnostic radiology is the only major source of ionizing radiation, 14% of the total global exposure obtained from anthropogenic and natural sources (Moores, 2006, de González & Darby, 2004). In this respect, serious concerns have arisen about health risks. In Japan, it is estimated that the diagnostic X-ray encounter can be attributed to cancer at a cumulative risk of 3.2%. According to the same researchers, this corresponds to 7,777 cancer cases per year. Other direct radiation hazards of X-rays come from epidemiological studies of exposed human populations (Wall et al., 2006). General radiography is believed to result in stochastic results even at low doses, even if 10mGy provides low doses at very low doses. (ICRP) thinks it is scientifically reasonable to assume that the incidence of cancer or hereditary effects increases as the absorption dose increases (Matthews and Brennan, 2008).

CHAPTER III
METHODS

The research method used in this study is outlined in this chapter which will give details about the procedure for data collection and the method of analysis used and also the limitation will be discussed. This study is to know the level of compliance to radiation protection safety and protocols by radiography, dental and medical related professionals, their awareness, knowledge and perception regarding radiation. The study further establishes the fact that whether healthcare professionals are familiar with ionizing radiation exposure and then also finds out their level of awareness in workplace and among students of the profession.

3.1 Research Model

The preferred methodology for this study is quantitative description because of its rigid way of categorizing responses to questions and then analyzing the numerical data statistically. In order to eliminate bias from the study, a careful design of data collection tool is yardstick as stated by Cresswell (1994), so there was a careful consideration in the design of the questionnaire. The population of the study was based on the radiography, dentistry, medical and other medical related professionals of Zliten teaching hospital, Libyan German hospital and Tripoli central hospital.

3.2 Participants and sample

A simple random method was be used in this study. The size of the sample was berandomly selected by the Cochran (1977) method. The questions and estimates of exposure to radiation and possible future risks are based on relevant literature and content expertise (Mettler, et al., 2008). Every radiography and dentistry, medical and medical related professionals was given an organized questionnaire obtained from Awosan et al., 2016 (Section II-III), Maryam and Abbas, 2011 (Section IV-VI) and 2017 (Section VII).

The format of the questionnaire that was administered to the study participants comprised of six (6) sections which the first part dealt with demographic questions regarding gender, age, marital status, department, nationality, income and cadre. The second part covered questions regarding knowledge about radiation hazards, the third part about attitude, risk perception and protection practices of radiation and the fourth part dealt with employee's awareness of necessity of using film-badge and periodical examination. The fifth section is on the awareness of the existence of personal protective devices in radiology department and last section is all about the knowledge of radiation with a 2-point scale.

Table 2.
Age distribution

Items	**Frequency**
<20	24
21-30	87
31-40	109
41-50	80
Total	**300**

In the above Table 2, the age of the respondents were <20 (8%), 21- 30 (29%), 31-40 (36.3%), 40 and above (26.7%) respectively.

Table 3.
Gender distribution

Items	**Frequency**
Male	224
Female	76
Total	**300**

As in Table 3, 74.7% of the respondents were male and 25.3% female.

Table 4.
Marital status

Items	Frequency	Percent
Married	112	37.3
Single	145	48.3
Widowed	20	6.7
Divorced	23	7.7
Total	**300**	**100.0**

As seenin the above Table 4, 37.3% of respondents were married, 48.3% were single, 6.7% widow and 7.7% were devorced.

Table 5.
Department

Items	Frequency	Percent
Radiology	98	32.7
Radiography	147	49.0
Dentistry	55	18.3
Total	**300**	**100.0**

The departments represented in this study were radiology (32.7%), radiography (49%) and dentistry (18.3%) (Table 5).

Table 6.
Income

Items	Frequency	Percent
$500	146	48.7
501-1000	33	11.0
1001-1500	55	18.3
1501-2000	33	11.0
2001 and above	33	11.0
Total	**300**	**100.0**

Table 6 above, shows the respective incomes of the respondents (48.7%) earn <$500, (11%) earn between $501-1000, (18.3%) earn between $1001-1500, (11%) earn between $1501-2000 while (11%) earn $2001 and above.

Table 7.
Cadre

Items	**Frequency**	**Percent**
Doctor	90	30.0
Nurse	56	18.7
Imaging scientist	30	10.0
Radiographer	34	11.3
Physicist	32	10.7
Biomedical engineer	28	9.3
Medical records staff	16	5.3
Administrative staff	14	4.7
Total	**300**	**100.0**

Table 7 shows the number of professionals within the study. (30%) of the respondents were doctors, (18.7%) were nurses, (10%) were imaging scientist, (11.3%) were radiographer, (10.7%) were physicist, (9.3%) were biomedical engineer, (5.3%) were medical records staff and (4.7%) were administrative staff.

3.3 Data Gathering Tools

Data were collected through personal information, environmental awareness, knowledge and behavior scale and information tests.

3.4 Scoring Scale Classification of the Substance

The efficiency of medical workers to know the level of compliance to radiation protection safety and protocols by radiography, dental and medical related professionals, their awareness, knowledge and perception regarding radiation.

3.5 Data Analysis

The associations between perception, knowledge and attitude were explored by means of descriptive statistics and in the analysis of level of knowledge with demographic characteristics (t-test) and ANOVA were used. p-value<0.05 is afforded significance. The data were analyzed using the statistical software SPSS 20.0.

3.6 Research Ethics

For the research to be reliable, valid and scientific process research ethics were considered, Bless & Higson-Smith (1995) adequately defined reliability of measurement as the degree to which an instrument produces equivalent results for repeated trials. They further indicate that an instrument which produces different scores every time it is used to measure an unchanging value has low reliability and can therefore not be depended upon to produce an accurate measurement. The pilot study was used and has shown consistency in the results making this study reliable. Validity explains the degree to which scientific explanations of phenomenon match reality (McMillan & Schumacher, 2006). Validity asks questions about whether an instrument is measuring what it is supposed to measure. The data collected in this study can be tested for validity. The pilot study has already indicated some degree of validity.

CHAPTER IV
RESULTS AND DISCUSSION

In this study a quantitative research approach was used to achieve the aims. This chapter includes statistical analysis of the data collected according to the research procedures described in Chapter 3 and in chapter 1 for the research questions.

4.1 Knowledge of Radiation Hazards

Table 8.
Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?

	Frequency	**Percent**
Acute radiation sickness such as nausea and vomiting	55	18.3
Skin injuries such as erythema, skin pigmentation, dermatitis, hair loss and skin desquamation	61	20.3
Cataract of the eye lens	29	9.7
Bone marrow depression	48	16.0
Infertility in men and women	30	10.0
Congenital malformations in babies delivered by pregnant women exposed to ionizing radiations	17	5.7
Cancers such as skin cancer, leukemia	22	7.3
Death	38	12.7
Total	**300**	**100.0**

According Table 8 above, regarding knowledge of radiation hazards it is clear that (18.3%) know of acute radiation sickness such as nausea and vomiting, (20.3%) skin injuries such as erythema, skin pigmentation, dermatitis, hair loss and skin desquamation, (9.7%) Cataract of the eye lens, (16%) know of Bone marrow depression, (10%) Infertility in men and women, (5.7%) Congenital malformations in babies delivered by pregnant women exposed to ionizing radiations, (7.3%) Cancers such as skin cancer, leukemia and (12.7%) know of death hazards of exposure of ionizing radiation.

Table 9.
Grading of your knowledge of radiation hazards

	Frequency	Percent
Good	123	41.0
Poor	177	59.0
Total	**300**	**100.0**

Table 9 above, shows the grading knowledge of radiation hazards. (41%) of the population says its good grading while (59%) says its poor grading in terms of knowledge.

Table 10.
Which of the following do you know as a personal protective device for reducing radiation exposure?

	Frequency	Valid Percent
Lead goggles	55	18.3
Lead apron	61	20.3
Lead gloves	29	9.7
Thyroid shield	48	16.0
Gonad shields	30	10.0
Grading of your knowledge of PPD	17	5.7
Good	22	7.3
Poor	38	12.7
Total	**300**	**100.0**

According to Table 10 above, regarding perception of protective devices, for reducing radiation exposure, it is clear that (18.3%) use lead goggles, (20.3%) use lead apron, (9.7%) use lead gloves, (16%) use thyroid shields, (10%) use gonad shields, (5.7%) use grading of knowledge of PPD while (7.3%) and (12.7%) respectively say it's either good or poor protective device for reducing radiation exposure.

4.2 Knowledge Regarding Consistent Use of PPDs and Dosimeter

Table 11.

Consistent use

	Lead goggles		Lead apron		Lead gloves		Thyroid shield		Gonad shields	
	Frequency	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**	**Frequency**	**Percent**
Consistent	278	213	71.0	92.7	123	41.0	255	45.7	159	45.7
Not consistent	22	87	29.0	7.3	177	59.0	45	54.3	141	54.3
Total	**300**	**300**	**100.0**	**100.0**	**300**	**100.0**	**300**	**100.0**	**300**	**100.0**

According to Table 11 above, regarding consistent use of PPDs and dosimeter: Lead goggles, it is clear that (92.7%) are consistent with usage while (7.3%) are not consistent. According to the table above regarding Consistent use of PPDs and dosimeter: Lead apron, it is clear that (71%) are consistent with usage while (29%) are not consistent. According to the table above regarding Consistent use of PPDs and dosimeter: Lead gloves, it is clear that (41%) are consistent with usage while (59%) are not consistent. According to the table above regarding Consistent use of PPDs and dosimeter: thyroid shield, it is clear that (85%) are consistent with usage while (15%) are not consistent. According to the table above regarding Consistent use of PPDs and dosimeter: gonad shields, it is clear that (45.7%) are consistent with usage while (54.3%) are not consistent.

Table 12.

Consistent use: Dosimeter (TLD) badge

	Frequency	**Percent**
Consistent	159	53.0
Not consistent	141	47.0
Total	**300**	**100.0**

According to Table 12 above regarding Consistent use of PPDs and dosimeter: dosimeter (TLD) badge, it is clear that (53%) are consistent with usage while (47%) are not consistent.

4.3 Employees' Awareness Regarding Radiation Safety Equipment

Table 13.
Employees' awareness: Using film-badge

	Frequency	Percent
Yes	149	49.7
No	151	50.3
Total	**300**	**100.0**

According to Table 13 above regarding Employees' awareness of using film-badge, 49.7% are aware while 50.3%) are not.

Table 14.
Employees' awareness: Periodical examination

	Frequency	Percent
Yes	115	38.3
No	185	61.7
Total	**300**	**100.0**

According to Table 14 above regarding Employees' awareness of eriodical examination, 38.3% are aware while 61.7% are not.

Table 15.
Awareness in radiology department: Thyroid Shield

	Frequency	Percent
Yes	248	82.7
No	52	17.3
Total	**300**	**100.0**

According to Table 15 above regarding Awareness in radiology department: Thyroid Shield, (82.7%) are aware while (17.3%) are not.

Table 16.
Awareness in radiology department: Gonad Shield

	Frequency	**Percent**
Yes	149	49.7
No	151	50.3
Total	**300**	**100.0**

According to Table 16 above regarding Awareness in radiology department: Gonad Shield, it is clear that (49.7%) say yes they aware while (50.3%) said no.

Table 17.
Awareness in radiology department: Lead Glove

	Frequency	**Percent**
Yes	122	40.7
No	178	59.3
Total	**300**	**100.0**

According to the Table 17 above regarding Awareness in radiology department: Lead Glove, (40.7%) are aware while (59.3%) are not.

Table 18.
Awareness in radiology department: Lead Goggles

	Frequency	**Percent**
Yes	260	86.7
No	40	13.3
Total	**300**	**100.0**

According to Table 18 above regarding Awareness in radiology department: Lead Goggles, (86.7%) are aware while (13.3%) are not.

Table 19.

Awareness in radiology department: Wall Shield

	Frequency	**Percent**
Yes	145	48.3
No	155	51.7
Total	**300**	**100.0**

According to Table 19 above regarding Awareness in radiology department: Wall Shield, (48.3%) are aware while (51.7%) are not.

Table 20.

Awareness in radiology department: Radiation Sign

	Frequency	**Percent**
Yes	117	39.0
No	183	61.0
Total	**300**	**100.0**

According to Table 20 above regarding Awareness in radiology department: Radiation Sign, (39%) are aware while (61%) are not.

Table 21.

Do you know the SI unit of absorbed dose equivalent.

	Frequency	**Percent**
Yes	253	84.3
No	47	15.7
Total	**300**	**100.0**

According to Table 21 above regarding their knowledge about the SI unit of absorbed dose equivalent, (84.3%) knew while (15.7%) did not know the SI unit absorbed dose equivalent.

Table 22.
CT scan involves the usage of X-Rays

	Frequency	Percent
Yes	127	42.3
No	173	57.7
Total	**300**	**100.0**

According to Table 22 above regarding if CT scan involves the usage of X-Rays, (42.3%) knew while (57.7%) did not know that CT scan involves the usage of x-rays.

Table 23.
Do you know the material of protective cloth for x-ray examination

	Frequency	Percent
Yes	120	40.0
No	180	60.0
Total	**300**	**100.0**

According to Table 23 above regarding the material of protective cloth for X-Ray examination, (40%) say yes they knew while (60%) did not know the material of protective cloth for x-ray examination.

Table 24.
Mammography involves the usage of X-rays

	Frequency	Percent
Yes	244	81.3
No	56	18.7
Total	**300**	**100.0**

According to Table 24 above regarding if Mammography involves the usage of x-rays, (81.3%) knew while (18.7%) did not know the Mammography involves the usage of x-rays.

Table 25.
Do you know the standard minimum safe distance from x-ray machine while performing portable X-Rays.

	Frequency	Percent
Yes	147	49.0
No	153	51.0
Total	**300**	**100.0**

According to table 25 above regarding the standard minimum safe distance from x-ray machine while performing portable X-Rays, (49%) said they know while (51%) said they did not know the standard minimum safe distance from X-Ray machine while performing portable x-rays.

Table 26.
Do you know the highest permitted level of occupational radiation dose.

	Frequency	Percent
Yes	124	41.3
No	176	58.7
Total	**300**	**100.0**

According to Table 26 above regarding the highest permitted level of occupational radiation dose, (41.3%) knew while (58.7%) did not know the highest permitted level of occupational radiation dose.

Table 27.
MRI involves the usage of x-rays

	Frequency	Percent
Yes	245	81.7
No	55	18.3
Total	**300**	**100.0**

According to Table 27 above regarding if MRI involves the usage of x-rays, (81.7%) knew while (18.3%) did not know that MRI involves the usage of X-Rays.

Table 28.
If fluoroscopy is on, and if you are not operating or assisting in the procedure, do you step out of the room?

	Frequency	Percent
Yes	140	46.7
No	160	53.3
Total	**300**	**100.0**

According to Table 28, regarding if fluoroscopy is on, and if you are not operating or assisting in the procedure, do you step out of the room, (46.7%) said “Yes”, while (53.3%) said “No”.

Table 29.
Ultrasound involves the usage of X-Rays.

	Frequency	Percent
Yes	121	40.3
No	179	59.7
Total	**300**	**100.0**

According to Table 29, regarding if Ultrasound involves the usage of X-Rays, (40.3%) said yes while (59.7%) said no they did not know that Ultrasound involves the usage of X-Rays.

Table 30.
Do you know the SI unit for measurement of radioactivity?

	Frequency	Percent
Yes	256	85.3
No	44	14.7
Total	**300**	**100.0**

According to Table 30, regarding the SI unit for measurement of radioactivity, (85.3%) said “Yes” while (14.7%) said no they did not know the Ultrasound involves the usage of x-rays.

Table 31.
Radiation is present inside CT scanner all the times 24 hours a day

	Frequency	Percent
Yes	144	48.0
No	156	52.0
Total	**300**	**100.0**

According to Table 31, regarding Radiation presence inside CT scanner all the time 24 hours a day (48%) say "Yes" they knew while (52%) said no they did not know that Radiation is present inside CT scanner all the time 24 hours a day

Table 32.
Do you know that there is a probability for risk of cancer after undergoing a chest x-ray examination

	Frequency	Percent
Yes	121	40.3
No	179	59.7
Total	**300**	**100.0**

According to Table 32, regarding the probability for risk of cancer after undergoing a chest X-Ray examination (40.3%) said they knew while (59.7%) said they did not know that there is a probability for risk of cancer after undergoing a chest x-ray examination.

Table 33.
Pregnant nurse can work in fluoroscopy in first trimester

	Frequency	Percent
Yes	253	84.3
No	47	15.7
Total	**300**	**100.0**

According to Table 33 above regarding pregnant nurse working in fluoroscopy in first trimester, (84.3%) said yes while (15.7%) said they did not know that pregnant nurse can work in fluoroscopy in first trimester.

Table 34.
Gamma rays are used for medical purpose.

	Frequency	**Percent**
Yes	252	84.0
No	48	16.0
Total	**300**	**100.0**

According to Table 34, regarding Gamma rays for medical purpose (84%) said yes they knew while (16%) said they did not know that Gamma rays are used for medical purpose.

4.4 What do Radiographers and Dental Professionals Know About Ionizing Radiation Exposure?

Table 35.

*Department * Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)? Crosstabulation*

			Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?								Total
			Acute radiation sickness such as nausea and vomiting	Skin injuries such as erythematic, skin pigmentation, dermatitis, hair loss and skin desquamation	Cataract of the eye lens	Bone marrow depression	Infertility in men and women	Congenital malformations in babies delivered by pregnant women exposed to ionizing radiations	Cancers such as skin cancer, leukemia	Death	
Department	***Radiology***	*Count*	*55*	*43*	*0*	*0*	*0*	*0*	*0*	*0*	*98*
		% within department	56.1%	43.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
		% within Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?	100.0%	70.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	32.7%
	Radiography	Count	0	18	29	48	30	17	5	0	147
		% within department	0.0%	12.2%	19.7%	32.7%	20.4%	11.6%	3.4%	0.0%	100.0%
		% within Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?	0.0%	29.5%	100.0%	100.0%	100.0%	100.0%	22.7%	0.0%	**49.0%**
	Dentistry	Count	0	0	0	0	0	0	17	38	55
		% within department	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	30.9%	69.1%	100.0%
		% within Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	77.3%	100.0%	**18.3%**
Total		Count	55	61	29	48	30	17	22	38	300
		% within department	18.3%	20.3%	9.7%	16.0%	10.0%	5.7%	7.3%	12.7%	100.0%
		% within Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

In the radiography department, (Table 35) there is a tendency that 49% know about ionizing radiation exposure in relation to all the harm it might cause *(bone marrow depression 32.7% recorded the highest, knowledge with regards to death and acute radiation sickness did not record anything – meaning the professionals do not have prior knowledge)*. In the dentistry department, there is a tendency that 18.3% know about ionizing radiation exposure in relation to all the harm it might cause (*there are higher % with death 69.1% and the cause of cancer 30.9%. Others like sickness, hair loss, infertility, etc recorded zero knowledge the dental professionals*).

Table 36.
Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	506.303[a]	14	**.000**
Likelihood Ratio	518.030	14	.000
Linear-by-Linear Association	246.230	1	.000
N of Valid Cases	300		

a. 2 cells (8.3%) have expected count less than 5. The minimum expected count is 3.12

Table 36 shows $P<0.05$ 0.000 that the relative proportion of radiographers and dental professionals are not independent of ionizing radiation exposure (*the radiographers and dental professionals have an effect on the outcome which is death, acute radiation sickness, bone marrow depression, skin injuries, cancer and infertility.*

4.5 What is The Healthcare Workers Level of Awareness of Radiation?

Table 37.

*Cadre * awareness Crosstabulation*

		Awareness													Total
		-.89	-.56	-.45	-.22	-.21	.04	.22	.28	.46	.56	.72	.90	1.38	
Doctor	Count	88	0	0	0	0	0	0	0	2	0	0	0	0	90
	% within cadre	97.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.2%	0.0%	0.0%	0.0%	0.0%	100.0%
	% within awareness	89.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	0.0%	0.0%	0.0%	0.0%	30.0%
Nurse	Count	3	0	0	3	14	0	7	0	21	5	0	1	2	56
	% within cadre	5.4%	0.0%	0.0%	5.4%	25.0%	0.0%	12.5%	0.0%	37.5%	8.9%	0.0%	1.8%	3.6%	100.0%
	% within awareness	3.1%	0.0%	0.0%	100.0%	43.8%	0.0%	100.0%	0.0%	19.4%	100.0%	0.0%	100.0%	7.4%	18.7%
Imaging scientist	Count	7	4	0	0	16	0	0	3	0	0	0	0	0	30
	% within cadre	23.3%	13.3%	0.0%	0.0%	53.3%	0.0%	0.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	% within awareness	7.1%	100.0%	0.0%	0.0%	50.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	10.0%
Radiographer cadre	Count	0	0	0	0	0	0	0	0	34	0	0	0	0	34
	% within cadre	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	% within awareness	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	31.5%	0.0%	0.0%	0.0%	0.0%	11.3%
Physicist	Count	0	0	0	0	0	0	0	0	32	0	0	0	0	32
	% within cadre	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
	% within awareness	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	29.6%	0.0%	0.0%	0.0%	0.0%	10.7%
Biomedical engineer	Count	0	0	0	0	0	0	0	0	19	0	0	0	9	28
	% within cadre	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	67.9%	0.0%	0.0%	0.0%	32.1%	100.0%
	% within awareness	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	17.6%	0.0%	0.0%	0.0%	33.3%	9.3%
Medical records staff	Count	0	0	0	0	0	0	0	0	0	0	0	0	16	16
	% within cadre	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
	% within awareness	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	59.3%	5.3%
Administrative staff	Count	0	0	2	0	2	3	0	0	0	0	7	0	0	14
	% within cadre	0.0%	0.0%	14.3%	0.0%	14.3%	21.4%	0.0%	0.0%	0.0%	0.0%	50.0%	0.0%	0.0%	100.0%
	% within awareness	0.0%	0.0%	100.0%	0.0%	6.3%	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	4.7%
Total	Count	98	4	2	3	32	3	7	3	108	5	7	1	27	300
	% within cadre	32.7%	1.3%	0.7%	1.0%	10.7%	1.0%	2.3%	1.0%	36.0%	1.7%	2.3%	0.3%	9.0%	100.0%
	% within awareness	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

From Table 37 above we can interpret that doctors have higher awareness % 30% with regards to the cadre/professionals. Administrative staff has the lowest awareness 4.7%.

Table 38.
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	949.101[a]	84	**.000**
Likelihood Ratio	659.208	84	.000
Linear-by-Linear Association	168.934	1	.000
N of Valid Cases	300		

a. 85 cells (81.7%) have expected count less than 5. The minimum expected count is .05.

Table 38 P<0.05 0.000 which that the relative proportions of health-care workers are not independent of the awareness towards radiation (*with references to Consistent use of: Lead goggles, Lead apron, Lead gloves, Thyroid shield, Gonad shields and Dosimeter (TLD) badge).*

4.6 What is The Healthcare Workers Perception of Radiation?

Table 39.
Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1298.696[a]	154	**.000**
Likelihood Ratio	814.468	154	.000
Linear-by-Linear Association	92.351	1	.000
N of Valid Cases	300		

a. 166 cells (90.2%) have expected count less than 5. The minimum expected count is .05.

Table 39 P<0.05 0.000 which that the relative proportions of health-care workers are not independent of the perception towards radiation (*with references to Thyroid shield, gonad shield, lead glove, lead goggles, wall shield, and radiation sign).*

CHAPTER V
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The demographic survey shows that the study was dominated by male between the age of 31 to 40 and are single working in radiography department as doctors with a monthly income of less than 500 USD.

Regarding the knowledge of radiation hazards, the workers know of acute radiation sickness such as nausea and vomiting and skin injuries such as erythema, skin pigmentation, dermatitis, hair loss and skin desquamation while others do not know about cataract of the eye lens, bone marrow depression, infertility in men and women, congenital malformations in babies delivered by pregnant women exposed to ionizing radiations, cancers such as skin cancer, leukemia and even death as hazards of exposure of ionizing radiation, this shows/that the students lack knowledge of radiation hazard and by grading it poor knowledge at 59%, which is also similar to the study of Mutyabule and Whaites (2002) on radiation protection measures in dental practices in Uganda signifying lack of knowledge regarding radiation exposure.

According to the workers perception regarding protective device for reducing radiation exposure, they perceived that the use of lead apron, lead goggles and thyroid shields are best protective devices for reducing radiation exposure and in grading of knowledge of PPD the majority of the workers 12.7% say it's either good or poor protective devices for reducing radiation exposure. As indicated by Shahab et al., (2012) that there is direct impact of radiation exposure to radiation from the knowledge and attitude of health workers regarding radiation safety.

In terms of consistent use of PPDs and dosimeter, the medical workers consistently make use of lead goggles, lead apron, thyroid shield and dosimeter (TLD) badge while lead gloves similar to the result of (Nafkoor & Brooks, 1992) and gonad shields is not consistently used and according to Lee and Ludlow (2013) there is a need to reinforce the health workers working about the issue of radiation safety.

According to the medical workers awareness of film-badge normally used, there is no periodical examination of workers who work with radiation equipment, and radiology department are aware that thyroid shield, lead goggle, is normally used though they are not aware of the usage of gonad shield, wall shield, radiation sign and lead glove. The workers have knowledge of the SI unit of absorbed dose equivalent and the SI unit for measurement of radioactivity. The medical workers are not aware that CT scan and ultrasound involves the usage of x-rays though they know that mammography and MRI involves the usage of x-rays and the students do not know the material of protective cloth for x-ray examination. Most of the medical student workers do not know the standard minimum safe distance from x-ray machine and the highest permitted level of occupational radiation dose Nias (1999). Walden and Farzeneh (1990) states that any amount of radiation may bring about some risk of cancer or genetic defects. They are not away if radiation is present inside CT scanner all the time 24 hours a day, there is a probability for risk of cancer after undergoing a chest x-ray examination, and they know if pregnant nurse can work in fluoroscopy in first trimester, and also know that gamma rays are used for medical purpose. This study correspond to that of Math *et al.* (2014) which recommends the need to increase the practitioner's awareness and attitude regarding radiation hazard and use of appropriate methods in order to reduce the radiation dose.

In the Radiography Department, there is a tendency that 49% know about ionizing radiation exposure in relation to all the harm it might cause *(bone marrow depression, knowledge with regards to death and acute radiation sickness did not record anything – meaning the professionals do not have prior knowledge)*. In the Dentistry Department, there is a tendency that *there are higher % with death 69.1% and the cause of cancer 30.9%. Others like sickness, hair loss, infertility, etc recorded zero knowledge the dental professionals*) in which the relative proportion of radiographers and dental professionals are not independent of ionizing radiation exposure (*the radiographers and dental professionals have an effect on the outcome which is death, acute radiation sickness, bone marrow depression, skin injuries, cancer and infertility*).

The administrative staff has the lowest awareness and it can be deduced that the closer you are to the events that occur in real time, the more tendency you are aware of the medical related happenings and development. The relative proportions of health-care workers are not independent of the awareness of radiation (*with references to Consistent use of: Lead goggles, Lead apron, Lead gloves, Thyroid shield, Gonad shields and Dosimeter (TLD) badge).*

The relative proportions of health-care workers are not independent of the perception towards radiation (*with references to Thyroid shield, gonad shield, lead glove, lead goggles, wall shield, and radiation sign).*

5.2 Recommendation

The study recommends the following:

- Attention to the preventive aspect in terms of providing a unit of precautions in hospitals that do not exist, and the provision of personal dosimeter and periodic readings, the obligation to conduct blood tests and medical examination of workers as is recognized internationally, protective clothing should be given to workers so that each one has special outfit technician.

- The establishment of a center for the calibration of X-ray devices and personal dosimeters in each city that has sections of radiation, in order to avoid any delay in knowing the overdose to take as the necessary precautionary measure.

- Attention to sections of radiation in terms of space, the appropriate allocation, and calibration of existing devices.

- The establishment of training courses for medical student and radiation technicians in the field of radiation protection and the proliferation of lectures dealing with radiation and risk and prevention.

- The establishment of training courses for the technicians of radiation to keep pace with the continuous scientific development in the devices and methods of medical diagnosis, and knowing the latest methods and devices of personal protection.

- Paying attention to workers in the sections of radiation in terms of nutrition and providing them with the necessary healthy meals.

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Appendix - 1

QUESTIONNAIRE

Dear respondents

The objective of the questionnaire is to collect information about **Knowledge, attitude and perception on radiation imaging among medical students in Libyan Hospitals.** The information you provide will be valuable for academic purposes of Near East University, Turkish Republic of north Cyprus (TRNC). Therefore, your genuine, honest, and prompt response. Will be a a valuable input for the quality and successful completion of the research. The information you give will be used only for academic purpose and will be kept confidential.

I. Demographic Data

i. Sex: ( ) Male ( ) Female

ii. Age: < 20 ( ) 21-30 ( ) 31-40 ( ) 40 and above ( )

iii. Marital Status: Married ( ) Single ( ) Widowed ( ) Divorced ( )

iv. Department: Radiology ( ) Radiography ( ) Dentistry ( ) Other…………

vi. Income a. Below 500 **$** b. 501 – 1000 **$** c. 1001-1500 **$** d. 1501-2000 **$** e. 2001 **$** and above

II. Knowledge of R**adiation** H**azards (Please tick the most appropriate in the boxes)**

(Awosan et al., 2016)

1. Which of the following do you know as radiation hazards (i.e., harm to the body or sickness due to exposure to ionizing radiations)?		
	Yes	No
Acute radiation sickness such as nausea and vomiting		
Skin injuries such as erythema, skin pigmentation,		

dermatitis, hair loss and skin desquamation		
Cataract of the eye lens		
Bone marrow depression		
Infertility in men and women		
Congenital malformations in babies delivered by pregnant women exposed to ionizing radiations		
Cancers such as skin cancer, leukaemia etc.		
Death		
2. Grading of your knowledge of radiation hazards		
Good		
Poor		

III. Attitude, Risk Perception and Protective Practices

3. Which of the following do you know as a personal protective device (PPD) for reducing radiation exposure?		
	Yes	No
Lead goggles		
Lead apron		
Lead gloves		
Thyroid shield		
Gonad shields		
Grading of your knowledge of Personal Protective Devices (PPDs)		
Good		
Poor		

IV. Consistent use of Personal Protective Devices (PPDs) and dosimeter (Maryam and Abbas, 2011).

Items	Not consistently used	Consistent use

Lead goggles		
Lead apron		
Lead gloves		
Thyroid shield		
Gonad shields		
Dosimeter (TLD) thermoluminescent dosimeter badge		

V. Employees' awareness of the necessity of using film-badge and periodical examination

Employees' awareness	**Yes**	**No**
Using film-badge		
Periodical examination		

VI. Awareness of the existence of personnel protective devices in radiology departments. Lead Apron

Awareness	**Yes**	**No**
Thyroid Shield		
Gonad Shield		
Lead Glove		
Lead Goggles		
Wall Shield		
Radiation Sign		

VII. Knowledge of radiation (Surendra, 2017)

No	Questions	Yes	No
1.	Do you know the SI unit of absorbed dose equivalent		
2.	CT scan involves the usage of x-rays		
3.	Do you know the material of protective cloth for x-ray examination		
4.	Mammography involves the usage of x-rays		
5.	Do you know the standard minimum safe distance from x-ray machine while performing portable x-rays		

6.	Do you know the highest permitted level of occupational radiation dose		
7.	MRI involves the usage of x-rays		
8.	If fluoroscopy is on, and if you are not operating or assisting in the procedure, do you step out of the room?		
9.	Ultrasound involves the usage of x-rays		
10.	Do you know the SI unit for measurement of radioactivity		
11.	Radiation is present inside CT scanner all the times 24 hours a day		
12.	Do you know that there is a probability for risk of cancer after undergoing a chest x-ray examination		
13.	Pregnant nurses can work in fluoroscopy in first trimester		
14.	Gamma rays are used for medical purpose		

Thesis

ORIJINALLIK RAPORU

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