INTEGRATING THE ISLAMIC PERSPECTIVES IN THE FUNDAMENTAL SAFETY PRINCIPLES TO IMPROVE RADIATION PROTECTION CULTURE AMONG MUSLIM DIAGNOSTIC RADIOGRAPHERS

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ABSTRACT

As one of the radiation personnel, diagnostic radiographers are responsible to ensure measures related to radiation protection are taken appropriately. However, the awareness towards radiation protection and safety were insufficient and there is a need to improve the radiation protection culture (RPC) among radiographers. Therefore, this paper aims to integrate the Islamic Perspectives in radiation fundamental safety principles which are related to diagnostic radiographer's responsibility. Later, is to highlight the application of integrating the Islamic perspectives towards improving RPC among Muslim radiographers. Out of the 10 safety principles, radiographers are able to directly contribute in six principles which are the responsibility for safety, justification of facilities and activities, optimisation of protection, limitation of risk, protection of oneself and others as well as future generations, and prevention of accidents. The Islamic perspectives related to those principles were taken from Al-Quran, hadith and *Maqasid al-Shariah*. They are related to the concept of responsibility, beneficence, justice, moderation (*al-wasatiyyah*), do no harm, protection of life and prevention from harm from the Islamic perspectives. In order to improve RPC, education and training of the involved professionals as well as adequate communication are important. Incorporating Islamic perspectives of radiation safety principles during the training session and constantly reminding the Muslim radiographers of those Islamic perspectives through poster display can be done. It is hopeful that by realizing the principles of radiation safety are in line with the teaching of Islam, Muslim radiographers will be more involved in the RPC programmes in the department.

KEYWORDS: Islamic perspective, Diagnostic imaging, Radiation protection

INTRODUCTION

Diagnostic imaging is a medical service which uses medical imaging modalities to image the human body for diagnosis and treatment of diseases (World Health Organization (WHO), 2017) . This service started with the use of an ionising radiation called x-rays in plain x-ray procedures. Later, x-rays are used in other diagnostic imaging procedures such as mammography, fluoroscopy and computed tomography (CT) procedures. In addition, radionuclide imaging uses other ionising radiation known as gamma radiation.

A concern regarding the use of ionising radiation in diagnostic imaging is that its energy is able to damage human tissue. This is because the ionising radiation is able to impart energy which releases electrons from an atom resulting in ionisation of human tissue (United Nations Environment Programme (UNEP), 2016). This fact however was known much later after the discovery of x-rays and after its wide use in clinical settings. It was unfortunate that by the end of 1950s, at least 359 doctors and radiation scientists were reported had died due to radiation exposure (United Nations Environment Programme (UNEP), 2016).

Because of that, an independent international organization called The International Commission on Radiation Protection (ICRP) was formed in 1928 in order to protect people and environment from harmful effects of radiation ("About ICRP," n.d.). In addition, the International Atomic Energy Agency (IAEA) was formed in 1957 to ensure the safe and secure use of science and technology related to ionising radiation ("Overview of IAEA," n.d.). Both organisations published many international standards, legislation and guidelines related to radiation safety and protection to be adopted by various countries. ICRP recommends the safe radiation dose limit to public and radiation personnels while IAEA develop the safety standards for radiation protection and monitor the compliance to those standards (Martin & Sutton, 2015).

In diagnostic imaging, radiation protection can be defined as actions taken by radiation personnel to safeguard patient, personnel and the general public from the unnecessary exposure to ionising radiation (Statkiewicz-Sherer, Visconti, Ritenour, & Haynes, 2018). Diagnostic radiographers are considered radiation personnel since they expose the patients with ionising radiations in order to produce medical images which facilitate in diagnosing diseases. Therefore, they are responsible to follow the safety standards of handling ionising radiation modalities.

However, the major issue in radiation protection is that the level of awareness of healthcare personnels including Muslim radiographers are insufficient towards radiation hazards and safety measures (Algohani, Aldahhasi, Algarni, Amrain, & Marouf, 2018; Senemtaşi Ünal, Geliş, & Baykan, 2017). Insufficient awareness towards radiation protection could bring harm by which unnecessary higher radiation dose might be used to produce an image. Thus, there is a need to create awareness and improve a radiation protection culture (RPC) in the department among diagnostic radiographers.

Radiation protection culture (RPC) is a combination of science, value, ethics and experience to promote the radiation protection principles in a diagnostic imaging department (International Radiation Protection Association (IRPA), 2014). Although RPC available in most diagnostic imaging department, it is difficult to improve the existing culture (Ploussi & Efstathopoulos, 2016). Thus, Muslim radiographers must view the radiation protection responsibilities beyond the professional context and must align it with Islamic perspectives. Islamic concepts of spirituality, religiosity, *Maqasid and Qawaid Al-Shariah*, *Ihsan*, *Itqan*, *Fitrah* and *Istiqomah* can be aligned to the daily radiation protection practice (Zainuddin, 2018).

This paper focuses more on the Islamic perspectives which can be aligned in the fundamental safety principles of radiation which are related to diagnostic radiographers' responsibilities. Later, is to highlight the application of integrating the Islamic perspectives towards improving radiation protection culture among Muslim radiographers. It is hopeful that the paper is able to inculcate the quality of act (*amal soleh*) among Muslim radiographers by which they may see their responsibility in radiation safety and protection beyond the professional requirements and as a mean of carrying *amanah* as a servant of Allah.

THE FUNDAMENTAL SAFETY PRINCIPLES OF RADIATION AND THE RELATED ISLAMIC PERSPECTIVES

The objective of modern radiation protection programmes are to protect people from short-term and long-term effects of ionising radiation. The effects include the adverse effects to specific organs, whole-body of a person and deformity of his or her offspring (Statkiewicz-Sherer et al., 2018). Thus, it is important to reduce the radiation risks to the extent practically possible.

In order to achieve the objective, 10 fundamental safety principles were formulated to be used in general setting which uses ionising radiation (International Atomic Energy Agency, 2006). Out of the 10 safety principles, radiographers are able to directly contribute in six principles and the examples of radiographer's responsibilities are listed in Table I below.

Table I Principles of radiation safety and example of radiographer responsibilities

No.	Principles	Description of principles	Radiographer's responsibilities examples
1.	Principle 1: Responsibility for safety	The prime responsibility for safety must rest with the person or organization responsible for facilities and activities that give rise to radiation risks.	Radiographers are responsible in ensuring the safety of their patients, public and themselves against radiation hazard.
2.	Principle 4: Justification of facilities and activities	Facilities and activities that give rise to radiation risks must yield an overall benefit.	Have knowledge to know whether the examination is necessary or not. Know the concept of benefit versus risk.
3.	Principle 5: Optimisation of protection	Protection must be optimized to provide the highest level of safety that can reasonably be achieved.	Must apply the radiation protection appropriately and ensure that the image quality is acceptable. Follow the As Low As Reasonably Achievable (ALARA) principle or the term optimisation for radiation protection (ORP) in daily practice.
4.	Principle 6: Limitation of risks to individuals	Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm.	Radiographers to ensure that the radiation dose to themselves are within the dose limit. In addition, the dose reference level for patients are acceptable.
5.	Principle 7: Protection of present and future generations	People and the environment, present and future, must be protected against radiation risks.	Apply gonadal shielding to patients and themselves whenever necessary.
6.	Principle 8: Prevention of accidents	All practical efforts must be made to prevent and mitigate nuclear or radiation accidents.	Need to follow the standard operating procedure in handling any radiation modalities and substances.

Source: Adapted from International Atomic Energy Agency (2006)

Thus, the fundamental radiation safety principles which are related to radiographers' responsibilities are the responsibility for safety, doing something beneficence (justification of benefit versus risk), optimisation, limitation of risk, protection of oneself and others as well as future generations, and prevention of accidents. There are various sources of Islamic inputs which are related to the themes of responsibility, beneficence, optimisation, limitation of risk, protection and prevention. The inputs are from the Quranic verses, hadith and concept of *Maqasid Shariah* as stated in Table II below.

Table II Islamic Perspectives related to the radiation safety principles and their identified themes

No.	Principles and Themes	Islamic Perspectives
1.	Principle 1: Responsibility for safety **Theme: Responsibility**	Source: Al-Quran "He who disbelieves will suffer the consequence of it and he who acts righteously, they will pave the way for their own good" (Quran 30:44) "Today no one shall suffer the least injustice, and you shall not be recompensed except according to your deeds" (Quran 36:54) ("Towards Understanding the Quran - Quran Translation Commentary - Tafheem ul Quran," n.d.)
2.	Principle 4: Justification of facilities and activities **Theme: Beneficence**	Source: Hadith Prophet Muhammad (PBUH) ordered his companions to do charity daily. They said: Who can do that? He said: Removing a thorny bush, or bones or dirt from the way (street) is a charity; showing the right path for those lost is a charity, enjoining right and forbidding wrong is a charity; helping those who are inefficient in their work is a charity." One of the companions said, "What if I didn't do any of these?" He said, "At least do no harm to others." The Hadith is authentic narrated through Abu Huraira (the Companion of the Prophet [PBUH]) in AlBokhari, Muslim and Ibn Hibban. AlHaithami: Majma AlZawayed, p 31107 (Al-Bar & Chamsi-Pasha, 2015)
3.	Principle 5: Optimisation of protection **Theme: Optimisation** **-Justice** **-Moderation**	Source: Al-Quran "Let not the hatred of a people swerve you away from justice. Be just, for this is closest to righteousness…" (Quran 5:8) (IslamReligion.com, 2008) "Thus, have We made of you an ummah (Community) justly balanced (*wasatan*), that ye might be witnesses over the nations, and the Messenger a witness over yourselves... " (Quran 2:143) "Be guardians of your prayers, and of the midmost (*wusta*) prayer, and stand up with devotion to Allah." (Quran 2: 238) "The best of them (*awsatuhum*) said: Did I not say to you, Why do you not glorify (Allah)?" (Quran 68:28) (Omer, 2013)
4.	Principle 6: Limitation of risks to individuals **Theme: Limitation of risk/Do no harm**	Source: Hadith Prophet Muhammad (PBUH) mentioned "Doing harm and reciprocating harm is not allowed". Sunan Abud Da'wood, Sunan Ibn Maja, Sunan alDarqutin and Mu'wata Malik (fairly good chain of narrators up to Abu Saeed AlKhodri (the Companion of the Prophet [PBUH]) (Al-Bar & Chamsi-Pasha, 2015)
5.	Principle 7: Protection of present and future generations **Theme: Protection** **-oneself and others** **-hereditary**	Source: *Maqasid al-Shari'ah* (objectives of the Islamic law) -Preservation of life (al-nafs) (Auda, 2008)
6.	Principle 8: Prevention of accidents	Source: Al-Quran "By intoxicants and games of chance Satan only desires to create enmity and hatred between you, and to turn you away from the

Theme: Prevention of accidents	remembrance of Allah and from Prayer. Will you, then, desist?" (Quran 5:91)

INTEGRATING THE ISLAMIC PERSPECTIVES IN THE FUNDAMENTAL SAFETY PRINCIPLES RELATED TO RADIOGRAPHERS' RESPONSIBILITIES

Muslim radiographers have the responsibility to fulfill their professional requirement as well as to fulfill their amanah as the vicegerent of Allah. This sense of responsible can be inculcated in Muslim radiographers by constantly reminding themselves that they are responsible of their deeds. Allah mentioned that "Today no one shall suffer the least injustice, and you shall not be recompensed except according to your deeds" (Quran 36:54). All actions done by them will be asked by Allah in the Hereafter. Allah will give good rewards in the Hereafter for their good deeds. Allah mentioned "He who disbelieves will suffer the consequence of it and he who acts righteously, they will pave the way for their own good" (Quran 30:44). Muslim radiographers should therefore feel responsible towards the radiation protection programmes in their department.

Moreover, Muslim radiographers must realise that the diagnostic imaging procedures are served to bring benefits to patients. The benefits should always outweigh the harm received by the patients from the procedures. Muslim radiographers must equip themselves with knowledge to know whether certain procedures requested by doctors is necessary or not. They must appreciate that Rasulullah S.A.W. encouraged Muslim to be kind and to benefits others (Refer to theme beneficence in Table II). The concept of beneficence in Islam means the acts of Muslims should be for the purpose of giving benefits to others which include helping others and preventing harms (Al-Bar & Chamsi-Pasha, 2015). By knowing whether a procedure is necessary or not, Muslim radiographers will not simply follow any request to perform a radiological procedure on patient. This will prevent the patient from receiving unnecessary radiation exposure.

When a radiological procedure involving radiation exposure is to be performed on patient, Muslim radiographers should apply the optimisation (ALARA or ORP) concepts in their clinical practice. By doing so, the Muslim radiographers have done justice to the patient and themselves. Allah mentioned "Let not the hatred of a people swerve you away from justice. Be just, for this is closest to righteousness…" (Quran 5:8). Justice in Islam means putting things in their rightful place (IslamReligion.com, 2008). In terms, of radiation protection, a Muslim radiographer must change their technical settings when producing medical images according to their patients' conditions. Their goal is to reduce the radiation dose given to patient as low as possible but still is able to produce medical images with optimum quality.

Optimum quality medical images mean that the images are able to facilitate the radiologists in doing their diagnosis. In other words, it is unsafe to give very high radiation dose to patient just to achieve pointless high-quality images. Radiographers should use lower radiation dose and produce optimum images which are able to fulfill their purpose in showing the diseases and ensure the standard diagnostic accuracy is achieved. This is in line with the concept of *al-wasatiyyah* in Islam. The term is derived from the word *wasat* which is in Arabic and means middle, fair, just and moderate (Omer, 2013). In Al-Quran, the word is referring to "the best" for example Allah mentioned "The best of them (*awsatuhum*) said: Did I not say to you, Why do you not glorify (Allah)?" (Quran 68:28). Muslim radiographers should therefore value the concept of optimisation since it is in line with the concept of *al-wasatiyyah* in Islam. By applying the optimisation principle, the Muslim radiographers are doing just to patients.

In addition, Muslim radiographers are responsible to reduce the harm caused by radiation in diagnostic imaging procedures. This is aligned with what mentioned by Prophet Muhammad (PBUH),

"Doing harm and reciprocating harm is not allowed". Radiographers must therefore ensure that the radiation dose to themselves are within the recommended dose limit. In addition, the dose reference levels for patients are within the acceptable levels. This can be achieved by the use of appropriate equipment and radiological techniques as well as following standard operating procedures and radiation protection training (Engel-hills, 2006).

Furthermore, the Muslim radiographers are responsible to ensure that the radiation dose given to patient is as low as reasonably achievable. This is because higher radiation doses are associated with higher risk of developing cancer and other radiation-related diseases. Moreover, it could also cause genetic mutation in the sperms and ovaries which can lead to disability in the future offsprings. Therefore, Muslim radiographers must guard the safety of patients, public, themselves as well as future generations from the adverse effect of ionising radiation. This is in line with the preservation of life (al-nafs) in *Maqasid al-Shari'ah* (objectives of the Islamic law). Many Islamic scholars highlighted that the purpose of the Islamic law is to serve the people's interest (*masalih*) (Auda, 2008).

In order to prevent any unwanted radiation accident to happen, Muslim radiographers must follow the standard operating procedure in handling any radiation modalities and substances. Allah reminded us to refrain ourselves from drinking alcohol and gambling since they would bring harm. Thus, the purpose of banning drinking alcohol and gambling is to serve as prevention of something bad to happen. Allah mentioned "By intoxicants and games of chance, Satan only desires to create enmity and hatred between you, and to turn you away from the remembrance of Allah and from Prayer. Will you, then, desist?" (Quran 5:91). The standard operating procedures also serve to prevent from accidental injuries from radiation to occur. Muslim radiographers should therefore value the importance of having the standards to follow.

Finally, Muslim radiographers should realise that the principles of radiation safety are in line with the teaching of Islam. By fulfilling the principles, they are not just observing their professional obligations in radiation protection. They have indeed fulfilled their responsibility as a Muslim. This is because the responsibility of radiographers in radiation safety is in line with the concept of responsibility, beneficence, justice, moderation (*al-wasatiyyah*), do no harm, *Maqasid al-Shariah* on protection of life and prevention from harm.

IMPROVING RADIATION PROTECTION CULTURE (RPC) AMONG MUSLIM DIAGNOSTIC RADIOGRAPHERS

A strong RPC in a diagnostic imaging department is important as it minimizes harmful effects related to the radiological procedures thus improving the services quality of the department (Ploussi & Efstathopoulos, 2016). Establishing and improving the radiation protection culture will therefore improve the quality and effectiveness of radiation protection programmes (IRPA,2014). The establishment of RPC involves three main development stages which are the basic compliance, self-directed safety compliance and a behavioral safety system (IRPA, 2014). Thus, it is important to improve the RPC from basic compliance stage to a behavioral safety system.

As one of the radiation personnel, diagnostic radiographers must actively participate in the RPC programmes of the department. An example of a department with strong RPC, the diagnostic radiographers are not only responsible for their own safety but also for others including their patients and colleagues while the manager support the act of good responsibility (IRPA, 2014). However, lack of collaboration is one of the major challenge in establishing a strong RPC (Ploussi & Efstathopoulos, 2016).

Thus, integration of Islamic perspectives in the fundamental radiation safety principles is an effort to motivate the Muslim radiographers to be more responsible with respect to radiation protection programmes. By realizing that the principles are aligned to Islamic perspectives, it is hopeful that Muslim radiographers will give full cooperation in the RPC programmes. This is because one of the behavioral elements of RPC is personal accountability (IRPA, 2014). It is important for the Muslim

radiographers to feel that the radiation protection is their personal responsibility. In this case, a connection between professional responsibility with religious obligations should certainly be helpful.

Two from four methods to strengthen RPC as recommended by IRPA (2014) are to educate and train the involved professionals and to establish adequate and proper communication among the professionals. The dissemination of the related Islamic perspectives is recommended to be done in these two methods. It is hopeful that the RPC programmes will be more effective to the Muslim radiographers when their radiation protection training also include Islamic perspectives. In addition, the Muslim radiographers should constantly be reminded about their responsibility regarding radiation safety by having posters displaying the Islamic perspectives in the department.

CONCLUSIONS

The fundamental radiation safety principles which are related to radiographers' responsibilities are the responsibility for safety, doing something beneficence (justification of benefit versus risk), optimisation of protection, limitation of risk, protection of oneself and others as well as future generations, and prevention of accidents. Muslim radiographers should realise that these concepts are in line with the concept of responsibility, beneficence, justice, moderation (*al-wasatiyyah*), do no harm, *Maqasid al-Shariah* on protection of life and prevention from harm from Islamic perspectives. Muslim should realised that their responsibility in radiation protection is not only limited to fulfilling professional obligation but to also please Allah. The Islamic perspectives of fundamental radiation safety principles should therefore be incorporated in the radiation protection training and be displayed in the department to improve the radiation protection culture among Muslim radiographers.

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