KNOWLEDGE, ATTITUDE, AND PRACTICE OF VETERINARY PRACTITIONERS TOWARDS RADIATION SAFETY IN MALAYSIA

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CERTIFICATION

This is to certify that we have read this research paper entitled **'Knowledge, Attitude, And Practice of Veterinary Practitioners Towards Radiation Safety In Malaysia** by Khairun Izzaty Binti Khairulaini, and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the course DVT 5436 – Research Project.

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Thank You

DEDICATIONS

"In the Name of Allah, The Most Beneficent & The Most Merciful"

The thesis is dedicated to

My family for their never-ending encouragement and prayers

&

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ABSTRACT

An abstract of the research paper presented to the Faculty of Veterinary Medicine in partial requirement on the course DVT 5436 - Research Project

KNOWLEDGE, ATTITUDE, AND PRACTICE OF VETERINARY PRACTITIONERS TOWARDS RADIATION SAFETY IN MALAYSIA.

By:

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Radiography examination is one of the most common diagnostic workup in veterinary medicine. This study was conducted to determine knowledge, attitude and practice of veterinary practitioners towards radiation safety in Malaysia. A self-administered online based questionnaire was distributed to veterinary practitioners including radiographers, veterinary assistant, and veterinary technician. Data was able to be collected from a total of 105 respondents. Questionnaire inquired on veterinary practitioners to determine the importance of radiation safety thus can assess the knowledge, attitude and practice towards radiation safety. Data collected was entered and analyzed using the Statistical Package for Social Sciences (SPSS) Version 28. Numerical data was presented in the form of means and standard deviations. Categorical data was presented in the form of percentages. The total knowledge, attitude and practice score was then computed. Overall, respondents showed a moderate knowledge, good levels of attitude and good practice towards radiation safety. These findings could help veterinarians to improve what's lacking in the knowledge, attitude and practice toward radiation safety in veterinary medicine in Malaysia.

Key words : Radiation safety, Veterinary practitioners, SPSS, Questionnaires.

ABSTRAK

Abstrak daripada kertas penyelidikan dikemukakan kepada Fakulti Perubatan Veterinar, Universiti Malaysia Kelantan untuk memenuhi sebahagian daripada keperluan kursus DVT 5436 – Projek Penyelidikan.

PENGETAHUAN, SIKAP DAN AMALAN PENGAMAL VETERINA TERHADAP KESELAMATAN SINARAN DI MALAYSIA.

Disediakan oleh :

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2022

Pemeriksaan radiografi adalah salah satu pemeriksaan diagnostik yang paling biasa dalam perubatan veterinar. Kajian ini dijalankan untuk mengetahui pengetahuan, sikap dan amalan pengamal veterinar terhadap keselamatan sinaran di Malaysia. Soal selidik berasaskan dalam talian yang ditadbir sendiri telah diedarkan kepada pengamal veterinar termasuk radiografer, pembantu veterinar, dan juruteknik veterinar. Data dapat dikumpul daripada seramai 105 orang responden. Soal selidik yang ditanya ke atas pengamal veterinar untuk menentukan kepentingan keselamatan sinaran dapat menilai pengetahuan, sikap dan amalan terhadap keselamatan sinaran. Data yang dikumpul telah dimasukkan dan dianalisis menggunakan perisian Statistical Package for Social Sciences (SPSS) Versi 28. Berangka dipersembahkan dalam bentuk sisihan piawai dan min. Data kategori dipersembahkan dalam bentuk peratusan. Jumlah skor pengetahuan, sikap dan amalan kemudiannya dikira. Secara keseluruhannya, responden menunjukkan pengetahuan yang sederhana, tahap sikap yang baik dan amalan yang baik terhadap keselamatan sinaran. Penemuan ini boleh membantu doktor haiwan untuk menambah baik apa yang kurang dalam pengetahuan, sikap dan amalan terhadap keselamatan sinaran dalam perubatan veterinar di Malaysia.

Kata kunci : Keselamatan sinaran, Pengamal Veterinar, SPSS, Soal Selidik.

1.0 INTRODUCTION

In veterinary medicine, the use of ionizing radiation for the diagnosis and treatment of several medical conditions is routine. Ionizing radiation is often used in veterinary medicine in the form of radiographs, computed tomography, fluoroscopy, and nuclear medicine (Mortiz,1989). Radiography is the most widely practiced and widely available of them, with in-house radiography equipment in most general clinics and specialty referral hospitals (Mayer,2018).

In the past, the risk of radiation exposure from medical imaging is not insignificant; it is now believed that radiation exposure and cancer development have a linear relationship (Brenner,2004). Many studies in recent years have documented the harmful effects of radiation exposure. Evidence suggests that exposing a fetus in-utero during pregnancy may result in a variety of malformations (Børretzen,2007).

According to numerous studies, veterinary practitioners are unaware of the risks associated with radiation use (Joseph S, 2003). Practitioners in charge of requesting radiological examinations have a tendency to underestimate the actual doses involved, have a lack of knowledge about the potential risks to population health, and do not discuss the potential risks of radiation with their clients (Shirangi,2007).

As there is no absolute safe threshold of ionizing radiation exposure, radiation protection and safety measures are required. Ionizing radiation exposure may go unreported due to the lack of the late onset of some tissue-damaging effects. The increased exposure of patients to ionizing radiation has led to the prediction of several radiation-induced cancers and cancer deaths in the world population in future years (Maulepas,2017).

Desouky, Ding, and Zhou (2015) asserted that ionization radiation might produce hydroxyl radicals that may cause strand breaks or base damage to DNA, which, to some extent, is associated with cancer risks. A exponential increase in the use of medical radiation has increased the incidence of papillary thyroid cancer (Veiga et al., 2016). Considering these dangers, veterinary practitioners need to be aware of both the benefits and risks of medical imaging. A systematic approach must be taken to ensure that there is a balance between the benefits from the veterinary uses of ionizing radiation and the risks associated with radiation exposure of workers, members of the public, as well as the animal's patient. (IAEA,2021).

2.0 RESEARCH PROBLEM

Measures for radiation protection and safety are necessary because there is no safe level of exposure to ionizing radiation. Furthermore, there appears to be a knowledge gap among veterinary practitioners which is troubling because it involves the lack of knowledge of the practitioners themselves which is reflective of the lack of data on the knowledge, attitude, and practice of veterinary practitioners towards radiation safety in Malaysia

3.0 RESEARCH QUESTIONS

3.1 What is the level of knowledge of radiation safety among veterinary practitioners in Malaysia?

3.2 What is the attitude of veterinary practitioners on radiation safety in Malaysia?

3.3 What are the practices by veterinary practitioners on radiation safety in Malaysia?

4.0 RESEARCH HYPOTHESIS

4.1 Veterinary practitioners in Malaysia have acceptable knowledge of radiation safety.

4.2 Veterinary practitioners in Malaysia have an acceptable attitude on radiation safety.

4.3 Veterinary practitioners in Malaysia have good practices in radiation safety.

5.0 RESEARCH OBJECTIVES

5.1 To determine the knowledge of veterinary practitioners toward radiation safety in Malaysia.

5.2 To assess the attitude of veterinary practitioners toward radiation safety in Malaysia.

5.3 To determine the current practices of veterinarian practitioners toward radiation safety in Malaysia.

6.0 LITERATURE REVIEW

6.1 RADIATION HAZARD

Ionizing radiation is an energy source. Unlike other forms of energy, such as heat (infrared radiation) or visible light, the human body cannot detect ionizing radiation exposure. Nonetheless, the chemical makeup of living cells changes as a result of ionizing radiation energy absorption by body tissues.

The type and thickness of material required to create an effective barrier or shield around an ionizing radiation source vary greatly depending on the type of ionizing radiation. A thin layer of plastic, glass, wood, metal or most other common materials can stop a stream of tiny charged particles known as beta radiation. X-rays and Gamma rays are similar to sunlight in that they are electromagnetic waves rather than particles. While sunlight can only pass through a few materials, such as window glass, X-rays, and Gamma rays can pass through almost any material. Even they, however, can be blocked by a sufficient thickness of lead (Cornell University Radiation Safety Manual, 2019).

6.2 CONSEQUENCES OF RADIATION EXPOSURE IN ANIMALS

Human victims of Hiroshima and Nagasaki were the first to be diagnosed with acute radiation syndrome(ARS). In persons with ARS, whole-body irradiation doses typically surpass 1 Gy, or roughly 160 times the average annual exposure (Murphy, 2018). Gray (Gy) is the dose of one joule of energy absorbed per kilogramme of matter, or 100 rad, is a unit of absorbed radiation. The effects of radiation exposure, including the time it takes for an animal to die after whole-body irradiation, differ by animal species and are influenced by the exposure length and radioisotope(s) used. The LD50/30 is defined as the radiation dose that kills 50% of the population in 30 days (Linet,2010).

Species	Dose
Burros	1.8–2.8 Gy
Cattle	1.6–2.75 Gy, 1.5 Gy for calves
Goats	2.37 Gy
Pigs	2.18–2.47 Gy
Dogs	2.55–3.35 Gy

TABLE 1: LD50/30 Values for Selected Domestic

Source: Adapted from *Rella*, J.G., 2015. Radiation. In Hoffman, R.S., Howland, M.A., Lewin, N.A., Nelson, L.S., *Goldfrank*, L.R. (Eds.), *Goldfrank*'s Toxicologic Emergencies (10th ed.)

Syndrome	Associated Exposure Dose	Clinical Manifestations
Cerebrovascular	≥15–20 Gy (humans) >80–100 Gy (lethal dose in animals)	Hyperthermia, ataxia, loss of motor control, apathy, lethargy, cardiovascular shock, seizures, coma
Pulmonary	6–10 Gy (humans)	Pneumonitis within 1–3 months of exposure followed by respiratory failure, pulmonary fibrosis, or cor pulmonale months to years later
Gastrointestinal	≥6 Gy (humans) 10–100 Gy (lethal dose for animals)	Anorexia, nausea, vomiting, diarrhea with or without blood, loss of peristalsis, abdominal distension, dehydration, sepsis
Hematopoietic	≥1 Gy (humans) 2–10 Gy (lethal dose for animals)	Pancytopenia, hemorrhage, sepsis
Cutaneous	$3–50^{+}$ Gy (humans)	Bullae, blisters, hair loss, pruritis, ulceration, onycholysis

TABLE 2 : Body System-Specific Manifestations Associated with Acute Radiation Syndrome (ARS)

Source: Adapted from Rella, J.G., 2015. Radiation. In Hoffman, R.S., Howland, M.A., Lewin, N.A., Nelson, L.S., Goldfrank, L.R. (Eds.), Goldfrank's Toxicologic Emergencies (10th ed.)

6.3 KNOWLEDGE OF VETERINARY PRACTITIONERS ON RADIATION SAFETY

6.3.1 VETERINARY RADIATION FACILITIES

Fixed facilities: Design of X-ray rooms

The three factors relevant to dose reduction ('as low as reasonably achievable') are time, distance, and shielding need to be considered when designing a room or converting an existing room for the use of X-rays. Fixed facilities are rooms dedicated to the acquisition of radiographs. The entire room is usually specified as a controlled area (Desouky,2015).

Imaging rooms in many veterinary practices are multipurpose and can be used for both X-ray imaging and non-radiological purpose. It is preferable, but not required, that the room be designated for radiography. However, while radiography is being performed, the room may only be used for other purposes if adequate radiation protection is provided. To function properly, computed tomography scanners and interventional radiography equipment must be housed in separate rooms (Jeyaretnam,2003).

Considerations relating to shielding

Shielding includes structural and ancillary protective barriers that are the best considered during the facility's design stage and must be consistent with the room's intended future use. Shielding specifications, including calculations, must be prepared by a qualified expert and the radiation protection officer. Walls, floors, doors, and windows, as well as penetrations in any of these, are subject to review and shielding requirements. To shield operators during procedures, a protective barrier should be installed at the control console, reducing the need for protective clothing (IAEA,2021)

Warning signs

To prevent unintentional entry, lights should be strategically placed at the entrances to controlled areas. The signs must be clear and simple to understand. When radiation is generated inside the controlled area, illuminated signs or flashing warning lights are typically activated outside the room (IAEA,2021).

6.4 ATTITUDE OF VETERINARY PRACTITIONERS TOWARDS RADIATION HAZARD

Individual monitoring collects information about veterinary practitioners and patient's radiation exposures to keep track of work practices and meet regulatory requirements. Individual monitoring of the operator and any other personnel identified in the safety assessment as workers subject to occupational exposure is required. Staff who are near an animal during exposure, in particular, must be monitored (Desouky,2015).

Individual external exposures are assessed using individual monitoring devices. These include thermoluminescent dosimeters, optically stimulated luminescence dosimeters, radio-photoluminescence dosimeters, film badges, and electronic dosimeters. Real-time or active monitoring devices, such as electronic dosimeters, need to be calibrated and traceable to a standards dosimetry laboratory. Unnecessary delays in the return, reading, and reporting of doses recorded on dosimeters are to be avoided (Damber,2016).

The animal handlers involved need to be informed about the radiation risks associated with the procedure. They need to give their informed consent to participate in the procedure. To minimize the hazards associated with the animal itself and the need for repeat exposures, animal handlers who participate in procedures need to be competent. The need for repeat exposures can also be kept to a minimum by having adequately trained staff to perform the procedures. Exposure charts (standard operating procedures) will assist with imaging techniques and thereby reduce the need for repeat exposures (Langley,2008).

6.5 PRACTICES OF RADIATION SAFETY AMONG VETERINARY PRACTITIONERS

Persons involved in the procedure must be as far away from the primary beam and the animal to be exposed as possible to minimize their exposure to scattered radiation; no part of the person's body must be in the primary beam. Workers who are subject to exposure need to wear personal dosimeters; members of the public such as animal owners who hold an animal or who assist during exposures usually do not need to wear personal dosimeters. Members of the public who are pregnant are not to hold animals or to assist during procedures (Surjan,2014).

Since the patient must remain calm for a limited length of time, obtaining diagnostic quality radiographs demands good technique and patient cooperation for optimal positioning. While this is usually possible with human patients who may be directed to remain in one position, the need to retain animal patients still complicates the capture of diagnostic images in veterinary medicine. Sedation or anesthesia, positioning and restraint devices including troughs and tape, and manual restraint, in which a staff member holds the animals for the period of radiographic exposure, all seem to be common techniques of patient restraint available to veterinarians (Shuhaiber,2002).

7.0 METHODOLOGY

7.1 RESEARCH DESIGN

This research is a cross-sectional study, targeting selected veterinary practitioners in Malaysia. The study conducted from February 1, 2022 until March 30, 2022.

7.2 SELECTION CRITERIA

Respondents are registered veterinarians, radiographer, veterinary technician, and veterinary assistant currently practicing in Malaysia and have access to X-ray machines.

7.3 SAMPLING PROCEDURE

A convenient sampling technique were applied. A self-administered online-based questionnaire were constructed. Brief and easily understandable questionnaires were prepared and the questionnaire form were filled up by the veterinary practitioners through variation of online base platform such as WhatsApp, email and Instagram.

7.4 MEASURING TOOLS

A self-administered questionnaire was adapted from a study entitled 'Knowledge, Attitude and Practice Regarding Pertussis among a Public University Students in Malaysia' by A.B. Amalina. The questionnaire was written in English. The questionnaire was then distributed to 10 respondents as a pilot study and for validation.

The newly developed questionnaire had 62 items divided into four section sections: Socio-demographic, knowledge, attitude, and practice sections. The knowledge section consisted of 26 items and was aimed at accessing and evaluating the general knowledge of veterinary practitioner in Malaysia about safety training, safe level, protection equipment, ALARA principles, and exposure factors. In the attitude section, 12 questions were used to assess behavioural perception towards radiation safety. 17 questions on practices were used to evaluate the actual practice of veterinary practitioners on radiation safety.

For the knowledge questions, incorrect responses were given a 0 score, uncertain responses (not sure) were given 1 score while 2 score was given for choosing the correct answer. The expected maximum total knowledge score was 52. For the attitude and practice sections, a score of 1 was given for choosing the answer reflecting a positive attitude or good practice and 0 was given for choosing the answer reflecting negative attitude or poor practice. The expected maximum total attitude score is 48 and a minimum score of 12. A correct statement with options strongly agree, agree, not sure, disagree, and strongly disagree are scored 5, 4, 3, 2, and 1, respectively. Practice are scored 2, 1, and 0 for "always", "seldom" and "never" respectively. Veterinary practitioner's KAP levels were defined as "good" , "moderate" and "poor. Veterinary practitioner with KAP scores 70% and above were grouped as those with a good knowledge, attitude and practice while practitioner with score range between 51-69 % were grouped as those with a moderate knowledge, attitude and practice and score below 50 % was are regarded as having an unacceptable attitude.

7.5 DATA ANALYSIS METHOD

Data collected was entered and analysed using the Statistical Package for Social Sciences (SPSS) Version 28. Numerical was presented in the form of standard deviations and means. Categorical data was presented in the form of percentages. To asses the level of KAP , each variable was assigned respective scores and the total scores were tabulated to obtain the total KAP score. Chi square test was used to assess the association between socio-demographic data and the level of KAP where ($p<0.05$) indicates significant association between the 2 data. Other than that, in order to describe the strength and direction of the relationship among knowledge, attitude and practice , Pearson correlation coefficient was used. The following criteria was used to assess the level of correlation between the variables, 0–0.25 = weak correlation, 0.25–0.5 = fair correlation, 0.5–0.75 = good correlation and greater than 0.75 = excellent correlation.

8.0 RESULTS

Table 8. 1 Knowledge assessment

Questions		Response n (%)		
		Yes	Not sure	No
K1	Diagnostic tests that use radiation include:			
A	Radiography (X-rays)	105 (100)	0(0)	0(0)
B	Computed tomography	86(81.9)	5(4.8)	14(13.3)
C	Ultrasound	14(13.3)	4(3.8)	87(82.9)
D	Fluoroscopy	23(21.9)	9(8.6)	73(69.5)
E	Magnetic Resonance Imaging (MRI)	40(38.1)	8(7.6)	57(54.3)
F	Scintigraphy	60(57.1)	28(26.7)	17(16.2)
K2	Cumulative absorption or from continuous exposure, an overdose of x-ray produces:			
A	DNA Mutations	94(89.5)	4(3.8)	7(6.7)
B	Carcinogenesis	97(92.4)	4(3.8)	4(3.8)
C	Cataracts	69(65.7)	22(21.0)	14(13.3)
K3	Have you received formal radiation safety training before?	21(20.00)	2(1.9)	82(78.1)
K4	There is no safe level of exposure to ionizing radiation.	62(59.0)	14(13.3)	29(27.6)
K5	I know ALARA principles.	69(65.7)	15(14.3)	21(20.0)
K6	The following equipment are personal protection equipment against radiation:			
A	Lead apron	105(100)	0(0)	0(0)
B	Thyroid collar/neck collar	105(100)	0(0)	0(0)
C	Lead gloves	66(62.9)	33(31.4)	6(5.7)
D	Lead glasses	23(21.9)	67(63.8)	15(14.3)
K7	The following statements describe why you may use a dosimeter when taking x-rays:			

A B C	For radiation protection For personal radiation monitoring For environmental radiation monitoring	22(21.0) 93(88.6) 39(37.1)	50(47.6) 12(11.4) 53(50.5)	33(31.4) 0(0) 13(12.4)
K8	The selection of appropriate exposure factor is vital in radiation safety.	101(96.2)	3(2.9)	1(1.0)
K9	Proper restraint and positioning of animals are essential in radiation safety.	102(97.1)	1(1.0)	1(1.9)
K10	Avoiding repetitive exposures reduces radiation risk to patients and personnel.	103(98.1)	0(0)	2(1.9)
K11	I need to switch on the red light when taking a radiograph to prevent unintentional entry.	99(94.3)	4(3.8)	2(1.9)
K12	It is important to place the IAEA recommended nuclear symbol outside the x-ray room.	101(96.2)	4(3.8)	0(0)
K13	The radiography room must be spacious enough to permit installation of the equipment with safety and convenience for both operator and the patients.	105(100)	0(0)	0(0)
K14	Wall lead shielding is very effective in reducing radiation exposure to bystanders.	103(98.1)	1(1.0)	1(1.0)

Majority of the respondents have moderate 92(87.6%) knowledge towards radiation safety with 2(1.9%) of respondents had a good knowledge and remaining respondents 11(10.5%) had poor total knowledge. All respondents which are 105(100%) answered correctly on first questions where radiography is a diagnostic test that use radiation. 86(81.9%) respondents answered correctly by agreeing computed tomography is a diagnostic test that use radiation while remaining 5(4.8%) and 14(13.3%) unsured and wrongly answered the question respectively. 4(3.8%) of respondents unsure on the question of ultrasound is a test that used radiation while 14(13.3%) answered correctly and remaining answered wrongly. Fluoroscopy and Magnetic Resonance Imaging (MRI) is a diagnostic test that do not use radiation and 23(21.9%) and 40(38.1%) respondents answered wrongly 73(69.5%) and 57(54.5%) answered correctly respectively however remaining respondents unsure on the answer. 60(57.1%) of respondents answered correctly on scintigraphy while remaining answered wrongly and unsured. 94(89.5%), 97(92.4%) and 69(65.7) answered correctly on questions where cumulative absorption or from continuous exposure, an overdose of x-ray produces will cause DNA mutations, carcinogenesis and cataracts respectively.

21(20.0%) respondents received a formal radiation safety before while remaining 84(80.0%) respondents are unsure and not received any formal radiation safety training. 62(59.0%) of respondents clearly agree that there is no safe level of exposure to ionizing radiation while 69(65.7%) know regarding ALARA principles however the remaining are unsure and do not know on ALARA principles. Lead apron, thyroid collar, lead gloves and lead glasses are the personal protection equipment against radiation. 105(100), 105(100%), 66(62.9%) and 23(21.9%) of respondents respectively answered correctly. 22 (21.0%), 93 (88.6%), 39 (37.15%) of respondents knows the reason of using dosimeter for radiation protection, for personal radiation monitoring, and for environment radiation monitoring respectively. Majority of respondents 101 (96.2%) was agree that that selection of appropriate exposure factor is vital in radiation safety. Majority of respondents 102 (97.1%) was agree that proper restraint and positioning animals are essential in radiation safety and 103 (98.1%) respondents was agree that avoiding repetitive exposures reduces radiation risk to patients and personnel. 99 (94.3%) of respondents knew that they need to switch on the red light when taking a radiograph to prevent unintentional entry. 101 (96.2%) of respondents knew the importance to place the IAEA recommended nuclear symbol outside the x-ray room. All of the respondents 105 (100%) agree that the radiography room must be spacious. Majority of respondents 103 (98.1%) knew that the wall shielding is very effective to in reducing radiation exposure to bystanders.

Table 8.2 Attitude assessment

		Response n (%)			
		Strongly agree	Agree	Neither	Disagree
A1	Rank your level of agreement with the following statements:				
A	I am always cautious of the ALARA principles.	31(29.5)	63(60.0)	10(9.5)	1(1.0)
B	Exposure of excessive doses of radiation pose risk to my health.	61(58.1)	44(41.9)	0(0)	0(0)
C	Exposure excessive dose of radiation poses health risk to my patient.	57(54.3)	47(44.8)	1(1.0)	0(0)
D	I update my knowledge on radiation safety frequently.	22(21.0)	57(54.3)	18(17.1)	8(7.6)
E	I have been adequately protected from radiation in my workplace.	34(32.4)	59(56.2)	7(6.7)	5(4.8)
F	I feel safe performing tasks that involve radiation in my workplace.	33(31.4)	61(58.1)	7(6.7)	4(3.8)
G	The basic principles of radiation protection are observed strictly in my workplace.	29(27.6)	64(61.0)	8(7.6)	4(3.8)

		Response n (%)			
		Strongly agree	Agree	Neither	Disagree
A2	It is important to wear the following items as PPE when taking radiographs:				
A	Lead apron.	101(96.2)	4(3.8)	0(0)	0(0)
B	Thyroid collar/neck collar.	93(88.6)	2(1.9)	0(0)	10(9.5)
C	Dosimeter.	36(34.3)	52(49.5)	16(15.2)	1(1.0)
D	Lead gloves.	26(24.8)	19(18.1)	59(24.8)	1(1.0)
E	Lead glasses.	13(12.4)	18(17.1)	69(65.7)	5(4.8)

For attitude scoring, majority of respondents has good 97 (92.4%) attitude, while 7 (6.7%) of respondents has moderate attitude, and 1 (1.0%) respondent has poor attitude. Majority of the respondents 63 (60.0%) agree that they are always cautious of ALARA principles while 31 (29.5%) of respondents are strongly agree regarding this attitude and the remaining were neither and disagree with 10 (9.5%) and 1 (1.0%) respectively. 61 (58.1%) and 57 (54.3%) of respondents strongly agree that the exposure of excessive doses of radiation poses risk to themselves and also the patient respectively. While the remaining respondents were agreeing to these statements. Majority of the respondents 57 (54.3%) agree that they update their knowledge on radiation safety frequently while 8 (7.6%) of the respondents disagree to this statement. 59 (56.2%) of the respondents agree that they have been adequately protected from radiation in their workplace and 61 (58.1%) of respondents agree that they feel safe performing tasks that involve radiation in their workplace. Majority of the respondents 64 (61.0%) also agree that the basic principles of radiation protection are observed strictly in their workplace. Majority of the respondents strongly agree that lead apron and thyroid collar/neck collar is important to wear as PPE when taking radiograph with 101 (96.2%) and 93 (88.6%) respectively. 52 (49.5%) of respondents agree that it is important to wear dosimeter when taking radiograph while majority of the respondents choose neither for the importance of lea gloves and lead glasses when taking radiograph with 59 (24.8%) and 69 (65.7%) respectively.

Table 8.3 Practice assessment

		Response n (%)		
		Always	Seldom	Never
P1	How frequent are you involved making radiographs?	45 (42.9)	60 (57.1)	0 (0)
P2	How frequent do you apply ALARA principles while making radiographs?	67 (63.8)	32 (30.5)	6 (5.7)
P3	How often do you undergo training on radiation safety?	7 (6.7)	67 (63.8)	31 (29.5)
P4	How often do you use appropriate radiographic techniques in your radiographs?	86 (81.9)	18 (17.1)	1 (1.0)
P5	I often expose patients to radiation due to X-ray repetitions.	12 (11.4)	86 (81.9)	7 (6.7)
P6	Repetitive exposure to x-rays are due to :			
A	Wrong positioning	25 (23.8)	75 (71.4)	5 (4.8)
B	Fractious patients	74 (70.5)	30 (28.6)	1 (1.0)
C	Faulty collimation	14 (13.3)	76 (72.4)	15 (14.3)
D	Low quality radiographs	19 (18.9)	78 (74.3)	8 (7.6)

P7	How frequent did you wear any of the following PPE during radiography?			
A	Lead apron	104 (99.0)	1 (1.0)	0 (0)
B	Thyroid collar/neck collar	90 (85.7)	13 (12.4)	2 (1.9)
C	Lead gloves	11 (10.5)	21 (20.0)	73 (69.5)
D	Lead glasses	5 (4.8)	17 (16.2)	83 (79.0)
P8	How often do you use radiation monitoring equipment?			
A	Film badge	22 (21.0)	35 (33.3)	48 (45.7)
B	Ionization chamber	57 (54.3)	20 (19.0)	28 (26.7)
P9	I do expose myself to x-ray radiation during patient restraining	22 (21.0)	77 (73.3)	6 (5.7)
P10	I follow the recommended technique chart when using an X-ray machine.	91 (86.7)	10 (9.5)	4 (3.8)

Majority of the respondents has good practice with 87 (82.9%) while the remaining has of the respondents has moderate practice with 18 (17.1%). Only 45 (42.9%) of the respondents were always frequent involved in making radiographs while the remaining 60 (57.1%) were seldom. Majority of the respondents 67 (63.8%) were always applied ALARA principles while making radiographs. Only 7 (6.7%) of respondents who often undergo training on radiation safety while the remaining were seldom and never with 67 (63.8%) and 31 (29.5%) respectively. Majority of the respondents 86 (81.9%) were always using appropriate radiograph technique. Majority of the respondents 86 (81.9%) seldom exposed patients to radiation due to x-ray repetitions. Majority of respondents seldom repeat x-rays due to wrong positioning, faulty collimation, and low-quality radiograph with 75 (71.4%), 76 (72.4%), and 78 (74.3%) respectively. Majority of respondents 74 (70.5%) always repeat x-rays due to fractious patient. Majority of respondents always wear lead apron and thyroid collar/neck collar during radiography with 104 (99.0%) and 90 (85.7%). only 11 (10.5%) and 5 (4.8%) who always wears lead gloves and lead glasses during radiography respectively. Majority of the respondents 48 (45.7%) never used film badge as radiation monitoring equipment , but majority of the respondents 57 (54.3%) were always use ionization chamber as radiation monitoring equipment. 77 (73.3%) of respondents were seldom exposed themselves to x-ray radiation during patient restraining and majority of the respondents 91 (86.7%) always follow the recommended technique chart when using an x-ray machine.

8.4 Association between demographic profile and knowledge, attitude and practices

Variables	p-value	Interpretation
Gender and knowledge	.0202	No significant association
Gender and attitude	.008	Significant association
Gender and practices	.383	No significant association
Experiences and knowledge	.043	Significant association
Experiences and attitude	<.001	Significant association
Experiences and practices	<0.001	Significant association
Education and knowledge	.274	No significant association
Education and attitude	.001	Significant association
Education and practices	.018	Significant association

The relationship between demographic and KAP the participants were measured using Chi Square technique. There is no significant association between gender and knowledge and practice however there are relation between gender and attitude, p=.008. There are association between experience and KAP of the participants as the all p value are <.005 (designated alpha level). There are association between education and attitude p=.001, practice .08 however there are no association between education and knowledge, p=.274.

8.2 Correlation between KAP scores

There is significant but fair correlation between knowledge and attitude with the (r=0.289,p=0.003). between knowledge and practice too shows a significant but fair correlation with (r=0.256,p=0.008). However, there is a highly significant but fair correlation between attitude and practice with (r=0.361,p=<0.001).

9.0 DISCUSSION

Radiation safety in veterinary medicine is same important as in human medicine. The risk of radiation exposure from medical imaging is not insignificant; it is now believed that radiation exposure and cancer development have a linear relationship (Brenner,2004). As there is no absolute safe threshold of ionizing radiation exposure, radiation protection and safety measures are required. Ionizing radiation exposure may go unreported due to the lack of the late onset of some tissue-damaging effects. The increased exposure of patients to ionizing radiation has led to the prediction of several radiation-induced cancers and cancer deaths in the world population in future years (Maulepas,2017). No study has been done previously in Malaysia regarding of knowledge, attitude, and practice of veterinary practitioners towards radiation safety. By assessing the level of KAP of veterinary practitioners regarding radiation safety, we can share the information together on what lacking in veterinary medicine regarding radiation safety and what to improve in the future. This way, many veterinary practitioners will be alerted and take seriously regarding radiation safety since radiation is a health risk.

From the KAP study conducted, it was found that a total of 92 (87.6) respondents that have moderate knowledge and only 2 (1.9) respondents that have good knowledge while the remaining respondents 11 (10.5) have poor knowledge. Majority of the respondents have moderate knowledge regarding what radiation can cause to the human and patients, what machine that emit radiation, what protective equipment that is important during radiography and also the important of radiation safety. There is no association between the education level and also total knowledge score. this is because radiation safety knowledge does not depend on the educational level, it can be learned on any level of education. Radiation safety knowledge also can be learnt from Internet. There is significant association between the job title of the respondents and also the total knowledge score. This is because veterinarian and radiographer usually have more knowledge regarding radiation safety due to practices and also learning experiences. Talk about experiences, there is an association between experiences and total score of knowledge. This is because people can increase their knowledge through experiences.

In general, majority of the respondents has good 97 (92.4) attitude towards radiation safety. 7 (6.7) respondents that have moderate attitude and the remaining 1 (1.0) has poor attitude towards radiation safety. Most of the respondents agree on what to do and what not to do during radiography examination. Most of the respondents agree the importance of PPE equipment and also the risk of radiation exposure. There is an association between job title, experiences, educational level and attitude towards radiation safety.

Concerning the practice, majority of the respondents have good practice 87 (87.9) and 18 (17.1) of the respondents has moderate score of practice. There is an association between experiences, educational level with the practice towards radiation safety.

The result obtained from this study showed a significant but fair correlation between knowledge and attitude. Between knowledge and practice too shows a significant but fair correlation. However, there is a highly significant but fair correlation between attitude and practice.

10.0 CONCLUSION

In conclusion, respondents showed a moderate knowledge, good levels of attitude and good practice towards radiation safety. These findings could help veterinarians to improve what's lacking in the knowledge, attitude and practice toward radiation safety in veterinary medicine in Malaysia. Improving the KAP towards radiation safety can reduce the risk of health towards radiation.

11.0 RECOMMENDATION

Several limitations were noted in this study, such as limited number of respondents and the respondents were not widely scattered throughout Malaysia. The respondents were mostly veterinarian with addition of a few radiographer, veterinary assistant and technician. The response form was randomly distributed and disseminated hence the KAP level of radiation safety in each state specifically cannot be determined.

For future study, it is advised to increase the sample size because this can help to make more through and deeper assessment of the KAP values. Next, the study must can be improved by having more respondents from radiographer, veterinary assistant and also veterinary technician. Finally, this study can be improved by getting the KAP level balanced from each state.

12.0 APPENDIX A.1

TKSNEWCAT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	poor	11	10.5	10.5	10.5
	moderate	92	87.6	87.6	98.1
	good	2	1.9	1.9	100.0
	Total	105	100.0	100.0	

TASNEWCAT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	poor	1	1.0	1.0	1.0
	moderate	7	6.7	6.7	7.6
	good	97	92.4	92.4	100.0
	Total	105	100.0	100.0	

TPSNEWCAT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	moderate	18	17.1	17.1	17.1
	good	87	82.9	82.9	100.0
	Total	105	100.0	100.0	

APPENDIX A.2

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	22.720[a]	18	.202
Likelihood Ratio	27.808	18	.065
N of Valid Cases	105		

a. 34 cells (89.5%) have expected count less than 5. The minimum expected count is .46.

Association between gender and knowledge

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.383[a]	18	.008
Likelihood Ratio	41.818	18	.001
N of Valid Cases	105		

a. 32 cells (84.2%) have expected count less than 5. The minimum expected count is .46.

Association between gender and attitude

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.935[a]	14	.383
Likelihood Ratio	17.388	14	.236
N of Valid Cases	105		

a. 24 cells (80.0%) have expected count less than 5. The minimum expected count is .46.

Association between gender and practices

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.160[a]	11	.043
Likelihood Ratio	10.741	11	.465
N of Valid Cases	105		

a. 18 cells (75.0%) have expected count less than 5. The minimum expected count is .05.

Association between experience and knowledge

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	268.250[a]	198	<.001
Likelihood Ratio	156.414	198	.987
N of Valid Cases	105		

a. 226 cells (99.1%) have expected count less than 5. The minimum expected count is .01.

Association between experience and attitude

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	340.908[a]	154	<.001
Likelihood Ratio	119.340	154	.982
N of Valid Cases	105		

a. 179 cells (99.4%) have expected count less than 5. The minimum expected count is .01.

Association between experience and practice

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	78.764[a]	72	.274
Likelihood Ratio	51.691	72	.966
N of Valid Cases	105		

a. 89 cells (93.7%) have expected count less than 5. The minimum expected count is .01.

Association between experience and knowledge

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	113.474[a]	72	.001
Likelihood Ratio	64.020	72	.737
N of Valid Cases	105		

a. 91 cells (95.8%) have expected count less than 5. The minimum expected count is .01.

Association between experience and attitude

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	80.383[a]	56	.018
Likelihood Ratio	43.719	56	.884
N of Valid Cases	105		

a. 68 cells (90.7%) have expected count less than 5. The minimum expected count is .01.

Association between experience and attitude

Correlations

		TPSNEWCAT	TKSNEWCAT
TPSNEWCAT	Pearson Correlation	1	.256**
	Sig. (2-tailed)		.008
	N	105	105
TKSNEWCAT	Pearson Correlation	.256**	1
	Sig. (2-tailed)	.008	
	N	105	105

**. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX A.3

Correlations

		TKSNEWCAT	TASNEWCAT
TKSNEWCAT	Pearson Correlation	1	.289**
	Sig. (2-tailed)		.003
	N	105	105
TASNEWCAT	Pearson Correlation	.289**	1
	Sig. (2-tailed)	.003	
	N	105	105

**. Correlation is significant at the 0.01 level (2-tailed).

13.0 REFERENCES

Azman, R. R., Shah, M. N. M., Ng, K. H. (2019). Radiation Safety in Emergency Medicine: Balancing the Benefits and Risks. Korean Journal of Radiology, 20(3), 6. doi:10.3348/kjr.2018.0416.

Borretzen, I., Lysdahl, K. B., & Olerud, H. M. (2007). Diagnostic Radiology in Norway trends in examination frequency and collective effective dose. Radiation Protection Dosimetry, 124(4), 339–347. doi.org/10.1093/rpd/ncm204

Radiation safety. Radiation Safety | Environment, Health and Safety. (n.d.). Retrieved January 6, 2022, from https://ehs.cornell.edu/research-safety/radiation-safety

Desouky, O., Ding, N., & Zhou, G. (2015). Targeted and non-targeted effects of ionizing radiation. Journal of Radiation Research and Applied Sciences, 8(2), 247–254.doi.org/10.1016/j.jrras.2015.03.003

Jeyaretnam, J. S. (2003). Occupational hazards and radiation safety in veterinary practice including zoo veterinary practice in Australia. https://ro.ecu.edu.au/theses/1306

Meulepas, J. M., & Brenner, D. J. (2017). Is there unmeasured indication bias in radiationrelated cancer risk estimates from studies of computed tomography? Radiation Research, 189(2), 128.doi.10.1667/rr14807.1

Mortiz SA, Wilkins JR, Hueston WD. Evaluation of Radiation Safety in 29 Central Ohio Veterinary Practices. American Journal of Public Health. 1989;79: 895-896.

Mayer MM, Koehncke NK, Belotta AF, Cheveldae IT, Waldner CL. Use of personal protective equipment in a radiology room a veterinary teaching hospital. Journal of Veterinary Radiology and Ultrasound. 2018;59: 137-146

Linet, M. S., Kim, K. P., Miller, D. L., Kleinerman, R. A., Simon, S. L., & de Gonzalez, A. B. (2010). Historical review of occupational exposures and cancer risks in medical radiation workers. Radiation Research, 174(6b), 793–808. https://doi.org/10.1667/rr2014.1

Shirangi A, Fritschi L, Holman CD. Prevalence of occupational exposures and protective practices in Australian female veterinarians. Aust Vet J 2007; 85:32–38.11

Surjan Y, Ostwald P, Milross C, Warren-Forward H. Radiation safety considerations and compliance within equine veterinary clinics: results of an Australian survey. Radiography. 2014;21: 224- 230

Morgan JP. Radiology experience by pre-veterinary students. Veterinary Radiology and Ultrasound. 1991;32: 223-225.

Murphy, L. (2018). Ionizing radiation in veterinary medicine. Veterinary Toxicology, 327–337. https://doi.org/10.1016/b978-0-12-811410-0.00019-2.

Shuhaiber S, Einarson A, Radde IC, Sarkar M, Koren G. A prospective controlled study of pregnant veterinary staff exposed to inhaled anesthetics and x-rays. International Journal of Occupational Medicine and Environmental Health. 2002;15: 363-373

J. J. Stein, “The carcinogenic hazards of ionizing radiation in diagnostic and therapeutic radiology,” Ca: A Cancer Journal for Clinicians, vol. 17, no. 6, pp. 278–287, 1967.

P. Schaff, J. Donadieu, P. Pirard, and B. Aubert, “Population exposure to ionizing radiation from medical examinations in France,” The British Journal of Radiology, vol. 81, no. 963, pp. 204–213, 2008.

IAEA. (2019, February 18). Safety standards. IAEA. Retrieved January 6, 2022, from https://www.iaea.org/resources/safety-standards

Langley RL, Pryor WH, O'Brien KF. Health hazards among veterinarians: A survey and review. Journal of Agromedicine. 2008;2: 23-52. 17.

Sullivan R, Keene B, Sachs M, Sussman O. A survey of X-radiation exposure in the practice of veterinary medicine. Public Health Reports. 1957;72: 883-887

Veiga, L. H., Holmberg, E., Anderson, H., Pottern, L., Sadetzki, S., Adams, M. J., Sakata, R., Schneider, A. B., Inskip, P., Bhatti, P., Johansson, R., Neta, G., Shore, R., de Vathaire, F., Damber, L., Kleinerman, R., Hawkins, M. M., Tucker, M., Lundell, M., & Lubin, J. H. (2016).

Thyroid cancer after childhood exposure to external radiation: An updated pooled analysis of 12 studies. Radiation Research, 185(5), 473. doi.org/10.1667/rr14213.1