One of the major health hazards we encounter in the veterinary hospital is exposure to x-rays. The regulations governing the use of x-ray machines are difficult to read and interpret. However, it is important as veterinary nurses that we understand the risks and potential health hazards radiation poses, and that we feel secure that there are governing bodies reviewing data and assessing risks on a regular basis.

This article pares down the legislation in to several short, easy to understand sections and will deal primarily with issues regarding irradiation apparatus, such as x-ray machines, and not radioactive materials.

**History**

The New Zealand Ministry of Health (MoH) first began to regulate the use of radiation in 1949. As changes evolved in both the technology and frequency of use the MoH reviewed their policies in 1965 and again in 2003 to reflect the highest standard of safety available at the time. There is an internationally consistent radiation safety regulatory system that New Zealand has not adopted at this time.

**Risks**

Risk factors for radiation exposure in humans have been widely studied by the International Commission on Radiological Protection (ICRP) since 1928. They have compiled a substantial body of data from member countries, including survivors both the 1986 Chernobyl nuclear power plant accident and the 1945 bombing of Hiroshima and Nagasaki, Japan and large numbers of people who have received radiation exposure as a routine part of medical treatment.

In veterinary medicine we are exposed to both ionizing and non-ionizing radiation. Ionizing radiation exposure occurs most commonly with use of x-rays and non-ionizing radiation exposure occurs from use of ultra-sound, lasers, and magnetic resonance imaging (MRI).

Ionizing radiation is high-energy radiation that in large doses can cause symptoms of radiation sickness such as nausea, vomiting, fever, hair loss, and in severe cases, death. Exposure to doses of ionizing radiation high enough to cause acute symptoms is rare in veterinary medicine. Low-levels of exposure can increase the risk of cancer, and the development of inherited genetic disorders which may not be apparent for years after exposure.

Non-ionizing radiation is low-energy radiation. Damage from non-ionizing radiation is more immediately obvious. Sunburn, eye damage from lasers, and heat-stroke can all be attributed, at least in part, to sources of non-ionizing radiation. Although the risk of developing serious health concerns, such as leukaemia or cancer, from non-ionizing radiation is considerably less than that of ionizing radiation care should still be exercised to minimize exposure. As sources of non-ionizing radiation are all around us there are no current laws or regulations governing exposure recommendations. Power lines, cell phones, furnaces, and ultra-violet (UV) radiation from sun exposure are all examples of non-ionizing radiation.

We are all exposed to a wide spectrum of radiation as part of daily life, and symptoms of over-exposure remain the same regardless of the source. Heat and light from the sun, radio waves, and microwaves all emit varying levels of radiation. Some home smoke alarms also contain a very minute amount of radioactive material. Low-level radiation is found in every
living organism, soil, water, and air. According to the New Zealand Ministry of Health (NZMOH) about 80% of our yearly exposure to radiation is from naturally occurring sources. The risk of developing complications from radiation is directly related to the dose. The lower the dose, the lower the risk.

**Radioactive verses Radiation**

There is a difference between something that is radioactive and something that produces radiation. Radioactive substances are unstable and emit radiation all the time as they break down. They cannot be turned off, and are always a risk. Radioactive Iodine (RAI) used for the treatment of thyroid disorders in cats, and the radioactive isotope, technetium 99m, used in scintigraphy, are both examples of radioactive substances we might encounter in veterinary medicine. Personal protective equipment (PPE) must be used at all times when working with or around radioactive substances.

An irradiating device, such as an x-ray machine, produces intense levels of radiation when in use, but can be rendered safe by disconnecting it from the power supply. It does not contain any radioactive material and is therefore harmless unless activated. PPE is only required when these machines are powered up.

One exception that should be noted is veterinary hospitals that utilize a gamma camera. Gamma cameras are relatively small and light and have a variety of uses in the veterinary environment. They contain a small amount of either caesium-137 or iridium-192, which is how the gamma rays are produced.

**Governing Laws and Legislation**

In New Zealand the sale, ownership and use of an irradiating device in veterinary medicine is outlined by three documents; New Zealand Radiation Protection Regulations (RPR) 1982, the Radiation Protection Act 1965, and the Code of Safe Practice for the Use of X-rays in Veterinary Diagnostics (NRL C8). These documents are prescriptive in their requirements.

Every practice with an x-ray machine must have someone licensed under the Act. This is normally the practice owner or business manager provided that person is a veterinarian who is licensed to practice in New Zealand. Prospective licensees must complete a 14-hour training course, and written exam. Every three years the licensee must show proof of continuing education as outlined by the National Radiation Lab (NRL). Anyone using the machine is considered to be under the supervision of the licensee as it is that licensee’s legal responsibility to ensure that training is provided and correct procedures followed. Additional licenses are required if the practice wishes to use other types of irradiating apparatus.

X-ray machines must be inspected and obtain a certificate of compliance which must be renewed every 1 – 5 years depending on the type of machine used. An inspection and maintenance log is also required for every machine.

The Code also specifically outlines the licensee's responsibilities for monitoring outgoing staff exposure, adequate radiation equipment such as cassettes, view boxes, methods of development of radiographs, and investigation of accidents or over-exposure.

**Radiation Safety Plan**

It is the responsibility of the licensee to ensure that a radiation safety plan exists. Some of the mandatory components of that plan include; induction and training requirements, an accurate technique chart, personnel monitoring plan and records, and accurate records of usage dating back ten years. For a full listing of requirements see MoH, NRL document c21 section 2.1.3
Audits of this plan should be done yearly, and all records must be available on demand to the National Radiation Laboratory.

No employee or member of the public is permitted in or around areas where radiographs are taken without the proper safety training. No one under the age of 16 is permitted to use or be around veterinary x-ray equipment when it is in use.

**Facilities**

The MoH is also very specific in regards to requirements for areas where radiographs are taken. It is required that there is no less than a two millimeter lead equivalent in the walls, windows, floors and ceilings (if occupied above or below) surrounding the radiology area to protect anyone not directly involved in radiography, and the public. There are similar requirements for areas where fluoroscopy or computer tomography (CT) are performed.

If the x-ray machine is located anywhere besides a special purpose room, such as a multi-purpose treatment area, there can be no other activities being performed while radiographs are being taken. All staff not directly involved in the taking of radiographs must vacate the area and entry to the room must be restricted to avoid personnel accidentally entering the room while films are being taken.

Warning signs that clearly state the nature of the hazard and display the radiation trefoil must be prominently posted.

**Competent Operators**

All staff using the x-ray machine must have received adequate training to be considered a 'competent operator'. According to the NZ Ministry of Health, certificate and diploma nurses are considered to be competent operators upon successful graduation. However, as the thoroughness of training for radiation safety varies greatly throughout the veterinary nursing programs it is in the individual's best interest in ensure that they understand the basic principles of radiograph production, radiation dose units and safe exposure quantities, health risks and precautions related to radiation exposure, and the requirements of the three governing documents spelled out above.

Most hazardous behaviors in the work-place have obvious and immediate consequences. The damage from over-exposure to radiation is not normally immediate. Because of this we are less likely to engage in activities that might result in bites, or falls but may be willing to forego the use of protective gloves when taking radiographs. “Just hurry up and take the film”.

We are under an obligation as veterinary nurses to not engage in any activity which may put others at risk. This includes allowing a co-worker to be present while radiographs are being taken without wearing the appropriate PPE.

**Digital Imaging**

The advent of digital radiography in veterinary medicine in New Zealand in 2009 adds another dimension to our ever-expanding diagnostic arsenal. Although the laws governing the use of digital radiography are the same the fact that we are no longer using intensifying screens makes it is easy to forget that the hazards associated with the use of x-rays still exists.

In digital radiography over-exposure of a radiograph can occur without impacting the quality of the image produced so may not be noticed by staff. As it is also easy to take, and delete, undesirable images there may be a tendency to take more views than necessary. In one
A human study cited by the International Commission on Radiological Protection (ICRP) facilities with digital radiography averaged 68 views per study compared with 16 views per study in facilities with conventional technology.

An Associated Press story by Marilynn Marchione released on June 14th, 2010 stated that we may be receiving up to six times more radiation from medical imaging than we were a decade ago. "Doctors order a test, not a dose". Although at this point we have no way to demonstrate the impact this may be having on our patients, increased exposure is certainly a concern for us.

**Relevance**

All the governing bodies, legislation, and NRL licensees aren't there when it comes time to put on that stinky, uncomfortable thyroid shield. They aren't the ones whose hands need to stay out of the primary beam, nor are they the ones who will be wig shopping when all their hair falls out from years of improper exposure. It still comes down to us to protect ourselves. Armed with knowledge, and foresight in to the long-term effects that radiation can have we are able to make informed decisions to ensure that all users are protected.

There will be a partner article in a later Journal edition discussing personal and environmental safety in relation to radiology. This will deal specifically with PPE, chemical spills, and maintenance.

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