Study and use of the GUT Matrix in diagnostic veterinary radiology of small animals

E T Nascimento[1 e 2], M N Azevedo[3], L A G Magalhães[1], C H S Sousa[4] e J G P Peixoto[2]

[1] Departamento de Ciências Radiológicas – DCR|IBRAG|UERJ, Rio de Janeiro, BR
[2] Instituto de Radioproteção e Dosimetria – IRD/CNEN, Rio de Janeiro, BR
[3] Advocacia Nascimento Azevedo, Rio de Janeiro, BR
[4] IRTech, Rio de Janeiro, BR

e-mail: elliasteixeira.medvet@gmail.com

ABSTRACT: Small animal diagnostic veterinary radiology is rapidly developing and has become an increasingly important instrument in the veterinarian's routine. The implementation and maintenance of the veterinary imaging service requires continuous management of the sector to avoid unnecessary exposure and protect the veterinary and public IOE, as ionizing radiation is invisible, odorless, inaudible and tasteless. The GUT technique, developed by Kepner and Tregoe, is a technique used to guide complex decisions that defines the priorities to be given to the different alternatives of actions and can be adapted to diagnostic veterinary radiology to help in the management of the service to prioritize problems and treat them. them.

Keywords: Small Animal Radiology, Audit, Radiological Protection, GUT.

1. Introduction

The GUT matrix is a tool for organizing problems and demands in order of priority. Precisely for this reason, it is also known as the Priority Matrix. The tool makes it possible to analyze problems according to their severity, urgency and tendency, improving the workflow and the decision-making process. It is an administrative tool to identify, observe, analyze and seek solutions to the company's problems and challenges, the GUT matrix seeks to prioritize problems in order to deal with the most urgent ones before the others (**HEKIS et al., 2013**).

Problems will exist in the day-to-day of a company, but solving them all at the same time will be difficult. That is why there must be a prioritization so that the most urgent ones are not left out (and end up becoming very harmful to the organization) in relation to the less urgent ones. "GUT" comes from the abbreviation of the words Severity, Urgency and Trend. Each of these elements must be evaluated when analyzing a problem that must be solved (**SOTILLE, 2014**).

• Severity: what impact will this problem have on people, company processes, short and long term results, etc.?

• Urgency: how long do you need to solve this problem and how much time do you have to solve it?

• Trend: how can this problem grow, what are its chances of growing (a lot or a little) and could it go away by itself?

The problems must be measured in order to define which of them will be a priority for the company. In the measurement, it is necessary to assign a score from 1 to 5 for each of these dimensions of the GUT Matrix (severity, urgency and trend) (**OLIVEIRA et al., 2016**)

Grades from 1 to 5 should be proportional to problems such as:

- NOTE: Severity, Urgency, Trend, respectively.

1. It's not serious, it's not in a hurry to be solved, it won't get worse and in some cases it gets better on its own;
2. Little serious, can wait to be resolved, will get worse after a long time;
3. Serious, must be done as soon as possible, it will get worse in the medium term;
4. Very serious, has a certain urgency and should be prioritized in the short term;
5. Extremely serious, immediate urgency, tendency to get worse if no necessary actions are taken.

After defining and listing the problems and assigning a grade to each one of them, it is necessary to add the values of each of the aspects: Severity, Urgency and Tendency, so that we can obtain those problems that will be our priorities (**ALVES et al., 2017**).

Those with a higher priority value will be the ones you should deal with first, as they will be the most serious, urgent, and most likely to get worse (**ZARPELAM, 2020**).

The great advantages of using the GUT Matrix is that it allows a more detailed and systemic view of the problems, helps the manager to quantitatively assess the company's problems, making it possible to list corrective and preventive actions and prioritize them for the total extermination or part of the problem.

2. Objective

Identify the main non-conformities found in Veterinary Clinics and Hospitals during the audit of the Laboratory of Radiological Sciences and apply the GUT matrix in diagnostic veterinary radiology of small animals to organize problems in order of priority, seeking their quick solution.

3. Material and methods

Access the LCR database to verify the number of veterinary clinics inspected in the State of Rio de Janeiro in the year 2023 (January 1st to February 27th). Identify, in the inspections carried out, which were the non-conformities found in the RVD services, the types of equipment inspected (fixed, mobile and portable), the type of application (use) within the service (used as fixed or mobile) and the main critical points for the RVD service that can lead to non-compliance of the service and consequently to increased exposure of workers and the general public.

Qualitatively and quantitatively study the elements that can lead to increased exposure of veterinary IOE and the general public (guardians, companions, other veterinary clinic/hospital workers who are not IOE) in the RVD service, that is, compromise the protection of those involved as establishes RDC 611/22 ANVISA through the elaboration of a GUT matrix worksheet (Table 1 and 2).

Define problems – identify problems that may compromise the service's operation (performed in the previous phases).

Define the severity – Assign a score to each problem: it is related to the impact (damage/loss) that the problem causes as a whole: 5 – Extremely serious; 4 – Very severe; 3 – Record; 2 – Slightly severe; and 1 – No severity.

Define the urgency – Define a note for each problem: it is related to the impact (damage/loss) that the problem causes on the whole: 5 – Needs immediate action; 4 – It is urgent; 3 – As soon as possible; 2 – Slightly urgent; and 1 – It can wait.

Define the trend – Define the severity of each problem: potential for the problem to grow (the evolution of the damage or loss if it is not resolved): 5 – It will get worse quickly; 4 – It will get worse in a short time; 3 – It will get worse; 2 – Will get worse in the long run; and 1 – Nothing will change.

Finally, order and prioritize the problems, that is, we determine which one should be corrected following degrees of priorities (the highest score first).

We define the priority – We determine the priority of each problem:

> 100 – Emergency – needs an immediate solution.
> 75 – Very urgent – needs an almost immediate solution;
> 50 – Urgent – needs a quick solution
> 25 – Slightly urgent – needs solution as soon as possible.
< 25 – Not urgent – They can wait, without immediate risk.

4. Result and Discussion

In the LCR/UERJ inspection report carried out in 10 veterinary clinics in the State of Rio de Janeiro in the year 2023, 6 fixed X-ray equipment (60%), 1 mobile (10%), 2 portable (20%) and 1 without information (10%). We found that 9 of these pieces of equipment were used as fixed equipment (90%) and 1 as mobile equipment (10%) and their characteristics are described in table 1.

Table 1- Characteristics of the equipment used.

Item and problems/clinics	1	2	3	4	5	6	7	8	9	10
	A	B	C	D	E	F	G	H	I	J
Emitter type: (F) Fixed; (M) Mobile; (P) Portable and No Information (NI)	F	F	F	F	NI	P	F	F	P	M
Mobility (Use how?): (F) Fixed; (M) Mobile.	F	F	F	F	F	F	F	F	M	F
kV: 90 / 100 / 125	125	125	125	125	NI	90	125	125	NI	125
mA: 20 / 100 / 200 / 300 / 500	300	500	500	500	NI	20	300	500	NI	200

Note: F – Fixed; M – Mobile; P – Portable; NI – No information;

Also, nonconformities were noted in these places, such as: 20% with problems in the collimation system, 20% with problems in the alignment of the central axis, 30% with problems in the accuracy and repeatability of tube tension and exposure time, 40% with problems in the semi-reducing layer, 20% with problems with dosimetry, 20% with problems with the IOE containing the patient, 10% with problems with personal protective equipment (PPE)/storage and 30% with problems with signaling (Tables 2 and 3).

Table 2 – Problems with equipment and environment.

Item / clinics	1	2	3	4	5	6	7	8	9	10
	A	B	C	D	E	F	G	H	I	J
Accuracy of the collimation system	X							X		
Central axis alignment	X				X					
Accuracy and Repeatability Tube Voltage and Exposure Time	X			X						X
CSR	X			X				X		X
Head leak test										
Radiometric survey										

Table 3 – Problems with exposure, signaling, dosimetry and PPE.

Item / clinics	1	2	3	4	5	6	7	8	9	10
	A	B	C	D	E	F	G	H	I	J
Individual dosimeters	X								X	
IOE containing the patient						X	X			
PPE and its storage									X	
Signaling				X				X	X	

The evaluation of the clinics allowed the elaboration of the GUT matrix to visualize the problems that must be tackled and solved as a priority (Tables 4 to 13).

Table 4 – Clinic A

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	3	4	3	**36**
3	Center beam alignment	3	4	3	**36**
4	CSR	4	5	3	**60**
5	Accuracy/repeatability Voltage/mAs	4	5	3	**60**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	5	5	5	**125**
8	PPE and its storage	0	0	0	**0**

Table 5 – Clinic B

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 6 – Clinic C

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 7 – Clinic D

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	3	3	2	**18**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	4	5	3	**60**
5	Accuracy/repeatability Voltage/mAs	4	5	3	**60**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 8 – Clinic E

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	3	4	3	**36**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 9 – Clinic F

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	4	4	4	**64**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 10 – Clinic G

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	4	4	4	**64**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 11 – Clinic H

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	3	3	2	**18**
2	Collimation system	3	4	3	**36**
3	Center beam alignment	0	0	0	**0**
4	CSR	4	5	3	**60**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 12 – Clinic I

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	3	3	2	**18**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	5	5	5	**125**
8	PPE and its storage	5	5	5	**125**

Table 13 – Clinic J

Item	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	4	5	3	**60**
5	Accuracy/repeatability Voltage/mAs	4	5	3	**60**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Classification of priorities according to the degree of severity of nonconformities found in the inspection of clinics according to the GUT matrix (Table 14 to 23) for corrections:

Table 14 – Clinic A

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	Individual dosimeters	5	5	5	**125**
2	CSR	4	5	3	**60**
3	Accuracy/repeatability Voltage/mAs	4	5	3	**60**
4	Collimation system	3	4	3	**36**
5	Center beam alignment	3	4	3	**36**
6	IOE containing the patient	0	0	0	**0**
7	PPE and its storage	0	0	0	**0**
8	Signaling	0	0	0	**0**

Table 15 – Clinic B

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 16 – Clinic C

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	Signaling	0	0	0	**0**
2	Collimation system	0	0	0	**0**
3	Center beam alignment	0	0	0	**0**
4	CSR	0	0	0	**0**
5	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 17 – Clinic D

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	CSR	4	5	3	**60**
2	Accuracy/repeatability Voltage/mAs	4	5	3	**60**
3	Signaling	0	0	0	**0**
4	Collimation system	0	0	0	**0**
5	Center beam alignment	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 18 – Clinic E

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	Center beam alignment	2	3	4	**24**
2	CSR	0	0	0	**0**
3	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
4	Signaling	0	0	0	**0**
5	Collimation system	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 19 – Clinic F

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	IOE containing the patient	4	4	4	**64**
2	Center beam alignment	0	0	0	**0**
3	CSR	0	0	0	**0**
4	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
5	Signaling	0	0	0	**0**
6	Collimation system	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 20 – Clinic G

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	IOE containing the patient	4	4	4	**64**
2	Center beam alignment	0	0	0	**0**
3	CSR	0	0	0	**0**
4	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
5	Signaling	0	0	0	**0**
6	Collimation system	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 21 – Clinic H

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	CSR	4	5	3	**60**
2	Collimation system	3	4	3	**36**
3	Signaling	3	3	2	**18**
4	IOE containing the patient	0	0	0	**0**
5	Center beam alignment	0	0	0	**0**
6	Accuracy/repeatability Voltage/mAs	0	0	0	**0**
7	Individual dosimeters	0	0	0	**0**
8	PPE and its storage	0	0	0	**0**

Table 22 – Clinic I

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	Individual dosimeters	5	5	5	**125**
2	PPE and its storage	5	5	5	**125**
3	Signaling	3	3	2	**18**
4	CSR	0	0	0	**0**
5	Collimation system	0	0	0	**0**
6	IOE containing the patient	0	0	0	**0**
7	Center beam alignment	0	0	0	**0**
8	Accuracy/repeatability Voltage/mAs	0	0	0	**0**

Table 23 – Clinic J

Priority level	Unconformities	Gravity	Urgency	Tendency	Total
1	CSR	4	5	3	**60**
2	Accuracy/repeatability Voltage/mAs	4	5	3	**60**
3	Individual dosimeters	0	0	0	**0**
4	PPE and its storage	0	0	0	**0**
5	Signaling	0	0	0	**0**
6	Collimation system	0	0	0	**0**
7	IOE containing the patient	0	0	0	**0**
8	Center beam alignment	0	0	0	**0**

The classification of problems found in the detailed audits of clinics A, B, C, D, E, F, G, H, I, J and more of the case study can be found in Appendix I. The result of the quantitative analysis of damages and impacts is below.

Clinics B and C are in compliance.

Clinic A presented 3 non-conformities: problem with the IOE dosimetry that needs an immediate solution; problem in the CSR that needs a quick solution; and, problem in the collimation system and alignment of the central beam that needs a solution as soon as possible.

Clinic D presented 2 non-conformities: problem in CSR and in voltage/mAs accuracy/repeatability that needs a quick solution.

Clinic E presented 1 non-compliance: problem with alignment of the central beam that needs a solution as soon as possible.

Clinic F presented 1 non-compliance: problem with IOE containing the patient during the exam that needs a quick solution.

Clinic G presented 3 non-conformities: problem with the IOE dosimetry that needs an immediate solution; problem in the CSR that needs a quick solution; and, problem in the collimation and beam alignment system that needs a solution as soon as possible.

Clinic H presented 3 non-conformities: problem in the CSR that needs a quick solution; and, problem in the collimation system that needs a solution as soon as possible; and, signaling problem that can wait, without immediate risk.

Clinic I presented 3 non-conformities: problem with the IOE dosimetry and the storage of the PPE that needs an immediate solution; and, signaling problem that can wait, without immediate risk.

Clinic J presented 2 non-conformities: problem in the CSR that needs a quick solution; and, voltage/mAs accuracy/repeatability issue that needs a quick fix.

Employers, managers and IOE should be aware of annual dose limits and control exposures so that these limits are not exceeded (**BRASIL, 2022**). The IOE must always wear full PPE while in the exam room or behind the screen. And never expose yourself to primary and secondary beams of X-rays, especially without protection (**BUSHONG, 2010**).

In small animal radiography (Figure 21), sandbags can be used on small animals to contain collaborative patients, decreasing veterinary and public IOE exposure to X-rays (IAEA, 2022). In large animal radiography (Figure 22), accessories can be used to prevent the IOE veterinarian or members of the public from holding the cassettes and the portable X-ray emitter.

Collimation of all exams to the study region of interest must be performed to reduce exposure inside the exam room. And, and the IOE should avoid placing the hand under the primary radiation beam (Figure 1) (**BRASIL, 2022** and **BUSHONG, 2010**).

Figure 1 - Sandbags to contain the patient (**IAEA, 2022**)

The IOE during the X-ray must be positioned in such a way that no part of the body, including extremities, when possible, is reached by the primary beam of ionizing radiation without being protected by at least 0.5 mm equivalent of lead. And, also, without protecting oneself from scattered ionizing radiation, by means of PPE with attenuation compatible with the radiation energy, not less than 0.25 mm equivalent of lead (Figure 23) (BRASIL, 2022).

The use of the UPI in all procedures involving practice with veterinary X-rays is important to reduce veterinary exposure and it is important to store it correctly (Figure 25 and 26) to increase its useful life (**ELLIS et al., 2018** and **COSTA, 2022**). Never fold the apron, never sit down or bend down with it on, this helps to avoid fractures and breakages that will make its use unusable. It is also important to carry out periodic evaluations to verify their integrity.

The individual monitoring program must be done through individual dosimeters placed on the body. Individual monitoring and care related to external exposure in radiodiagnosis meet the following requirements (**BRASIL, 2022**):

• Permanent individual monitoring of each worker in controlled areas is carried out through individual dosimeters, which must be used by anyone during their stay in the X-ray room.

• The individual dosimeters used by the service are currently provided by the company responsible for monitoring and supplying the dosimeters, of the TLD type – Thorax, or Hand, for example.

• The period of use of the dosimeters, as well as their exchange and evaluation, is monthly.

• In the event of emergency exposures, accidents or suspected accidents, arrangements are made for the immediate evaluation of the individual dosimeters of the workers involved.

• Before the distribution of individual dosimeters, an analysis is made to verify the possibility of the worker receiving a value above 3/10 (three tenths) of the fraction of the annual effective dose limit. If necessary, an assessment of doses of separate body regions is carried out, when there is a risk of non-homogeneous exposure of the human body.

• The names of users of individual dosimeters in the service, their codes and the accumulated dose in the last six months are listed.

The use of a dosimeter is important for monitoring veterinary IOE (Figure 2). A study found that in fixed X-ray equipment, the estimated doses were higher than the estimated doses in portable X-ray equipment, considering a single type of exam (**ROSA et al., 2018**).

Figure 2 – Chest and extremities dosimeters

In fixed X-ray equipment, without protection, the dose equivalent values in the hands can be above the annual dose limit established by CNEN for the IOE. For mobile X-ray equipment, all estimated values may be below the reference limits or the detection limit (**ROSA et al., 2018**).

The dose to the lens may be above the limit for unshielded fixed X-ray equipment. In the chest region, the estimated dose without protection in fixed X-ray equipment can be twice the reference limit dose established by CNEN (**ROSA et al., 2018**).

The objective of the accuracy test of the collimation system is to verify the coincidence between the radiation field and the indication of its size or the area of the image receptor. Instrumentation: image receptor, radiopaque objects and screen (Figure 3) (**CONFEA, 2021**). The purpose of the X-ray beam central axis alignment test is to verify the orthogonality between the X-ray beam central axis and the image receptor plane (Figure 3) (**CONFEA, 2021**).

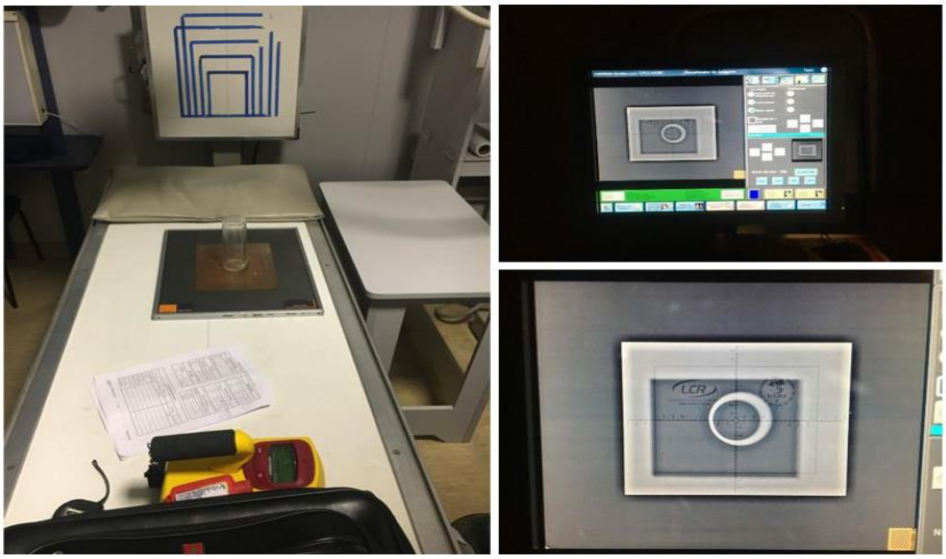

Figure 3 – Collimation test and central axis alignment.

The objective of the semi-reductive chamber test is to verify the filtration of the X-ray beam (Figure 4) (**CONFEA, 2021**). The purpose of the area kerma product indicator accuracy test (Figure 4) is to verify the response of the device and associated electronics that indicate the area kerma product. Instrumentation: kerma-area measuring instrument or radiation measuring instrument (**CONFEA, 2021**).

The purpose of the exposure time accuracy and reproducibility test (Figure 4) is to verify the response of the electronic circuit that controls the exposure time (**CONFEA, 2021**). The purpose of testing the accuracy and reproducibility of the high voltage applied to the X-ray tube (Figure 4) is to verify the response of the electronic circuit that controls the high voltage of the tube. (**CONFEA, 2021**). The objective of the Air Kerma linearity test with mAs (Figure 4) is to verify the response of the electronic circuits that control the high tube voltage and the anode current as a function of the load. (**CONFEA, 2021**).

Figure 4 – Multímetro PTW NOMEX - testes de quilovoltagem e tempo de exposição

Safety signs are of great importance for radiological protection, their correct use prevents accidental exposure by the public and by the IOE (**BELLON, 2021**). It is important to have this area delimitation so that unsuspecting people do not enter the room during the procedure and accidentally expose themselves (**ROSA et al., 2018**).

The use of the red signal light over the entrance door to the x-ray room (Figure 5) is mandatory according to RDC 611/22 ANVISA. On the external face of the door and entrance, the existence of the international symbol of ionizing radiation, the trefoil, and the following warnings is also required (**BELLON, 2021**):

• “X-rays, entry prohibited” or “X-rays, entry prohibited to unauthorized persons”;

• “When the red light is on, entry is prohibited”.

Inside the x-ray room, the following warnings are required (Figure 5):

• “The presence of companions in the room during the radiological procedure is not allowed, except when strictly necessary and authorized”;

• “Companion, when there is a need to contain the patient, demand and correctly use lead-bearing clothing for their protection”;

• “Only 1 (one) patient can remain in this room at a time”;

• “Women who are pregnant or suspected of being pregnant: inform the doctor or technician before the exam”.

Figure 5 - Mandatory safety signage.

A company's safety culture is the sum of the mindsets, postures and behaviors of all employees regarding safety in the work environment. A positive safety culture is absolutely critical to the success of any worker safety and health program (**3M, 2018**).

The protection of workers and the general public in the RDV is mandatory as established in RDC 611/22 ANVISA. For this, actions are needed that can help control the exposure of veterinary IOE and think about the implementation of a safety culture in radioprotection in the work environment, among them are:

- Know RDC 611/22 ANVISA and IN 90/21 ANVISA and implement, at least, quality assurance, radiological protection and permanent education programs;
- Carrying out radioprotection training – Qualification/Qualification;
- Understand and apply the basic principles of radiation protection (justification, optimization and dose limitation) and the fundamental principles of safety and radiation protection (time, distance and shielding);
- Never expose yourself to the primary beam of X-rays and never expose yourself to the secondary beam of X-rays without protection and never hold the portable X-ray emitter or the radiographic cassette/chassis;
- Never hold the patient during the X-ray. Use mechanical retention devices when possible. Otherwise, let the guardian and companions hold the patient. And, if possible, sedate the patient. The person in the public restraining the patient must wear full PPE;
- Always use complete PPE (apron, thyroid protector, gloves and leaded goggles) when you are not behind the screen during the exam;
- Always use the individual dosimeter during your workday and position the individual dosimeter on the apron during the exam;
- Employer always offer complete PPE to IOE veterinarians and employees always use complete PPE during the X-ray;
- Always narrow the exam to the smallest possible area of study interest; It is
- Remember that the veterinary assistant, when helping with the X-ray, is also an IOE.

The GUT technique, developed by Kepner and Tregoe, is a technique used to guide complex decisions that defines the priorities to be given to the different alternatives of actions.

It is a tool that serves to prioritize problems and treat them. This tool rationally answers the questions “what should we do first?” and “where should we start?”.

The first step is to qualify the problems, and then assign a score corresponding to the variables established in a matrix, prioritizing actions taking into account the severity, urgency and tendency of a given problem. The severity factor concerns the non-resolution of the problem and indicates the impact, mainly, in relation to the results, and processes that will arise in the long term. Urgency is the variable related to the availability of time needed to resolve a given situation. And the trend looks at the trend or pattern of evolution, reduction or elimination of the problem (**HÉKIS et al., 2013**).

Its methodology indicates that, after giving the grades to each of the problems, the values must be added to obtain those that will be treated with priority (**ALVES et al., 2017**).

Those with the highest score should be treated as a priority, as they are considered the most serious, urgent and with a greater tendency to get worse (Table 1) (**ZARPELAM, 2020**).

5. Conclusion

The analysis of the audits made it possible to identify the problems that could influence the image quality and compromise the security of the installation. We note that the lack of professional training, quality control of instrumentation are the regulatory requirements of radiological protection compromises can compromise the safety of IOE and public.

The identification and quantification of nonconformities allowed, through the GUT matrix, in a simple, clear and objective way to prioritize the problems to be treated by the holders of the mitigated facilities or eliminating the risks of increased unwanted exposures, making veterinary radiological practice safer.

Thus, we understand that this study was important for the knowledge of veterinary radiological activities, helping with safety and suggesting practical solutions that can help in the implementation of a safety culture for the area of veterinary radiological medicine.

6. Acknowledgments

First, I thank God for everything. Thanks to the IRTech Team, IRD/CNEN and LCR/DCR/IBRAG/UERJ for their support. I would also like to thank CAPES ("This study was partially financed by the Coordination for the Improvement of Higher Education Personnel – Brazil (CAPES) – Financial Code 001") for the scholarship from 2021 to 2023 during the Master's Course in Radioprotection and Dosimetry at the Institute of Radioprotection and Dosimetry – IRD.

7. References

3M, 2018. Como criar uma cultura de segurança em sua empresa. Sumaré, SP, 2018. https://www.3m.com.br/3M/pt_BR/epi/solucoes-de-seguranca-pessoal/protecao-em-altura/artigos/~/como-criar-cultura-seguranca/?storyid=cc15fc2e-eeda-42e7-8743-9ee517a2e4b1

ALVES et al., 2017. Aplicabilidade da matriz GUT para identificação dos processos críticos: o estudo de caso do departamento de direito da universidade federal de Santa Catarina. Santa Catarina, 2017.

ÁUSTRIA, 2021. International Atomic Energy Agency. Safety report series no. 104. Radiation protection and safety in veterinary medicine.

BELLON, ARTHUR MARCHI. Aspectos de Proteção Radiológica em uma Clínica de Radiodiagnóstico Veterinário. Monografia do curso de Física Médica do Instituto de Biociências, Universidade Estadual Paulista "Júlio de Mesquita Filho", Campus de Botucatu. São Paulo – SP, 2021.

BRASIL, 2021. Protocolos para execução de testes em sistemas de radiologia Diagnóstica e intervencionista. CONFEA, Brasília, 2021.

BRASIL, 2021. IN 90/21 da ANVISA. Requisitos sanitários para a garantia da qualidade e da segurança em sistemas de radiografia médica convencional. Brasília, 2021.

BRASIL, 2022. Ministério da Saúde. Agência Nacional de Vigilância Sanitária. RDC Nº 611/22 da ANVISA. Requisitos sanitários para o funcionamento de serviços de radiologia diagnóstica ou intervencionista. Brasília, 2022.

BUSHONG, STEWART C. Ciência radiológica para tecnólogos: física, biologia e proteção / STEWART CARLYLE BUSHONG; [tradução SANDRO MARTINS DOLGHI… et al.]. – Rio de Janeiro: Elsevier, 2010.

COSTA, GABRIEL CARDOSO. Avaliação de Doses Ocupacionais e de Tutores em Radiologia. Dissertação de Mestrado do curso de Pós-graduação *Stricto senso* de Radioproteção e Dosimetria do Instituto de Radioproteção e Dosimetria - IRD. Rio de Janeiro, 2022.

HEKIS et al., 2013. Análise GUT e a gestão da informação para tomada de decisão em uma empresa de produtos orgânicos do Rio Grande do Norte, 2013.

KATHERINE L. ELLIS, ALISON J. MORTON, JORGE A. HERNANDEZ, MATTHEW D. WINTER. Radiation Exposure to Personnel Obtaining Equine Appendicular Radiographs Using a Handheld Generator, Elsevier, Original Research, 2018

OLIVEIRA et al., 2016. Aplicação da matriz GUT em uma microempresa de assistência técnica. ENGEMA. 2016.

ROSA, PC e BARROS, FS. Exposição das mãos do operador na radiologia veterinária. XXIII Congresso Brasileiro de Física Médica – CBFM. Porto Alegre, 2018.

SOTILLE, 2014. PM Tech Capacitações em projetos. Rio Grande do Sul, 2014.

ZARPELAM, 2020. Aplicação de matriz GUT na priorização de tarefas no setor financeiro de uma empresa de bebidas. Paraná, 2020.