

Medical Waste Risk Management

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Abstract

Medical waste risk management needs extra attention since many health professionals are in contact with this type of waste every day. Medical waste can induce infections in result of handling accidents, or when they are treated with negligent. It is the responsibility of the producing entities to establish a waste management plan and prevention, and to train and equip their staff against the risks that this kind of waste represents.

The objective of this research is to identify risks and gaps in the process of medical waste management, created in human and animal healthcare centers in the Ilha do Pico-Azores, and investigate current practices regarding training in this area, proposing improvements in the process.

This research is based on a case study in the Ilha do Pico, covering entities such as health centers, medical clinics, pharmacies, veterinary clinics, nursing homes and physical therapy clinics. The data is collected through interviews and surveys to healthcare professionals in order to investigate the risk throughout the life cycle of medical waste.

This research concludes that, although there are already some procedures implemented, there are still many risks that can be minimized. It was also concluded that these risks are mainly associated with the lack of training and awareness of health professionals. After the identification of the risks, the research suggest viable solutions for the gaps found.

Keywords: Risk analysis, Medical waste, risk management, life cycle, Ilha do Pico

1- Introduction

Risk management is defined as a set of principles and techniques, methods and procedures that enable companies to identify the risks, that the business is exposed to, and at the same time suggest an efficient way of minimizing it. A healthcare professional was a 1.5 times higher risk of contracting a disease than other workers.

The need to prevent professional risk associated with the handling of medical waste (MW), dangerous equipment, exposure to infectious agents, physical factors, among others, is the primary reason to ensure safer environments in healthcare facilities and guarantee that the work can be developed on a more healthy and safer way (Tavares A., 2010).

2 - The Risk

According to Hull (1992), the risk reflects the probability and consequences. The probability by itself does not lead to the risk, but the probability together with the impact of the consequences lead to risky situations.

2.1 - Risk Management in Medical Waste

The degree of risk can be described as the product of the probability of occurrence of an event by the seriousness of its consequences. At this stage the risk classification proceeds to prioritize which risks should be treated according to the classification from the previous equation.

The probability and impact matrix has as main objective to rank the handling of risks. This matrix is constructed to assign risk ratings (very high, high, medium, low and minimal) to risks or conditions based on the combination of ranges of probabilities and consequences. Risks with high probability and high impact are strong contenders to further analysis, including quantification and aggressive risk management

The risk matrix is a matrix that for each risk found makes the allocation or assignment of management and assesses the impact - High, Medium, Low, according to probability of occurrence and severity of consequences. With this information we can assess risk, understand its origin and implement measures to control it.

To analyze the risk, Coelho (2007) refers that the risk matrix is only one of several options that exist but, is usually an accepted model for situations where there are different types and risk areas.

The risk treatment begins after the identification of hazards and risks, to be able to classify and evaluate them and implement measures aimed at their elimination. When this is not possible, the risk must be reduced and controlled. Subsequently, these residual risks should be evaluated in order to verify whether it is possible to reduce them further.

Therefore, implementing the defined measures and ensuring the elimination and reduction of risk through periodic reviews, the risk control of the entity is done. This control can be accomplished through the development of plans for results monitoring, to assess the assumptions previously placed and correct the results less favorable or through internal audits and data collection.

When a risk is identified, there are available several options to decision makers: to do

- Eliminate - Implement measures that can eliminate a particular risk;
- Avoid – Ensure that certain risks do not occur;
- Reduction - Implement measures that can reduce the negative effects of risk;
- Transfer – delegate risk management responsibility to other actors;
- Absorption (retaining) the risk - Maintain responsibility for risk management.

The last two options - the transfer and absorption - are usually combined in a process of risk allocation. All identified risks are analyzed and the responsibility to manage each risk is assigned to a partner. So, if it's impossible to eliminate the risks, measures can be identified to minimize

adverse effects. Risk allocation can also include the option of sharing risks, where two or more partners jointly decide to manage some risks.

If risks are managed in advance, some will be eliminated, some will be reduced and the remaining risk will already have attenuation measures.

2.2 - Medical Waste

The Decree Law 178/2006 of September 5th, subparagraph b) of Article 4 of the DLR 20/2007/A, considers medical waste: "The waste originated from medical units that are developed in the provision of healthcare in activities of prevention, diagnosis, treatment, rehabilitation and research related to human beings or animals, in pharmacies, forensic activities, education and any other involving invasive procedures, such as acupuncture, piercings and tattoos".

According to the Strategic Plan for Medical Waste (SPMW) from 2011 to 2016, the producers of MW from different economic activities, leads to a very different and specific waste production, not only in regard to their real risk, but also in terms of cultural and ethical issues, or the simple perception of risk. These wastes are currently divided in four groups according to the existing legal framework:

Group I - equivalent to urban waste - those who do not have special requirements in their treatment. Included in this group: Waste from general services (offices, meeting rooms, lounges, toilets, changing rooms, etc.);

Group II - non-hazardous MW - those who are not subject to specific treatments, and may be assimilated to urban waste. Included in this group: Diapers and removable covers not contaminated and with no traces of blood; personal protective equipment used in general service and support, with the exception of used in MW collection;

Group III - bio hazardous MW - waste contaminated or suspected of contamination likely to incineration, allowing subsequent disposal as municipal waste. Belong to this group: All waste from rooms or wards of suspected infectious patients, from hemodialysis units, surgery rooms, treatment rooms, autopsy and pathology rooms and laboratory investigation

Group IV - specific hospital waste - several types of waste that require incineration. Included in this group: anatomical parts, fetuses and placentas,

until publication of specific legislation; Cutting and slicing materials, needles, catheters and all invasive materials.

According to Pruss (1998), Pruss (1999) and WHO (2010), approximately 80% of the waste produced by the healthcare units are treated as household waste. The waste from administrative tasks, canteens, laundries, packaging materials and other substances are the ones that don't require special care in handling or that don't constitute risk to humans and environment. The remaining 20% are considered hazardous and may originate health risks.

MW include all types of waste generated from human and veterinary medical activities (public or private) and covers the diagnosis, prevention, treatment and palliative care, research and laboratory activities (Abah & Ohimain, 2011).

Hazardous waste includes infectious waste, pathological waste, pharmaceutical waste, chemical waste, biological waste, waste with high content of heavy metals, pressurized containers and radioactive waste. Improper handling of waste can lead to environmental pollution, such as water, air, soil, resulting in unpleasant odors, promoting the growth and multiplication of insects, rodents and vermin, and can lead to the transmission of diseases such as typhoid, cholera, human immunodeficiency virus (HIV) and hepatitis (B and C) (Pruss et al, 1999).

Due to constant exposure, health professionals are at risk of contracting infectious diseases by contact with needles and other sharp devices during the course of their duties (Alagoz and Kocasoy, 2008). MW can represent high risks not only for those who deal with them, but also to the community, if they are placed in areas with inadequate controlled or easily accessible by the general public, especially children (WHO, 2010c). Therefore, MW management must have a complete plan, including all aspects of production, sorting, collection, storage, transportation, treatment and final destination. (Cheng et al, 2009).

3 – Case Study – Ilha do Pico, Azores

Initially we carried out an investigation of all entities that produce MW in Ilha do Pico, public and private, in order to understand the universe of study. Ilha do Pico is the second largest Ilha do

Pico, in the Azores archipelago, with a population of 14,144 people (2011 Census) and an area of 447 km², consisting in a volcanic cone with 2351 meters of altitude above sea level.

Administratively, the Ilha is made up of three counties: Lajes do Pico and Madalena, both with six parishes, and São Roque do Pico, with five parishes. All the entities under study don't have the capacity to carry out the waste management operations, such as the collection, transport and disposal. Due to this fact, and according to the Regional Legislative Decree No. 29/2011/A of November 16th, all entities are obligated to contract a licensed company for that purpose.

3.1 Methodology

The methodology was done in two stages: extensive research and literature review in order to understand the context of the current problem on MW risk management in Pico; developed study based on interviews, surveys and photographic records, which constituted the fundamental basis for building the Risk Matrix and risk control measures.

The purpose of the surveys was to determine the frequency of an event in a population. After formal approval of each entity, these methods were applied among the officials and employees of the entities selected, making a total of 70 participants such as doctors, nurses, physiotherapists, pharmacists and healthcare cleaning professionals.

The survey data was introduced in a SPSS - Statistical Package for the Social Sciences, database and which was carried out a descriptive analysis.

The surveys given to health professionals were divided primarily into four areas: evaluation of MW management practices, perceptions and risk management, accidents, training and knowledge about risk. We included all these analyses to cover all aspects that endanger professionals.

3.2 – Results

The surveys were used to evaluate the concepts acquired in MW. For the question regarding the containers here the rejected drugs (medicines) are placed, 34.9% of participants answered correctly, and selected the red container/cut-drilling. However, as can be seen in Figure 1, 32.9% of professionals believe that these wastes

are placed in the white container. The white container is not cut-drilling, so this lack of knowledge leads to the probability of a personal injury accident such as needle sticks or cuts.

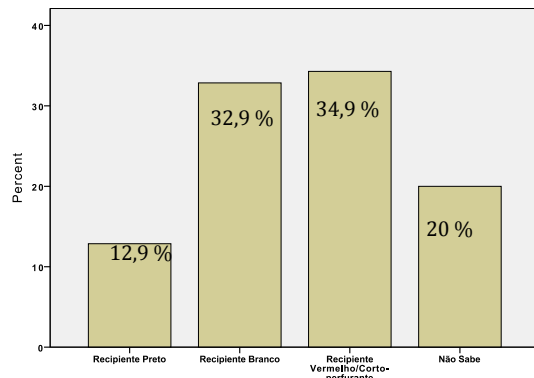


Figure 1 – Rejected drugs (medicines)

For waste from the general services, the percentage of correct responses was greater than 80%, which indicates that regarding to this subject, professionals are properly informed.

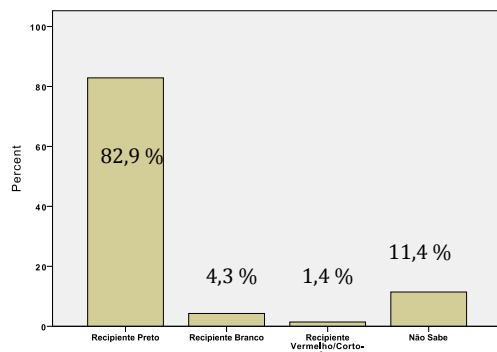


Figure 2 - Waste from general services (such as offices, meeting rooms and toilets)

The next question was about collecting body fluid bags and related systems (Fig. 3). At this stage, some doubts have appear since 18.6% of respondents felt that these residues correspond to the black container, or forming part of the group I or II. This is considered critical in the screening step, since these residues belong to group III, or the white container, and so possess biological risk. If not screened properly, there may be contamination of the group I and II and consequently accidents (infections).

In the data collecting it was also exanimated the percentage of staff trained on MW. As seen in Table 1, this percentage is higher than 50%. This means that only 38 professionals have training in this subject. We also conclude that nurses are the

healthcare professionals with more knowledge in the area.

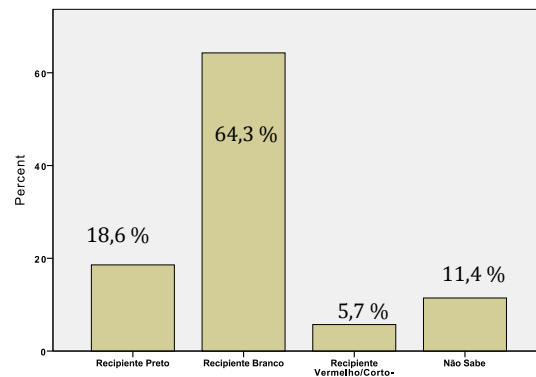


Figure 3 - Bags and collecting body fluids respective systems

Although the participants were mostly female, considering the percentages it appears that there is more lack of training in males. The low percentage of staff with specific training and MW handling can be the source of the errors found on the previous questions, concluding that there is a lack of training in entities that generate MW on Ilha of Pico.

Table 1 – Professionals with training on MW

Profissionais		Sim	Não	Total
Masculino	Médico	18,2%	18,2%	36,4%
	Enfermeiro	9,1%	18,2%	27,3%
	Técnico de Saúde	9,1%	9,1%	18,2%
	Auxiliar de Limpeza		18,2%	18,2%
	Total	36,4%	63,6%	100,0%
Feminino	Médico	5,1%	5,1%	10,2%
	Enfermeiro	32,2%	6,8%	39,0%
	Técnico de Saúde	6,8%	5,1%	11,9%
	Auxiliar de Limpeza	13,6%	15,3%	28,8%
	Outro		10,2%	10,2%
Total	57,6%	42,4%	100,0%	
Total	Médico	7,1%	7,1%	14,3%
	Enfermeiro	28,6%	8,6%	37,1%
	Técnico de Saúde	7,1%	5,7%	12,9%
	Auxiliar de Limpeza	11,4%	15,7%	27,1%
	Outro		8,6%	8,6%
Total	54,3%	45,7%	100,0%	

On the final phase of the survey, and after some doubts about matching MW to their containers, as seen in Table 2, 58.6% of respondents considered that do not have enough training and knowledge about MW and the risks that are associated with its handling. The responsibility of training is given to each entity together with the company that provides service, in this case, Azormed SA.

The lack of periodic and updated training leads to

more errors in MW life cycle, leading to spending financial and human resources in an inefficient and an ineffective process.

After analyzing this data, correlations were conducted in order to understand the analysis of sample data.

Table 2 – Professionals who consider enough knowledge about MW and risks associated with these

Profissionais		Sim	Não	Total
Masculino	Médico	27,3%	9,1%	36,4%
	Enfermeiro	27,3%		27,3%
	Técnico de Saúde	9,1%	9,1%	18,2%
	Auxiliar de Limpeza		18,2%	18,2%
	Total	63,6%	36,4%	100,0%
Feminino	Médico	6,8%	3,4%	10,2%
	Enfermeiro	16,9%	22,0%	39,0%
	Técnico de Saúde	1,7%	10,2%	11,9%
	Auxiliar de Limpeza	11,9%	16,9%	28,8%
	Total	37,3%	62,7%	100,0%
Total	Médico	10,0%	4,3%	14,3%
	Enfermeiro	18,6%	18,6%	37,1%
	Técnico de Saúde	2,9%	10,0%	12,9%
	Auxiliar de Limpeza	10,0%	17,1%	27,1%
	Total	41,4%	58,6%	100,0%

Regarding the knowledge acquired, it appears that 58.6% assume that they should develop more information on this matter. The healthcare cleaning professionals are the ones that accept that they aren't adequately trained and updated. Nurses, as we seen in table 1 are the ones with more training, although are also those who admit that their knowledge is not satisfactory (18.6%) and so require annual training to keep updated.

Table 3 - Professionals who consider sufficient knowledge about MW and the risks associated with these

Profissionais		Sim	Não	Total
Masculino	Médico	27,3%	9,1%	36,4%
	Enfermeiro	27,3%		27,3%
	Técnico de Saúde	9,1%	9,1%	18,2%
	Auxiliar de Limpeza		18,2%	18,2%
	Total	63,6%	36,4%	100,0%
Feminino	Médico	6,8%	3,4%	10,2%
	Enfermeiro	16,9%	22,0%	39,0%
	Técnico de Saúde	1,7%	10,2%	11,9%
	Auxiliar de Limpeza	11,9%	16,9%	28,8%
	Total	37,3%	62,7%	100,0%
Total	Médico	10,0%	4,3%	14,3%
	Enfermeiro	18,6%	18,6%	37,1%
	Técnico de Saúde	2,9%	10,0%	12,9%
	Auxiliar de Limpeza	10,0%	17,1%	27,1%
	Total	41,4%	58,6%	100,0%

This method allows us to see how a variable affects the outcome of another and in this case in particular, to understand how the errors in the MW operation are affected by the lack of training.

Table 4 – Correlation between drug rejected and a satisfactory knowledge

Fármacos (medicamentos) rejeitados		Conhecimentos Satisfatórios		Total
		Sim	Não	
Recipiente Preto	Médico	22,2%	22,2%	44,4%
	Enfermeiro		11,1%	11,1%
	Auxiliar de Limpeza	11,1%	33,3%	44,4%
	Total	33,3%	66,7%	100,0%
	Recipiente Branco	Médico	13,0%	4,3%
Enfermeiro		17,4%	26,1%	43,5%
Técnico de Saúde		4,3%	13,0%	17,4%
Auxiliar de Limpeza		8,7%	13,0%	21,7%
Total		43,5%	56,5%	100,0%
Recipiente Vermelho/Corto-perfurante	Médico	4,2%		4,2%
	Enfermeiro	37,5%	20,8%	58,3%
	Técnico de Saúde	4,2%	4,2%	8,3%
	Auxiliar de Limpeza	16,7%	4,2%	20,8%
	Total	62,5%	37,5%	100,0%
Não Sabe	Médico	7,1%		7,1%
	Enfermeiro		7,1%	7,1%
	Técnico de Saúde		21,4%	21,4%
	Auxiliar de Limpeza		35,7%	35,7%
	Total	7,1%	92,9%	100,0%
Total	Médico	10,0%	4,3%	14,3%
	Enfermeiro	18,6%	18,6%	37,1%
	Técnico de Saúde	2,9%	10,0%	12,9%
	Auxiliar de Limpeza	10,0%	17,1%	27,1%
	Total	41,4%	58,6%	100,0%

In the correlation between professionals who have training and correctly separating the rejected drugs (Table 4) we found that various professionals who thought that they had adequate knowledge about the MW, didn't answer correctly on the local deposition of rejected drugs.

Doctors are the ones that have a higher rate of wrong answers, with 42.3%. In other hand, nurses demonstrated again more knowledge in this subject. In the participants who admitted not having sufficient knowledge, 92.9% also assumes that they have no idea of the storage of rejected drugs.

Table 5 - Correlation between professionals who feels that a waste separation is made correct

Separação correcta dos resíduos		Possui Formação		Total
		Sim	Não	
Concordo	Médico	14,3%	11,4%	25,7%
	Enfermeiro	20,0%	5,7%	25,7%
	Técnico de Saúde	11,4%	2,9%	14,3%
	Auxiliar de Limpeza	8,6%	22,9%	31,4%
	Outro		2,9%	2,9%
Total		54,3%	45,7%	100,0%
Não concordo nem discordo	Médico		6,2%	6,2%
	Enfermeiro	31,2%	6,2%	37,5%
	Técnico de Saúde	6,2%	12,5%	18,8%
	Auxiliar de Limpeza	12,5%	6,2%	18,8%
	Outro		18,8%	18,8%
Total		50,0%	50,0%	100,0%
Discordo	Enfermeiro	42,1%	15,8%	57,9%
	Técnico de Saúde		5,3%	5,3%
	Auxiliar de Limpeza	15,8%	10,5%	26,3%
	Outro		10,5%	10,5%
Total		57,9%	42,1%	100,0%
Total	Médico	7,1%	7,1%	14,3%
	Enfermeiro	28,6%	8,6%	37,1%
	Técnico de Saúde	7,1%	5,7%	12,9%
	Auxiliar de Limpeza	11,4%	15,7%	27,1%
	Outro		8,6%	8,6%
Total		54,3%	45,7%	100,0%

In table 5, about 25% of doctors and nurses, considered that the wastes are properly separated in their workplaces. However, 58.9% of nurses, and professionals with more training, believe that this separation is inadequate. The healthcare cleaning professionals is the group with less training acquired, and is also the one who mostly agree with the separation of waste, constituting 31.4% of answers. We may conclude that since they have no training, do not have the same standards to evaluate this practice.

Table 6 - Correlation between the professionals who have training and consider waste separation a difficult task.

Separar resíduos é complicado?		Possui Formação		Total
		Sim	Não	
Concordo	Enfermeiro	66,7%	16,7%	83,3%
	Auxiliar de Limpeza		16,7%	16,7%
	Total	83,3%	16,7%	100,0%
Não concordo nem discordo	Médico	5,6%	5,6%	11,1%
	Enfermeiro	16,7%	11,1%	27,8%
	Técnico de Saúde		5,6%	5,6%
	Auxiliar de Limpeza	11,1%	22,2%	33,3%
	Outro		22,2%	22,2%
Total		33,3%	66,7%	100,0%
Discordo	Médico	8,7%	8,7%	17,4%
	Enfermeiro	28,3%	6,5%	34,8%
	Técnico de Saúde	10,9%	6,5%	17,4%
	Auxiliar de Limpeza	10,9%	15,2%	26,1%
	Outro		4,3%	4,3%
Total		58,7%	41,3%	100,0%
Total	Médico	7,1%	7,1%	14,3%
	Enfermeiro	28,6%	8,6%	37,1%
	Técnico de Saúde	7,1%	5,7%	12,9%
	Auxiliar de Limpeza	11,4%	15,7%	27,1%
	Outro		8,6%	8,6%
Total		54,3%	45,7%	100,0%

Of those who disagree that the separation task of MW is complicated, 58.7% have training (Tab 6). On the other hand, 16.7% of professionals with no training believe that is not complicated. This

percentage may be related to the fact that there are a large percentage of professionals who do not have training, and with that, they are not inform about the legislative standards and the risks associated with the separation of MW. Still, about 66.7% of trained nurses understand that separating the MW is a difficult task.

It was also examined the professionals perceptions about the health risk of the MW (Table 7). The red container/cut-drilling bags are those with higher health risk, since this risk includes biological, chemical and cut-drilling material.

From the data shown in Table 5, it appears that 61% of participants didn't attribute to the red bag and the cut-drilling container high risk. On the other hand, 35% of participating nurses have training and know that this container has a very high risk to health.

Table 7 - Correlation between the professionals who take health risk in the operation of the MW

Risco para a Saúde do Saco Vermelho/corto-perfurante		Possui formação?		Total
		Sim	Não	
Não Têm Risco	Técnico de Saúde	33,3%		33,3%
	Auxiliar de Limpeza		66,7%	66,7%
	Total	33,3%	66,7%	100,0%
Têm Risco Baixo	Médico	50,0%		50,0%
	Técnico de Saúde	50,0%		50,0%
	Total	100,0%		100,0%
Têm Risco Médio	Médico		14,3%	14,3%
	Enfermeiro	42,9%		42,9%
	Auxiliar de Limpeza	14,3%	14,3%	28,6%
	Outro		14,3%	14,3%
	Total	57,1%	42,9%	100,0%
Têm Risco Elevado	Médico	6,7%	13,3%	20,0%
	Enfermeiro	13,3%	13,3%	26,7%
	Técnico de Saúde	6,7%		6,7%
	Auxiliar de Limpeza	13,3%	13,3%	26,7%
	Outro		20,0%	20,0%
Total		40,0%	60,0%	100,0%
Têm Risco Muito Elevado	Médico	7,0%	4,7%	11,6%
	Enfermeiro	34,9%	9,3%	44,2%
	Técnico de Saúde	4,7%	9,3%	14,0%
	Auxiliar de Limpeza	11,6%	14,0%	25,6%
	Outro		4,7%	4,7%
Total		58,1%	41,9%	100,0%
Total	Médico	7,1%	7,1%	14,3%
	Enfermeiro	28,6%	8,6%	37,1%
	Técnico de Saúde	7,1%	5,7%	12,9%
	Auxiliar de Limpeza	11,4%	15,7%	27,1%
	Outro		8,6%	8,6%
Total		54,3%	45,7%	100,0%

About 7% of doctors assign very high risk to this kind of waste, and of these only 4.7% have specific training in MW. Although this is a minority, it is concern that a health professional assumes that has training on MW and considers that the group IV has no health risk. It is also concerning the fact that some professionals classify this waste as having no risk or having a low risk.

3.2 - Risk Matrix and Risk Control

The Risk Matrix, which was constructed based on extensive interviews to experts in the area,

includes the global and elemental risks in the Tables below (table 8 and 9).

Table 8 – Global Risks Matrix

Global risk	Characteristics	Specific Risk	Assignment Management	Risk Assessment			Classification
				P	C	GR	
Economic and Financer	inflation		Regional Government	6	4	24	High Risk
	Interest rate			3	4	12	Average Risk
	currency			2	2	4	Low Risk
Human	Culture			3	3	6	Low Risk
	ethnic			2	1	2	Minimal Risk
	Beliefs / values			2	1	2	Minimal Risk
	Risk Profile			3	2	6	Low Risk
Politic and legal	Governmental legislation	Licenses	Regional Government	2	2	4	Low Risk
Commercial	Price variation		Azormed	4	3	12	High Risk
	Payment Risk		Azormed	5	3	15	High Risk
Force Majeure	Natural Disasters	Contaminatio		2	4	8	Average Risk
	Wars			2	4	8	Average Risk

After the identification of the hazards and specific risks of the company, it is necessary to implement and verify the risk control measures. The Tables 9

and 10 describe the control measures and their effectiveness.

Table 9 - Elemental Risks Matrix

Element risk	Characteristics	Specific Risk	Assignment Management	Risk Assessment			Classification	
				P	C	GR		
Operation and maintenance	Production, Selection, Collection and Packaging	Lack of Personal Protection Equipment - PPE	Professional / Administrative Council	5	6	30	High Risk	
		Separation of group I and II of III and IV	Professional	4	3	12	High Risk	
		Differentiated circuits for collection	Administrative Council	3	3	9	Average Risk	
		Contamination	Professional	5	6	30	High Risk	
		Infection	Professional	5	6	30	High Risk	
		Inadequate cleaning of containers	Professional	3	3	9	Average Risk	
		Breach of the rules of use of containers		4	3	12	High Risk	
		Lack of information on the containers (date and group)	Professional/ Azormed	4	4	16	High Risk	
	Storage	Absence of specific storage location	Administrative Council	4	3	12	High Risk	
		access unconditioned		3	3	9	Average Risk	
		incorrect identification		3	2	6	Low Risk	
		No ventilation / cooling and lighting		3	2	6	Low Risk	
		Inadequate capacity to produce		3	3	9	Average Risk	
		Lack of signage		3	2	6	Low Risk	
		Walls and floors inadequate		3	2	6	Low Risk	
	Transport	Inappropriate transportation system	Group I & II	City hall	3	1	3	Minimal Risk
			Group III & IV	Azormed	3	3	9	Average Risk
	Treatment	Inappropriate sterilization	Group III & IV	Azormed	4	4	12	High Risk
	Final Destination	Incorrect deposition	Group III & IV	Azormed	3	3	9	Average Risk
	Management	Data Control	Lack of control data (weight, date)	Administrative Council	3	2	6	Low Risk
Lack of registration tabs and transportation			3		2	6	Low Risk	
No confirmation of data between the entity and Azormed			3		2	6	Low Risk	
Information		Lack of toxicological data sheets of chemicals used	Administrative Council	3	3	9	Average Risk	
Accidents		Do not Report Accidents with MW	Professional	5	5	25	High Risk	
Training		Absence of Annual Training	Administrative Council	4	5	20	High Risk	

Table 10 – Elemental Risk Control Measures.

	Risk	Control Measures	
Global Risks	Inflation	- As for inflation, it is not possible to implement measures that can prevent this risk; it is an external risk that always affects any market.	
	Price variation	- Implemented prices can be adjusted in the short and medium term contracts by limiting its variation. These contracts should be performed by professionals with legislature knowledge.	
	Payment Risk	- This risk is by commercial market, being only minimized through contracts and effective management and responsible.	
Elemental Risks	Lack of Personal Protection Equipment - PPE	- PPEs available to all employees who need, as well as easy access to storage of PPE	
	Separation of group I and II of III and IV	- Carry out awareness-raising and training of employees that separate MW	
	Contamination	- Implement strict measures for the disinfection and MW handling in order to avoid contamination - Perform strategic planning action in the event of contamination, so that it is controlled as quickly as possible	
	Infection	- Making strategic planning action in the event of infection, so that it is controlled as quickly as possible.	
	Breach of the rules of use of containers	-Carry out awareness raising and training of employees who deal with MW. - Appoint a responsible person to ensure that the rules of use are met	
	Lack of information on the containers (date & group)	- Appoint a responsible person to oversee and fill MW containers when positioned on the place of use.	
	Absence of specific storage location	- Gather information and define a storage location endowed with the necessary conditions to minimize the risks.	
	Inappropriate sterilization	-Improve control system	
	Do not Report Accidents with MW	-Appoint a responsible person to whom employees should report accidents and to clarify any existing doubt over a workplace accident.	
	Absence of Annual Training	- Request training to external companies or elect a n employee with skills that can disseminate and sensitize other colleagues periodically.	
	Average Risk		
		Differentiated circuits for collection	Along the management, entities implement a circuit that involves the lowest possible contact with employees, customers or consumers.
		Inadequate cleaning of containers	- Train healthcare cleaning professionals for proper cleaning and inform them of the risks associated with non-compliance.
		access unconditioned	- Restricting access to MW storage area only to trained people and aware of the dangers
		Inadequate capacity to produce	- Through the previous records, estimate the production of MW by the entity and request suitable and sufficient capacity for safe use.
		Inappropriate transportation system for group III & IV	Require that the entity providing services has a system of adequate transportation and insurance that does not endanger workers.
		Lack of toxicological data sheets of chemicals used	- Provide and expose in an accessible place to all employees the safety data sheets of raw material used.
	Low Risk		
		incorrect identification	- Request IDs for all storage locations of MW.
		No ventilation / cooling and lighting	- Provide storage spaces with fans / coolers and lighting appropriate for the proper packaging of MW.
		Lack of signage	-Flag all containers and areas subject to contact with MW.
		Walls and floors inadequate	-Equip the storage spaces with walls and floors easy to clean.
		Lack of control data (weight, date)	-Appoint a responsible person to conduct data collection and record methodically all the data needed for effective management.
	Lack of registration tabs and transportation	- Request to the managing entity transportation guides. - To designate a responsible person who takes control of the transposition guides.	
	No confirmation of data between the entity and Azormed	- Request periodically data to Azormed	
Minimal Risk			
	Inappropriate transportation system for group I & II	- Require that the entity providing services has a system of adequate transportation and insurance that does not endanger workers.	

4- Conclusion

This research was based on a wide bibliographic research and applied to the case study of the in MW risk management in Ilha do Pico-Azores.

The main problems are related to lack of legal standards for medical separation of solid waste and especially with the lack of educational in MW management in healthcare. As described throughout this research, MW management is of great importance due to their potential environmental hazards and public health risks, especially in developing countries, where the financial and technological resources on MW management are still missing. During the current study it was found that a high percentage of professionals responsible for cleaning and collecting MW do not have any training or awareness about this subject. These human resources have often minimal education and knowledge that limited the information in this area. Healthcare cleaning professionals are those with lower education, and consequently those who commit more errors in the separation of MW. Although the healthcare cleaning professionals are not responsible for any screening, they have the right and obligation to be aware of the risks that they are subject when making the packaging and transportation of these wastes. These professionals are also responsible for cleaning and disinfecting the containers, so they are exposed to several risks.

It was also found that the physical therapists, firefighters and pharmacists (included under "other") are professionals who have less knowledge about MW. This professional groups have daily direct contact with MW, so it is extremely important that the concepts on this topic are updated and consolidated. In other hand, nurses are those, which, in general, have more knowledge and are more able to deal with MW. However, although nurses are more often exposed to this type of waste, it was found that there are always some doubts linked to the existence of a wide variety of MW. Doctors (veterinarians, dentists and general practitioners), that represent 15% of the sample in this study, have shown uncertainties regarding the screening of MW. The construction of the risk matrix summarizes the set of risks associated with the life cycle of MW and allowed to identify and classify risks, their impact and attribution to the manage entity. MW in Ilha do Pico has some flaws, and there are still no fully effective environmental measures. These residues are largely handled by workers with low education

without sufficient quality control. In many entities, the MW are placed in municipal landfills. Therefore, environmental pollution, due to the dump of MW in municipal solid waste landfills, illegal segregation, lack of recycling and transmission of infectious diseases can be a great concern to Ilha do Pico.

This case study of Pico demonstrates that despite significant advances have been implemented in MW management; there are still many adversities, including the implementation of ineffective and inefficient regulations and legislation, fragmented institutional efforts, lack of awareness and training and insufficient financial resources. It should be developed and implemented an integrated framework to improve MW risk management in in Ilha do Pico-Azores.

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