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Waste Management in Health Services: The Case of Animal's Vivarium in Fiocruz - Brazil

Patricia Wigg Abirached*, Maria Cristina Troncoso Ribeiro Pessoas*, Marcelo Jasmim Meirino**, Osvaldo L.G. Quelhas**, Leonardo Bezerra Pimentel**

* Oswaldo Cruz Foundation - FIOCRUZ, Brazil
** School of Engineering, Fluminense Federal University, Brazil.

Email: patwigg@gmail.com, marcelo@latec.uff.br, quelhas@latec.uff.br, leonardo@latec.uff.br

Abstract

The use of laboratory animals in experiments is relevant to the evolution of science. This fact, along with the development of new technologies and cultural ethical values, places the Bioterium under specific laws and regulations, which aim, among other things, the operationalization, biosafety, sustainability, quality and the animal health. It is known that the development of new processes and the design of new facilities are based on current standards, however, the existing facilities are now obsolete and their renovation are more complex. The absence of sanitary barriers is a major factor of contamination in older buildings that perform these functions. This fact can be represented by the cross-flow of materials, people and waste and by mishandling of equipment and instruments. However, reprogramming the flows, correct disposal of infectious waste, controlled manipulation and small specific interventions can minimize these consequences. Thus, the focus of this research is the analysis of flows of an existing vivarium in order to generate guidelines for implementation of a Waste Management Program site, with emphasis on Architecture Environmental sustainability and Biosafety. In this research, we used the following instruments: specific environmental and operational analysis; questionnaires answers by users, specialists and coordinators, interviews, photographic survey, architecture and urbanism plans; legislation; existing waste management plans; bibliographic research, among others. With a completed diagnosis, a strategic blueprint was drawn showing the solutions of the deviations found in workflows, as well as an assessment of the results.

Keywords: Waste. Biosecurity. Sustainability. Health. Bioterium.

1 Introduction

1.1 Initial Considerations

In recognition of the urgent need to change the current environmental reality, coupled with the objective responsibility of the users and, primarily, an awareness of sustainability and biosafety, Healthcare Waste Management Programs (HWMP) are being implemented in various facilities throughout the country and the world.

Waste, produced in all stages of human activity, varies both in terms of composition and volume, according to consumption practices and production methods. It is the result of the processes of various activities performed by the community of origin: industrial, household, medical, commercial, agricultural, service related and are found in solid, gaseous and liquid states.

Thus, such waste, whose composition varies according to its biological, physical and chemical properties, must be appropriately handled in a technological and sanitary manner, which is not only essential for maintaining environmental quality, but for the health of the professionals that work in areas that generate said waste.

The main concerns are focused on the impacts that waste can have on the health of humans and the environment, such as the contamination of man, water, soil, the atmosphere and the proliferation of

vectors. Hazardous waste produced, generally by the healthcare industry, is particularly worrying, since when it is improperly managed, it becomes a serious threat to the environment and the individuals that handle it. This waste often comes from hospitals, medical clinics, laboratories and other large generators, and tends to be titled "medical waste"; however, waste of a similar nature is produced by extremely varied generators, including pharmacies, dental and veterinary clinics, home care, morgues, institutions for elderly care, blood banks, laboratory and research clinics, educational institutions in the area of healthcare, among others.

1.2 Problem Situation Formulation

According to ANVISA – National Sanitary Surveillance Agency (2006), 149,000 tons of residential and commercial waste is generated. Furthermore, due to the poor conditions of the waste management system, there are no precise statistics regarding the number of generators, nor the quantity of Healthcare Wastes (HCW) generated daily, but it is believed that HCW represent less than 2% of the total, of which 10% to 25% require special care.

According to data from the National Research on Basic Sanitation, conducted by the BIGS – Brazilian Institute of Geography and Statistics, in 2000, 74% of Brazilian cities deposit healthcare waste in the open air, 57% separate the medical waste and only 14% appropriately deal with healthcare waste.

While new processes and systems have been designed to comply with the standards of Biosafety and Waste Management, the attempt to adapt establishments and the existing spatially obsolete work processes is met with many obstacles, including the fact that Brazil currently has few professionals specialized in this area, who can not only follow the standards and manuals, but also monitor their implementation in accordance with relevant legislation.

In this context, this work describes the issue in order to gather a series of technical and historical information, by reviewing recent literature, that is capable of enabling the development of objectives and the proposal of methods to be applied that comply with the requirements of the establishment in question and serve as a guideline for any other establishment similar in size.

1.3 Research Objectives and Delimitations

This study's general objective is to identify spatial and operational guidelines for the implementation of a Waste Management Program in the Laboratory Animal Breeding Bioterium in a sustainable manner, with an emphasis on Architecture and Biosafety.

This research encompasses the analysis of waste, people, and material flow, architectural solutions, and final disposal, of the Rodents and Lagomorphs Breeding Service, in compliance with the emergency requirements and important guidelines for implementing a Healthcare Waste Management Program guided by the principles of biosafety, contamination risks and animal well-being. As a matter of confidentiality, the name and location of the Institution studied could not be disclosed.

2 Review of Literature

2.1 Healthcare Waste

Because they are more specific and have a higher degree of danger, wastes from healthcare activities receive more targeted care and cannot always be reused.

According to RDC ANVISA No. 306/04 and CONAMA Resolution No. 358/2005, the following are defined as HCW generators: all services related to human or animal healthcare, including home care and fieldwork services; analytical laboratories for health products; morgues; funeral homes and services where embalming takes place, forensic medicine services, drug stores and pharmacies including handling; teaching and research establishments in the healthcare area, zoonoses control centers; pharmaceutical

product distributors, importers, distributors and producers of materials and controls for in vitro diagnostics, mobile healthcare service units; acupuncture services, tattooing, among other related activities.

- Classification

According to RDC ANVISA No. 306/04, healthcare wastes are classified as:

Group A – Biological: Waste with the possible presence of biological agents that, given its characteristics, may pose a risk of infection.

Group B – Chemical: Waste containing chemical substances that may pose a risk to human or environmental health, depending on its characteristics of flammability, corrosivity, reactivity and toxicity.

Group C – Radioactive: Any material resulting from human activity that contains radionuclides in quantities greater than the exemption limits specified in the standards of the National Nuclear Energy Commission – CNEN and for which reuse is inappropriate or unanticipated.

Group D – Common Waste: All other wastes not included in the groups above. All of the wastes from groups A, B and C become part of this group if they have undergone preliminary treatment and have had their hazardous characteristics eliminated or minimized to the exemption limits established, no longer presenting biological, chemical or radiological health or environmental risks, and may be treated as household waste.

Group E – Sharp Objects: Must be separately discarded in the location where they are generated, in duly identified compatible packaging receptacles resistant to breakage and leakage, and with a cover.

2.2 Solid Waste

Over time, several authors have emerged with the intention of designating what is “trash”, the “rest” or, for today’s society, everything resulting from some human activity that no longer serves its original functions, but can be recycled. Thus, the following are some definitions relevant to understanding this theme.

According to Ferreira (1988), in everyday language, the term “trash” is usually used to describe everything that is no longer useful, whereas “waste” is more often used to describe the remains (scraps) from processing manufactured products.

According to the Portuguese Language Dictionary, trash is that which is removed from the house, the garden, the street, and thrown away; useless, old, worthless things. Waste is that which remains of any substance; the remainder.

CONAMA Resolution No. 05/1993 defines solid waste as: waste in a solid or semi-solid state that is the result of industrial, household, medical, commercial, and agricultural activities and sweeping services. Included in this definition is the sludge from water treatment systems, sludge generated in equipment and facilities for pollution control, as well as certain liquids whose characteristics make it impossible for them to be released into the public sewage system or bodies of water, or that require technically and economically unviable solutions when confronted with the best available technology.

2.3 Sanitary Quality

Currently, the criteria in scientific research require animals with known sanitary standards, which have contributed to national institutions investing in the improvement of their bioteriums. Microbiological standardization has decreased the number of animals used by reducing the variations within and between test groups, therefore contributing to the well-being and health of laboratory animals, reducing risks to human health due to zoonoses. (FELASA, 1999).

The common practice of introducing new animals in bioteriums for research can cause, when standard health tests are not effective, certain types of epidemic diseases capable of generating significant loss of time, data and finances. Thus, for a bioterium to function ideally, evaluating the sanitary quality becomes essential. This evaluation begins with defining the microbiological standard and the animal’s parasite.

Ideally, the breeding bioteriums' facilities should have sanitary barriers and health surveillance programs verifying that their colonies are free of specific pathogens and which microorganisms are monitored.

2.4 Bioethics and animal welfare

The proposal of modernity, research and technological evolution should be linked to the real contribution and benefits for the industry, medicine, agriculture, preservation of the environment and, ultimately, preservation of all segments. However, when it comes to something groundbreaking, questions arise with regard to the advantages stated.

Ethics is the science of morals and has to do with right and wrong; it is a cultural attitude, a critique of the relevant values and positions at the time of action. "The conflicts between the attempts to resolve vitally important situations and the ethical principles of respect for life, the abstinence from inflicting pain and suffering, give rise to an ethical issue of using animals for experimentation". (RIVERA, 2006).

In turn, ethics summons man to use all the resources and products available, in such a manner as to promote integral development for the benefit of all. Therefore, when discussing matters regarding biomedical research, one must not forget moral and ethical values, because Science and Technological Progress should be developed with the well-being of society and the preservation of biodiversity in mind. Finally, we must have the perception that technology unleashes creative powers, but also destructive powers. (PESSOA, 2006)

Ethics and social responsibility possess concepts that are intertwined. Social responsibility does not exist without ethics being present in all fields of action, such that an ethical attitude cannot abstain from respect for the environment, human relationships, animal welfare and the impact that any action can have on society.

In this regard, Angeli (2003, p.21) believes that "man can use nature's resources, but in the least aggressive manner possible". And, that "man must stop being a subject to the Queen of pollution and destruction, (...)". Thus, scientific work must be produced in a manner aiming for biosafety and biosecurity, through good practices, equipment introduction, and the construction of safe physical facilities so that the use of animals benefits society and healing, yet in a rational and conscious manner.

The animals most used in Bioteriums, such as guinea pigs, rats, mice and rabbits, are animals capable of suffering and feeling pain, fear and stress. Therefore, it is essential to have an ethical stance that does not allow for the disrespect of these animals. There must be a concern for their well-being, and an attempt to avoid unnecessary stress and minimize the suffering that we may cause them.

The humanitarian principle of animal experimentation consists of:

a. Replacement: Indicates the replacement of animals with materials lacking sensation, such as tissue cultures and/or computer models;

b. Reduction: Use the smallest possible number of animals;

c. Refinement: Indicates the use of less invasive materials and techniques.

Therefore, decisions must have clear limits in accordance with the appropriate scientific information, so that man may exploit natural resources without causing negative impacts on our planet. First, one must understand the advantages, the potential risks, the challenges and the impacts on the well-being, the human rights and the survival of mankind.

Animal research, conducted in an ethical and responsible manner, always provides hope for the development of new methods of prevention, treatment, cures and control of disease, suffering and pain (ACLAM, 2004).

2.5 Biosafety

Biosafety aims at minimizing risk. Corroborating this premise, Teixeira & Valle (2003) conceptualize biosafety as a set of actions focused on prevention, minimization and elimination of the risks inherent to research, production, teaching, technological development and service rendering activities, targeting the health of humans, animals, environmental preservation and quality results.

The law that deals with biosafety in Brazil is Law No. 11.105, of 24 March 2005, which creates the National Biosafety Council (CNBS) and restructures the National Technical Biosafety Commission (CTNBio). It establishes safety standards and mechanisms for monitoring the construction, cultivation, production, handling, transport, transference, importation, exportation, storing, research, commercialization, consumption, release into the environment and the disposal of Genetically Modified Organisms (GMOs), aiming to protect the life and health of humans, animals, plants, and the environment.

Classifying the level of biosafety in animal testing and breeding laboratories is guided by several factors. Among them is the pathogenicity of the infected microorganisms, virulence, route of infection, endemicity, epidemiological consequences, the availability of effective treatment and prophylactic measures. "The levels are assigned in ascending order, by the degree of protection provided for the laboratory personnel, the environment and the community". (BRASIL, 2001)

2.6 Breeding Bioteriums

In general, within bioteriums there are chemical, physical and biological risks present. In these cases, it is important to take a precautionary approach in guiding preventative actions with regard to heath and the environment. This helps to minimize exposure of the work team, the animals and the environment to the potentially hazardous agents. Emphasis is placed on biological agents, because they are most commonly present in bioteriums, namely: fungi, bacteria, viruses, parasites, protozoa, insects and any other form of "life".

Bioterium facilities, according to Cardoso (2001), are capable of producing and maintaining animal species intended for serving as biological reagents in different types of controlled trials. However, its purity must be ensured and monitoring must occur within the bioterium in order to provide uniform reactions that enable the repeatability and reproducibility of experimental results.

Also according to Cardoso (2001), both the bred animals that will be used as reactive, and the infected animals require a permanent monitoring of the environment, hygiene, prophylaxis, epidemiology, nutrition and genetics. This demonstrates a strict operational discipline. It also means that there should be a counterpart, in spatial and constructive terms, that responds to this functional organization.

However, each situation is specific, and the design should be established in accordance with the production plan or the use of animals in accordance with the purpose of the institution. We must establish requirements regarding the functional organization, spatial and constructive, necessary for the implementation of an animal breeding or testing laboratory that complies with the standards of hygiene, asepsis and safety, which is necessary for obtaining or using the different animal species according to their sanitary standard.

3 Methodology

For this approach, we used the methodology of case study.

According to Ludke and André (1986), case study is the study of a case, whether it is simple and specific or complex and abstract. The case is always well defined, and should develop clearly defined outlines during the study. The case may be similar to others, but must be distinct, with its own interest, unique.

The case study of this research is the Laboratory Animal Breeding Bioterium of FIOCRUZ, where data were collected on the geographical location, accessibility and priority needs to support good practices of Architecture and Biosafety.

The following instruments were applied on this case study:

• Questionnaires: Development of specific questionnaires for users, experts and coordinators according to their different activities and different interpretations of priorities needs for the Bioterium.

• Architecture and Urbanism Plants: Analysis of the plans with the aim of to check the status of accessibility to the facilities.

• Existing Legislation: Identification and analysis of legislation related to Architecture and biosafety with the aim of identifying the need for legal compliance of the Bioterium.

• Plans for the management of existing waste: Identification of waste management practices used in order to propose opportunities for improvement.

• Bibliographic research: Research in the areas of Healthcare Waste, Solid Waste, Sanitary Quality, Bioethics and animal welfare, Breeding and Biosafety Bioteriums.

• Field of Research: Developed after the literature research, with the aim of increasing knowledge of the author about the case study, through interviews with experts and observation of facilities conditions and activities in the Bioterium (analysis of waste streams, people and materials, architectural solutions and waste disposal).

4 Case Study

The Laboratory Animal Breeding Bioterium studied aims at breeding, raising and maintaining laboratory animals under conventional conditions, free of specific pathogenic germs. These animals are used in research, production, and quality control programs and training developed internally and externally. It also develops activities for monitoring the genetic and sanitary quality of animals, enables internal and external human resources in the bioterium area, offers training and consulting, and develops genetic engineering and molecular biology techniques to create animals suited to research purposes.

Currently, despite having received small physical and operational interventions, Bioteriums are obsolete before the new legislation, new equipment and new knowledge.

Thus, it becomes important to develop a more detailed study and to recognize the points that need improvement in order to control the quality of animals, since the facilities influence the results. Applying the principle of containment harmonizes three elements, namely: the protection equipment, the physical facilities and the professionals' behavior.

4.1 Biosafety

The laboratory is classified as Animal Biosafety Level 2 (ABL-2), since some of the obligatory and recommended requirements provided for by law are not met, such as:

a) Signs with biohazard symbol: both the entrance door of the bioterium and the animal room doors do not have signs.

b) Wash basin for hands near the animal room entrance/exit: there are no wash basins in the access corridors to the rooms and the existing ones were removed.

c) Animal room entrance and exit doors with interlocking: this was turned off in several locations.

d) Walls, doors, ceilings and floors impermeable and resistant to infection: the deterioration of the coating is more evident in areas for cage washing and those that require greater aseptic conditions.

Furthermore, the materials handled in these environments and the waste generated emit a very unpleasant odor, capable of interfering with the work routine of the professionals and compromising the health of those who work for 8 hours straight in these conditions. Added to this, most of these professionals work under the intense heat generated by the processes and equipment in the washing and sterilization areas, further decreasing the quality of their performance and the incentive to use PPEs, demonstrating the clear need to increase the exhaust fan and ventilation systems throughout the bioterium.

4.2 Flows

Although this construction has a nearly ideal physical structure, a series of non-conformities, resulting from improper operation generating cross flow, can be found.

It was possible to identify that the circulation area that should receive employees, materials and wastes from the animal rooms and bring them to the exit is blocked, forcing the entrance and exit flows to cross, leading to possible contamination and compromising the hygienic condition of the animals.

4.3 Waste

According to the CONAMA resolutions, all establishments that generate Healthcare Waste are required to have a Healthcare Waste Management Plan – PGRSS.

There are three destinations for waste generated. Common waste is separated and the recyclable material goes into containers in the building's inner area, and the rest is taken to external storage. Biological waste is removed from the animal rooms with the materials used. The two are separated in the washing room, disposed into containers and taken to external storage. The carcasses are chemically treated, packaged and kept in the freezer until collection. The chemical and sharp wastes are collected in special receptacles and taken to external storage. Below are tables 8 through 13, with the wastes generated for each animal species bred in the bioterium and its general classification.

4.4 Bred Animals

The animals bred in the Bioterium studied are small in size, including guinea pigs, mice, hamsters and lagomorphs (rabbits). The sanitary standards for animals in this laboratory, according to MAJERWICZ (2003), are:

a) "Conventional" animals, bred in bioteriums that do not have appropriate sanitary barriers for preventing the introduction of microorganisms, therefore having an unknown microbiota. They are usually bred in open cages and under conditions of open access to the animal room, and are therefore always subject to new infections (COBEA, 1996);

b) Specific Pathogen Free Animals (SPF) are free of the defined pathogenic organisms that cause clinical or subclinical diseases, or even potentially pathogenic to a certain animal species. This health standard depends on an individual list of microorganism exclusion (Górska 2000). The SPF animals are kept in bioteriums with efficient sanitary barriers or are housed in facilities that guarantee their microbiological standard. Its microbiota is controlled, so that it houses only agents that are non-pathogenic to the species (COBEA 1996). The microbiota is unknown, so the undesirable pathogenic microorganisms must not be detected during testing (Górska 2000).

4.5 Analysis of Results

The Breeding Bioterium requires that the animals remain within the quality standards related to sanitary conditions. It is necessary to remember that this standard is not only linked to the origin of the animal, but it is affected by its management and the environment in which it is kept.

In order to maintain the sanitary conditions recommended in the research, it is necessary that the environment has barriers that assist in controlling the risk agents. Thus, it is recommended that there be a separation between the clean flows and those that pose potential contamination risks, in cases where there

is sufficient physical space. This facilitates handling. It is important to intervene in order to maintain a balance between the containment elements, such as: the conduct, the physical areas and the collective safety equipment.

In this sense, the case study verified that the flows led to a routine crossing of waste, clean material, equipment, people and animals. To improve the work procedure, changes in the direction of flow were suggested and some layout modifications were developed.

To resolve some of these inadequacies, it is suggested that a unidirectional flow be implemented to provide procedures where there is no way for the work flow to travel back. Thus, it promotes procedures without resulting in counter-flows, proposing demarcated sectoring in order to provide for better control of environmental quality. This intervention demonstrates that good work practices, provided for through a waste management program, bring benefits to all working groups, primarily in the sanitary conditions of animal breeding.

5 Conclusion

For the proper functioning of a bioterium, there is a range of issues to be raised, discussed and solved, a collection of risks which go unseen without the aid of qualitative evaluations and special lenses, and relevant ethical and cultural debates capable of promoting the creation of laws and standards that serve to guide these and similar ideals. This whole carrousel is only capable of turning if it has a central axis and harmony between the processes, conduct, building facilities, and prevention.

Taking from all the aforementioned information, one could say that with awareness, necessary training, identification of waste minimization practices, the participation and involvement of the establishment's employees, social responsibility, updated equipment and practices, the creation of a manual for good practices for waste management and bioteriums, implementation of internal auditing and monitoring procedures and the improvement of work safety and hygiene measures, the results will rarely be satisfactory.

Thus, one can conclude from a conceptual basis and the practices demonstrated that this work can serve as a starting point for the development of new research, not just for the animal breeding bioterium in question, but also for all those with the objective of starting a Healthcare Waste Management Program tied to Risk Management in their place of work.

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