

# Waste diagnosis in public dental facilities in Recôncavo Baiano county: contributions to integrated waste management

## Diagnóstico de resíduos em instalações dentárias públicas em um município do Recôncavo Baiano: contribuições para o gerenciamento integrado de resíduos

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### Abstract

Health Care Service Waste (HSW) plays an important role in public health due to its intrinsic hazards, the presence of pathogenic organisms, and the heterogeneity of its composition. Since the incorrect disposal of HSW can cause serious damage to society and to the environment, waste management should be implemented from the moment residues are generated until their final disposal. Thus, the aim of this study was to evaluate the management process of dental waste in Family Health Units (FHUs) of a city in Recôncavo Baiano county in Bahia, Brazil. Data collection was performed by means of direct observation, pictures and written descriptions of the management process, and included a structured questionnaire answered by the dentists working in the units. Our results show that the FHUs analyzed in this study did not comply with the prescribed legal standards when dealing with dental waste. Thus, a Health Care Service Waste Managing Program needs to be implemented.

**Keywords:** Medical Waste. Waste Management. Occupational hazard.

### Resumo

Os Resíduos de Serviços de Saúde (RSS) possuem um papel de destaque no cenário da saúde pública, devido a sua periculosidade intrínseca, presença de organismos patogênicos e a heterogeneidade de sua composição. Na medida em que a sociedade e os profissionais tomam consciência de que o destino inadequado dos RSS, causam sérios danos à sociedade e ao meio ambiente, é necessária a implantação de uma gestão de resíduos. Desta maneira, esse estudo teve como objetivo avaliar o processo de gerenciamento dos resíduos odontológicos nas Unidades de Saúde da Família (USF) de um município do Recôncavo Baiano. Para tanto, realizou-se observações no local de estudo referente ao processo de gerenciamento, sendo realizado registro escrito e fotográfico e a aplicação de um formulário estruturado para os cirurgiões-dentistas das USF. Constatou-se que nas USF estudadas não são cumpridas as normas legais quanto ao manejo dos resíduos odontológicos sendo necessária a implantação de um Plano de Gerenciamento de Resíduos dos Serviços de Saúde.

**Palavras-chave:** Resíduos de Serviços de Saúde. Gerenciamento de Resíduos. Risco ocupacional.

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## INTRODUCTION

High consumption rates and waste production are among the most serious environmental problems faced by modern societies. Expansion and densification of urban centers worsen the problem, while sanitary infrastructure cannot keep pace with the accelerated growth rhythm<sup>1</sup>.

Urban sustainability is a set of priorities that includes improvement of environmental conditions, prevention of degradation, and actions that contribute to the selective collection of recyclable waste and their final disposal<sup>2</sup>.

Health Care Service Waste products (HSWs) are the result of medical, dental, laboratorial, pharmaceutical as well as educational activities that deal with human and animal health. Due to their characteristics, this type of waste requires specific processes in terms of management, treatment and final disposal. They are classified in five groups: A, B, C, D, and E<sup>3</sup>.

Group A, which is subdivided into five groups (A1, A2, A3, A4, and A5), comprises waste that might contain biological and contaminated agents, which, due to their concentration or virulence, could cause infections.

The waste in Group B can pose public health and environmental risks depending on the flammability, corrosivity, reactivity, and toxicity of their components.

Group C waste includes any materials resulting from human activities that contain a higher quantity of radionuclides than the elimination limits specified by the National Nuclear Energy Commission (CNEN).

Group D comprises common waste that do not pose any biological, chemical or radiological risks to human health or the environment, as long as they are segregated and disposed of in 24 hours to avoid organic matter putrefaction which is considered a biological risk.

Group E includes sharp objects (sharps) such as razor blades, needles, glass ampoules, diamond tips, scalpel blades, lancets, spatulas, etc.

Although HSWs represent 1% of total solid wastes, they are a potential source of pathologies and represent a risk for the personnel working in health centers as well as for the whole community. Thus, the need for the appropriate

management of these residues<sup>4</sup>.

Health Family Units (HFUs) are public institutions for health promotion and protection that aim to improve quality of life. Dental care was added to the Family Health Program (FHP) in 2000, and resulted in the reorganization and restructuring of dental health procedures<sup>5</sup>.

Despite the improvement in integrated waste management, there is still a huge distance between theory (resolutions, norms and laws) and practice. Consequently, the aim of this study is to assess the management process of dental waste in FHUs located in Reconcavo baiano county.

## MATERIAL AND METHODS

This research, which covered the dental facilities of seven FHUs located in urban and rural areas of a Recôncavo baiano county, adopted an exploratory methodology within a qualitative approach. The subjects of this study were the dentists working at the above mentioned FHUs. Inclusion criteria were being employed by the municipal government, working as a dentist in a FHU, agreeing to taking part in the study, and signing the Informed Consent Form (ICF).

Data were obtained by direct and systematic observations during prescheduled visits, and by identification and recording (written and photographic) of types of waste and their management. Dentists were also asked to answer a structured questionnaire about waste management steps in the FHU they worked at.

The study was approved by the Maria Milza College Research Ethics Committee (REC - FAMAM nº 1.024.683) in accordance with the guidelines and standards regulating research involving human beings (Resolution 466/12 of the National Health Council).

## RESULTS

Dental care was identified as a critical area in the FHUs due to potential infection risks. This identification is important for waste management planning and will directly affect the collection flow of different waste categories.

Due to the diversity of procedures, dental

care facilities generate different types of HSWs that require appropriate handling. Ferreira and Silva<sup>6</sup> explain that although dental offices produce a small amount of waste, it poses the same risk as the waste generated in hospitals.

The dental waste generated in the FHUs under investigation were classified in groups in accordance with ANVISA (Board of Directors Resolution n°306/2004)<sup>3</sup> and CONAMA (Resolution n°358/2005)<sup>7</sup>, and are listed below:

Group A waste was found in the offices where patients were treated. Professionals who handle these materials should be aware of their hazard in order to avoid individual or environmental contamination. Group B waste found in the dentists' offices included drugs and disinfectants that also require specific handling. Group C comprises radioactive waste which was not generated in the FHUs under study. Group D waste was found in the same areas that generate dental residues, but since they do not pose any risks, they must be managed according to the norms of the environmental authority

responsible for urban waste collection<sup>8</sup>.

Regarding sharp objects (Group E), they are generally found together with group A waste in the offices where patients are treated (Figure 1).

After the identification of waste types, a diagnosis of the critical dental waste management issues was made, and all the procedures from segregation to final disposal were listed.

#### ***Analysis of the dental waste segregation procedures in FHUS***

In the FHUs under investigation, the infectious waste (group A) was disposed of in inappropriate containers without identification, and was stored and transported in plastic bags together with the common waste (group D) as shown in Figure 1a and 1b. The dentists' answers in the questionnaire confirmed this information.

As confirmed by direct observation, chemical waste (group B) and sharps (group E) were disposed of in individual containers.

SOURCE	GROUPS
Dental office and cleaning room	<b>GROUP A</b>
	Cotton/gauze with blood and/or saliva, suction device, gloves, disposable masks, caps, extracted dental elements, used anesthetic tubes, surgical thread without needle, teeth, tartar, secretions (pus, blood), paper bibs.
	<b>GROUP B</b>
	Image processing effluents (developers and fixers), mercury, drugs, disinfectants, x-ray film.
	<b>GROUP E</b>
	Endodontic file, drills, needles, broken glass utensils (dappen pot, glass plate), diamond tips, scalpel blades, x-ray film lead protection.
<b>GROUP D</b>	
Dental Office, Cleaning and Sterilization room	Administrative area wastes such as paper, plastic, glass, metal and others.

Source: Data collected by the author

**Figure 1** – Dental waste identified in FHUs and classified according to the group they belong to. Data obtained between January and April 2015 in the city of Governador Mangabeira, Bahia, Brazil.

### ***Analysis of dental waste conditioning and identification procedures in FHUS***

GROUP A (biological waste) - According to our observations, there was no appropriate conditioning of group A dental waste in the FHUs. Black plastic bags were used for the disposal of infectious as well as common waste. In the dental offices there was just one wastebasket for all types of waste, without identification, which renders segregation impossible.

No containers of standard size or material were found, and this fact goes against biosafety rules. The interviewed dentists said that biological waste was disposed of in blue or black plastic bags, depending on their availability in the FHUs. When asked about waste segregation, all the dentists stated that the FHU does not segregate nor identify the waste at its generating source, and that everything is thrown in the wastebaskets together with the common waste (Figure 2a and 2b). According to the dentists' responses, due to the lack of white bags, infectious waste is disposed of together with common waste which is, thus, unnecessarily contaminated. When asked about the waste symbols, one dentist identified the chemical waste correctly, three individuals the biological and radioactive waste, and all the interviewed professionals recognized the sharps symbol.

GROUP B (chemical waste) - Amalgam waste was stored in a resistant plastic container without identification in only one of the FHU studied. In the other six FHUs, this type of waste was disposed of in glass containers with water and without identification. When asked, all the dentists replied they stored amalgam waste in containers with water.

The questionnaires answered by the dentists indicate that no FHU sends the mercury waste for recycling, as recommended in the ANVISA<sup>8</sup> management handbook. Regarding radiographic materials, just one of the seven FHUs under study has an X-ray set and is responsible for all the radiographic exams required by the dentists working in the other 6 FHUs of the county. Thus, it is this unit that accumulates all the generated radiographic waste. The radiographic effluents produced

in the above mentioned FHU are disposed of in containers without identification, are kept in an inappropriate location and are mixed with other materials. This behavior increases the risk of contamination in case of incorrect handling or delay in waste collection.

Radiographic film requires individualized disposal, for they contain lead sheets. In the FHUs under investigation, the films were disposed of in inappropriate containers with incorrect identification, placed in unsuitable places, and mixed with other materials. According to the questionnaires, only one dentist reported disposing of films in plastic containers, but without identification. The other professionals did not perform this procedure in the FHU they worked at.

GROUP C (radioactive waste) - No dental waste of this group was found in the FHUs under investigation.

GROUP D (common waste) - As already mentioned, common waste management in the FHUs did not comply with RDC n<sup>o</sup> 306/2004, since they are disposed of together with the biological waste in inappropriate containers and without identification (Figures 1a and 1b).

GROUP E (sharps) - we observed that in all FHUs the dentists stored sharps in rigid containers (cardboard boxes) identified with the biohazard symbol (Figure 1c). However, they lacked the original internal bag increasing the risk of workplace accidents during internal and external transport.

### ***Analysis of the dental waste internal transport and storage procedures in FHUs***

Waste collection occurred in the FHUs once a day after patient care. Internal transport was performed manually without assistance of any collection device, and the staff responsible for this procedure did not wear any personal protection equipment (PPE)

Waste storage does not comply with the law in force because it is not protected from strangers and animals that can spread microorganisms (Figure 2d and 2e).

Colored or labeled wastebaskets to identify the type of waste they contain were not found in any FHU. This information was confirmed by the dentists in their questionnaires.

As most of the waste was stored in black plastic bags and stored together outside the building for final disposal, we can conclude not only that there is no segregation, storing or identification, but also that all the generated waste will have the same destination. Instead of following these procedures, the FHUs under study mixed HSW with urban solid waste. In addition, the external storage facilities did not comply with the ABNT standards in force.

#### ANALYSIS OF THE DENTAL WASTE TREATMENT PROCEDURES IN FHUS

No generated waste treatment was observed in any of the FHUs under investigation. As reported by the dentists in their questionnaires, they do not know if there is any waste treatment after the removal from the dental office. No treatment was performed by the dentists themselves during waste generation.

#### *Analysis of external collection and transport*

#### *procedures of dental waste in FHUs*

According to the dentists' statements, the local government is responsible for the common waste external transport to their final disposal site. However, during our assessment period, public cleaning services were not observed.

In terms of biological waste external transport, the professionals interviewed affirmed that although the county has specific transport, selective collection is not assiduous.

#### *Analysis of dental waste final disposal procedures in FHUs*

Regarding final waste disposal, during our visits we observed waste accumulation in the external areas and absence of a removal routine which increase the risk of contamination. The dentists did not know the location of the final disposal site of waste generated at the FHUs.



Source: Data collected by the author

**Figure 2** – FHU Dental Waste. a-b. Group A waste; c. Sharps container. d-e. External storage facility. Data obtained between January and April 2015 in the city of Governador Mangabeira, Bahia, Brazil.

## DISCUSSION

It was observed that dental services are a potential source of contamination and, according to Batista<sup>9</sup>, workplaces might pose contamination risks to health service workers. Moreover, the physical, chemical and infectious characteristics of HSWs might cause environmental contamination and increase the risk of public health problems when inappropriately handled. Improper handling of HSWs can also cause workplace accidents<sup>10</sup>. Schneider<sup>11</sup> states that waste characterization, in terms of a qualitative classification of their individual traits, is the first step in any coherent management process.

Group A waste was inappropriately mixed with group D waste. According to Brazilian Technical Standards Association (ABNT), regulation NBR 12.808 defines segregation as “any operation to separate waste at the time of its generation in accordance with a previously adopted classification for that specific waste.” This regulation is considered a management tool to reduce the contamination risk of infectious waste<sup>12</sup>.

Mathur, Patan and Shobhwat<sup>13</sup> recommend that, in order to avoid accidents, individualized waste segregation must be performed at the generating source, according to waste type and including chemical neutralization.

Regarding the absence of appropriate containers for group A waste, the ABNT-BR 9191 law in force determines that segregated waste must be stored in appropriate bags or containers that are compatible with the type and quantity of each waste. The amount of waste in each bag and container cannot exceed  $\frac{2}{3}$  of their volume in order to avoid workplace accidents. It is forbidden to reuse those materials which must be disposed of in rigid, resistant, sealed, and identified containers. The incorrect conditioning of infectious waste goes against the law which determines the use of milky white bags that must be resistant, waterproof and identified with the infectious waste symbol. Black bags should be used just for urban solid wastes<sup>14</sup>.

Additionally, as stated in the technical specifications, the wastebaskets must be

resistant to tearing, puncturing, leaking and overturning; must have an internal smooth surface and rounded edges; must have a pedal to open the lid and must be identified with an infectious waste label<sup>3</sup>.

According to ANVISA-RDC nº 306 and CONAMA Resolution nº 358, the presence of wastebaskets in the amount and quality required by the quantity of generated HSWs is one of the factors that promote efficient waste segregation in each environment<sup>3,7</sup>.

It is mandatory that all the workers responsible for waste segregation recognize and identify the waste symbols, because as stated by ABNT-NBR 7.500, labels identifying the generated waste must be visible in bags and in the internal and external storage containers<sup>15</sup>. Storing must be performed according to waste type and category in order to reduce risks and to facilitate management operations<sup>16,17</sup>.

Among the main chemical waste (Group B) produced in the health area is dental amalgam, which is composed of silver (Ag), tin (Sn) and mercury (Hg) alloy in which the amount of the latter can vary between 43 and 54%. Mercury is known for its toxicity to individuals and the environment, and it is not part of any living being. Thus, when continuously absorbed, even in small amounts, it poses a serious risk for human and living beings. It has an accumulative effect, is extremely volatile, and it evaporates at comparatively low temperatures (12°C), releasing an odorless and colorless vapor which is very difficult to detect. It can be rapidly inhaled, mainly in poorly aerated environments; and mercury drops are accidentally spilled in dental offices<sup>18</sup>.

Thus, the safe conditioning of mercury ensures the professionals', the patients', and the environment's health. And according to the law in force, waste containing mercury must be stored in resistant plastic containers with water, and sent to have the silver alloy recovered<sup>16</sup>.

Santos et al.<sup>19</sup> suggests that even knowing that no liquid can completely avoid the release of mercury vapor into the environment, mercury should be stored in a liquid substance. He states that the best way to store amalgam waste is in unbreakable and hermetically sealed containers with glycerin.

The need of recycling mercury is also reported

by Nazar, Pordeus and Werneck<sup>20</sup> who state that the best option is to send amalgam waste to recycling laboratories. They also advice to gradually replace the amalgam with other less toxic restoration material.

The standard regulation NR-15 endorsed by the Brazilian Ministry of Labor, order n° 3214, lays down the limit of 0.040mg/m<sup>3</sup> for workers exposed to mercury in a 48-hour week<sup>21</sup>.

Chemical waste resulting from radiographic exams require special attention due to the heavy metals in their composition which must be treated in an individualized manner. They can contaminate surfaces and underground waters, and represent a risk factor for aquatic and terrestrial organisms<sup>16,22</sup>.

Chemical waste must be stored in accordance with the chemical compatibility requirements of their components as described in the ANVISA-RDC n° 306, in order to avoid interactions among components within the containers, which could lead to package weakening or deterioration. Permeability of the container materials to waste components must also be checked and avoided<sup>3</sup>.

Water used to rinse radiographic films contains fixer residues which must also receive specific treatment before being thrown into the sewage system. This procedure should be performed by companies that work with silver recovery<sup>22</sup>.

Training programs on radiological effluents must be implemented in order to avoid the inadequate disposal of this type of waste that can cause environmental contamination.

According to Nuttal<sup>23</sup>, radiographic films are considered chemical waste due to the presence of heavy metals (lead sheets). When placed together with common waste, they release those metals and may contaminate the environment.

Brasil<sup>3</sup> explains that the radiographic film can be disposed of together with common waste as long as the lead sheet is stored in an identified and resistant container to avoid its propagation in the environment.

With regard to the mixture of biological and common waste, the waste management process should begin with segregation as stated by Cussiol<sup>24</sup>, in order to avoid increase of waste volume, mixing, and contamination by infectious residues.

When considering the non-conformity treatment of infectious waste (group E), ABNT-NBR 13853 and ANVISA/RDC n° 306 state that waste sharps must be disposed of immediately after use at the generation site in tear-, puncture- and leak-resistant rigid containers equipped with lids and identified according to the standards of the above mentioned regulations<sup>3</sup>.

Professionals must be trained to handle sharps properly, including correct box assembly which proved efficient to increase storage quality.

Based on ANVISA, transport must be done in accordance with a previously determined route, separately and, depending on the type of waste, in a labeled, rigid, waterproof container with a hinged lid and round corners and edges. The containers must have coated wheels to reduce noise, and when bigger than 400 L, they must be provided with drains<sup>3</sup>. And as stated in ANVISA-RDC n° 306, staff involved in the collection and transport of HSW must wear the required PPE<sup>13</sup>.

Incorrect waste storage poses a health risk to garbage collectors due to the presence of contaminants. Besides, the collectors might act as vectors spreading diseases contracted when in contact with those waste products. The infectious potential of health waste requires special attention and techniques of waste handling and management from generation to final disposal.

According to ANVISA, internal transport is the waste transfer from the generation site to the external collection site<sup>3</sup>. Transfer must be performed in carts following ABNT NBR 12.810, and waste must be temporary stored until external collection<sup>12</sup>.

ANVISA states that waste transfer from the generation site to the temporary storage site must be performed following a pre-established route that does not coincide with people or activity flow. Moreover, transport should be done for each waste type separately in specific containers<sup>3</sup>.

According to ABNT-NBR 12.807, 12.808, 12.809, 12.810 external storage of health waste requires ventilation, lighting, having walls and floors of masonry, smooth, waterproof, washable, white doors and roofs, having direct connection with the sewage system, and being

identified with the correct hazard symbol<sup>3,12</sup>.

ANVISA defines the concept of treatment as a method or procedure that can modify hazardous characteristics by reducing or eliminating occupational accidents and environmental damage. Treatment must occur at the generation site or somewhere else following transport safety standards<sup>3</sup>.

Group A and E waste must be referred to specialized companies for treatment. Group E waste must be preferably incinerated, while group A waste should be physically treated by means of autoclaving, incineration and microwaving, or by means of other validated procedures involving level III microbial inactivation equipment in order to reduce or eliminate microbes. After treatment with these alternative technologies, health care service waste may join common waste and follow the same circuit without posing any risks to public health. After treatment A1, A2 and A5 waste must be stored as follows: if the structure is not physically inactivated, waste must be stored in milky white bags until reaching 2/3 of their capacity. Otherwise, those residues can be stored as if they were group D waste products. Group A3 waste without legal or scientific value must be buried or treated. If treated, they must be stored in reds bag with the inscription "anatomical pieces". Group A4 waste does not need treatment<sup>3</sup>.

Group B waste, such as pharmaceutical products used in dental care, are subject to special control as defined by Ordinance MS 344/98 and their updates must comply with the law in force. ANVISA provides for the technical regulation of health care service waste management and includes the liquids used in health care facilities for radiographic film development (group B waste)<sup>3</sup>. It states that fixers used in radiology should go through silver recovery processes, while developers should be neutralized to reach a pH between 7 and 9 in order to reduce their hazardous effect on the environment when thrown into the sewage system<sup>23</sup>.

As they do not represent any biological, chemical or physical risk, group D waste can be compared to common waste and does not need special treatment before final disposal.

The inconstancy of public cleaning services

and waste selective collection does not comply with ANVISA, which states that waste that undergoes rapid putrefaction should be refrigerated, if storage before collection is longer than 24 hours. In the case of a lack of refrigeration, other conservation methods should be applied at the generation site<sup>3</sup>.

External transport is the removal of HSWs from the storage facilities (temporary storage) to the final disposal site or treatment unit, using techniques that ensure packaging conditions, and worker, population and environmental integrity. It must be in accordance with urban cleaning norms and with ABNT-NBR 12.810 and NBR 14.652<sup>12</sup>.

Group A, D and E waste should be sent to the sanitary landfill and disposed of in the specific location for each type of waste. Chemical waste containing heavy metals must be sent to recycling companies, to a class I hazardous waste landfill or go through treatment in accordance with the guidelines of local environmental agencies<sup>3</sup>.

Final disposal of waste occurs in dumps and landfills. In the former, waste is directly deposited on the bedrock or ground and the percolated liquids they release may contaminate soil, ground and superficial waters. According to NBR 8.419, a landfill applies a technique that allows the disposal of waste without causing risks to public health and reduces environmental impact. Solid waste is reduced to the smallest possible volume and is covered with a layer of earth at the end of every working day. The project must have the required facilities to guarantee its operation and sanitary control during its operation period and after its closure<sup>16</sup>.

## FINAL CONSIDERATIONS

According to the information collected, segregation, identification, conditioning, storage, transport, and final disposal of solid dental waste generated at FHUs are flawed.

To correct these shortcomings, the involvement of administrators and health professionals during the whole waste management process is necessary to increase workers' safety, and to reduce workplace accidents and environmental contamination.



It is of the utmost importance that all waste generating establishments elaborate and implement a Health Care Service Waste Management Program. This tool helps health unit managers to find solutions and alternative actions for existing problems. Thus, the program must take into consideration the peculiarities, human resources, and materials used by each institution.

Waste management improves performance and handling, increases individual safety, and enhances the institution's social image. Moreover, it promotes cost reduction by reducing waste production, transport and HSW treatment, and generates revenues

through segregation and commercialization of recyclable materials.

To effectively change the current shortcomings, environmental agencies should increase waste management monitoring and implement activities to raise dentists' awareness regarding their clinical, ethical and legal obligations, as well as their role in public health and environmental protection.

Resolution ANVISA-RDC nº 306/2004 allows for permanent education to orient, motivate, raise awareness, and inform all the professionals involved with health care service waste, and is considered one of the most important strategies for the correct implementation of the plan.

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