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**Evaluation of the knowledge, attitudes and perception of dentists from Palmas and Gurupi/TO towards the residues generated in the health service**

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## ABSTRACT

This study investigated the discard of health service residues produced in dental offices at the state of Tocantins, Brazil. The study discussed the aspects related to the knowledge and attitudes of dentists towards the residues generated in their work environment, as well as their perception on the residues generated in other dental offices. A total of 239 dentists were interviewed, among which 78.2% worked in private offices and had already attended a post-graduation course (68.6%). When evaluated regarding their perception, some dentists stated that they believed that amalgam residues resulting from restorative procedures were wrongly discarded in either common garbage (30.1%) or sewerage (8.8%). Besides, they also believed that residues of sharp objects were occasionally discarded in either common garbage (9.2%) or plastic recipients (14.2%). Most respondents (88.1%) affirmed that they discarded chemical solutions of radiographic processing in the sewerage the and 61.9% stated they believed that the infected garbage was discarded together with the common garbage. It was therefore concluded that, in general, the dentists interviewed were unaware of the correct procedures for the discard of health service residues, since there was both negligence in these practices by many of them and the perception that other clinicians also performed incorrect discard of residues generated in their work environment.

**Keywords:** Medical waste disposal. Environment and public health. Environment.

## 1. INTRODUCTION

One of the main goals of health professionals should be to offer conditions to provide a high-quality treatment for their patients. It is known that different materials are used in dental treatments, which may generate liquid effluents that require specific treatment, as well as a great variety of solid residues that need appropriate management before discard, since they constitute important sources of contamination for both the environment and population in general (SISINNO et al., 2005).

The residues generated in all services delivering treatment for both animal and human health, such as hospitals, clinics, laboratories, pharmacies and drugstores, veterinary clinics, health centers, teaching and research institutes, and others, are classified as Health Service Residues (ANVISA, 2004; CONAMA, 2005). These include all solid and semi-solid residues produced in the practice of certain activities in health centers. This definition also includes the liquids produced in these sites, whose particularities do not allow their discard in the public sewerage system (CASTRO, 1995).

When inappropriately discarded, these residues may endanger both the environment and the human health. This negligent practice favors the indiscriminate dissemination of insects and rodents and contamination of the soil, water, aquatic and terrestrial faunas. Also, it may endanger the human alimentary chain. Conversely, the inappropriate manipulation of some materials such as sharp objects may cause accidents with severe consequences for professionals, who could be infected by diseases as hepatitis B and AIDS.

For these reasons, the Health Service Residues (HSR) have raised great attention in the last years. The promotion of awareness of both the population and authorities on the problems caused by the incorrect management of HSR has encouraged the discussion of public policies and development of legislations, aiming to assure both sustainable development and public health preservation (AGAPITO, 2007).

The management of residues generated by the modern society is an incontestable need and requires the arousal of collective awareness in relation to the individual responsibilities when dealing with this question (MARANGONI, 2006). The Health Service Residues (HSR) have been included in this context, highlighting that the inappropriate discard of these residues might endanger and damage both the natural resources and the quality of life of the current and future generations.

Considering the aforementioned discussions and the lack of studies in the literature analyzing the awareness of dentists on the correct discard of residues generated in their work environment, this study evaluated the knowledge, attitudes and perception of dentists from Palmas and Gurupi/TO towards the discard of residues generated in their offices and other health services.

## 2. LITERATURE REVIEW

The residues generated in health centers were only legally addressed in the early 90s, when the Brazilian Council of Environment Protection approved the Resolution 006 on September 19<sup>th</sup> 1991. However, this issue has had a great importance in the last years. Such challenges gave rise to public policies and legislations based on the environment sustainability and human health preservation (AGAPITO, 2007). The Resolutions 283 and 358 of the Brazilian Council of Environment Protection defined Health Service Residues (HSR) as “those produced during animal or human health treatment, including home care and field work services; originated by research, development or experimentation centers in the field of pharmacology and health; deteriorated or expired drugs and immunotherapy drugs; laboratories for analysis of health products; morgues, funeral homes and services where embalming activities are performed; legal medicine services; drugstores and pharmacies; teaching and research centers in the health area; zoonoses control centers; distributors of pharmaceutical products, importers, distributors of materials and controls for in vitro diagnosis; mobile health care units; acupuncture and tattoo services”, which, due to their characteristics, require differentiated processes in their management, demanding or not previous treatment for final discard (CONAMA, 2001; CONAMA, 2005).

According to both the RDC Resolution 306 of the Brazilian Sanitary Surveillance Agency and Resolution 358 of the Brazilian Council of Environment Protection, the Health Service Residues (HSR) were classified into five groups according to their characteristics and consequent environment and health risks: Group A (potentially infective), Group B (chemical waste) Group C (radioactive tailings), Group D (common waste), Group E (sharp objects) (ANVISA, 2004; CONAMA, 2005; CUNHA et al., 2017; ESTEQUI et al., 2018).

According to Castro (1995), the progressive growth of HSR generation rate is related to the population growth, as well as to the increased mean life expectancy of the Brazilian population. These factors would cause a significant increase in the Health Service Residues, due to the increased need of health services for an older population.

Therefore, the problems involving Health Service Residues (HSR) are increasingly concerning the authorities responsible for political decisions, either for the Brazilian states or cities, on the problems caused by the incorrect management of HSR. One of them comprises a more individual aspect and is directly related to the risks to the employees of health centers regarding the management of their local residues. Other decision comprises a socio-economic and sanitary view and is related to the destination of these residues and the way that this should be done in order to avoid damage to both the environment and population. Such problems have led the authorities to elaborate and guide programs for residues management (CARVALHO, 2003).

The Health Service Residues Management Plan (HSRMP) is a management procedures protocol aimed at proper management of residues produced in health centers. These procedures should be planned and implemented based on from normative and legal, scientific and technical aspects, aiming both to minimize the generation of residues and to provide them a safe and efficient discard. This also aims at the protection of employees and preservation of public health, natural resources and the environment, strictly following the RDC Resolution 306 and the Resolution 308 (ANVISA, 2004; CONAMA, 2005). The management has been initiated by planning the necessary physical and material resources, ultimately followed by training of the human resources involved.

The elaboration of the HSRMP is responsibility of each center. However, the intern management of these residues is not yet a common practice in hospitals, private offices and pharmacies, among others (IPT/CEMPRE, 2000). The inappropriate discard of the health service residues could cause contamination of the soil and underground and superficial waters, endangering the human health and the environment (MARINGONI, 2006).

Several residues are generated in dental offices after patient treatment. Mercury and other heavy metal residues originated from procedures involving the utilization of amalgam may cause environment contamination if there is negligence during its use and also inappropriate discard in the garbage, soil, water, and air. In living beings, mercury contamination may also occur by indirect ingestion through both the airway and skin contact (PÉCORA, 2003).

Barbin et al. (2003) highlighted that amalgam residues should be kept in recipients with a wide opening made from break-resistant materials. They stressed the importance of maintaining both 1/3 of water above the residue and keeping the recipient hermetically closed, free from cotton, gauze, sticks, stainless steel matrix strips, and other contaminants. The recipients should be kept in low-temperature places, free from direct sunlight incidence.

The effluents originated from radiographic processing comprise solutions with high silver concentration and also contain hydroquinone, quinone, metol, sodium thiosulfate, sodium sulphite, and boric acid (CARVALHO, 2000; BRASIL, 2002; FERNANDES *et al.*, 2005), besides other chemicals that are highly toxic for both the environmental and human health, such as cyanide, chloride, iron, total phosphorous, total nitrogen, and sulphite (HOCEVAR & RODRIGUEZ, 2002). These effluents are also characterized by high values of Oxygen Chemical Demand (OCD), about 200 g/L. Besides, the effluents not only contain the initial components of developers, but also a variety of substances resulting from the chemical reactions of developers with silver, oxygen, and other components (STALIKAS et al., 2001). The washing of radiographic films after developing and fixation also generates effluents containing all components of

the developer, fixer and its byproducts, including hydroquinone, quinone, metol, sodium thiosulfate, sodium sulphite, elementary sulfur, acetic acid, sodium acetate, boric acid, and others, besides silver (CARVALHO, 2000; BRASIL, 2002; FERNANDES et al., 2005). The Resolution 358 of the Brazilian Council of Environment Protection has stated that solutions generated in this process are characterized as Group B residues (dangerous chemical residues) and therefore should be either submitted to reutilization, recovery or recycling; or they should be submitted to specific treatment and final disposal, not being discarded as effluents in the environment (CONAMA, 2005).

Concerning the residues of sharp objects, Scheneider et al. (2001) stated that they should be packed in proper recipients to avoid accidents. Guandalini et al. (1999) *apud* Eleres et al. (2006) recommended that they should be placed in a collector box (Descartex); however, they mentioned that any recipient could be used provided it met the characteristics of resistance to perforation, tightness, and impermeability. Besides, it should contain the international symbol of biological risk and the word “sharp objects inside”. The emptying of these recipients for reutilization has been prohibited (MARINGONI, 2006). According to the Brazilian Association of Technical Norms (BATN), NBR 12809, such recipients should not be filled above 2/3 of their capacity (ABNT, 1993). The inappropriate discard in plastic bags and common garbage could cause the exposure of employees (from health area and/or workers who perform garbage collection) and general public to this residue, which could result in infectious diseases or lesions, besides environment contamination (WHO, 1999).

Other residues, such as gloves, gauze, and cotton should be discarded according to the recommendations of the BATN: in opaque milky white bags (with the international symbol of infectious discard and the words “hospital waste” or “health service residues”), initially discarded in a garbage can with cover and separated from other common residues (plastic, paperboard and glass), which should be packed following the recommendations of the Resolution 275 and sent to recycling or reutilization (CONAMA, 2001; CARVALHO et al., 2007). Scarlato et al. (2003) assured that recycling has been one of the most efficient alternatives for managing the residues; however, not all materials may be reutilized due to the particularities and properties of its elements.

Due to these approaches, it could be added that environmental education and the discussion of this theme during the formation of health professionals would be necessary, highlighting the environmental damages caused by the residues when incorrectly managed and discarded. Regarding the society, the public power must provide orientation and support to organize actions for environment benefit. Besides, the Sanitary Surveillance of Brazilian States, Cities and Federal District, supported by Brazilian Agencies of Environment Protection and Urban Cleanness and the Brazilian Commission on Nuclear Energy must diffuse, guide and supervise the observance of the law (COUTINHO & CARVALHO, 2007).

### 3. MATERIAL AND METHOD

The procedures conducted in this study were initiated after approval by the Institutional Review Board of UNIRG University Center (protocol #0031/2009). The volunteers that comprised the study sample were identified from a list that contained data on the dentists from the cities of Palmas and Gurupi/TO registered at the Brazilian Federal Dental Council (FDC). Overall, 350 professionals were registered in this list.

A preliminary questionnaire containing 30 questions was applied to 10 dentists aiming to detect possible difficulties in the understanding and variables that could bias the results. After this pilot test, alterations were made to the questionnaire, which then comprised 25 questions. This instrument was composed of aspects that allowed evaluation of the knowledge, attitudes and perception of dentists towards the residues generated in their offices and other health services.

The first contact with the dentists was made by phone. In this occasion, the research methodology was briefly explained, emphasizing the importance of participation for the study success. Also, they were assured that their information would receive a confidential treatment and that data obtained in the study would exclusively have a scientific purpose, with their privacy guaranteed. The dentists were then visited and received an envelope containing the questionnaire, an information letter presenting the study objectives and the informed consent form, which should be signed by the volunteers that accepted to participate in the study.

### 4. RESULTS

From the 350 dentists registered in the FDC list, 37 could not be found in their respective contacts. The remaining 313 professionals were visited, yet 239 agreed to participate in the study. The age of professionals ranged from 23 to 58 years old, with 128 (53.6%) males and 111 (46.4%) females. The mean time of professional experience was higher than 15 years.

A percentage of 78.2 worked exclusively in private offices, only 8.0% worked in public services, and the remaining worked in both (13.8%). The majority of professionals interviewed had a specialist degree (68.6%). Initially, the participants were questioned on the type of residues generated in their work environment. They answered that the majority of residues were sharp objects (28.9%), followed by infectious residues (20.1%), amalgam rests (18.4%), radiographic film packages (17.1%), and radiographic processing chemicals (15.5%) (FIGURE 1).

**Figure 1.** Types of health service residues generated by the dentists interviewed in their work environment.

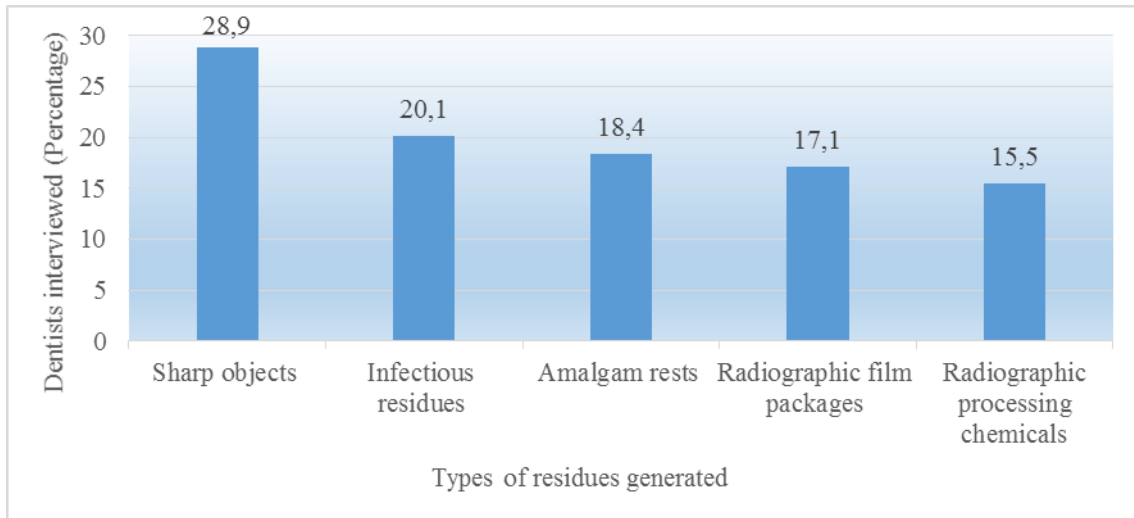
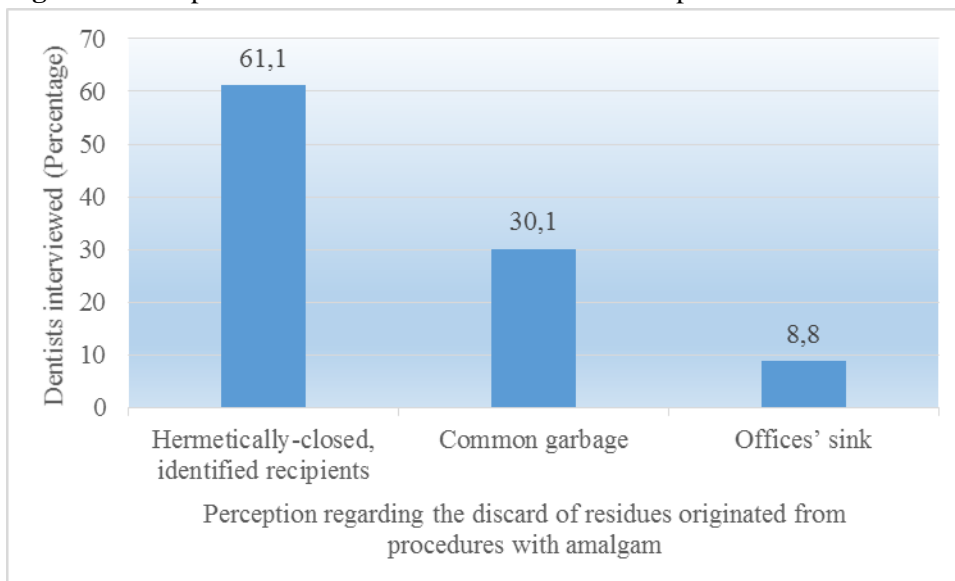


Figure 2 presents the results related to the perception of respondents regarding the discard of residues originated from procedures with amalgam in other dental offices. Most respondents believed that amalgam rests were discarded in hermetically-closed, identified recipients (61.1%). Conversely, 30.1% of participants believed that amalgam residues were discarded in common garbage, and 8.8% believed that amalgam residues were discarded in the offices' sink.

**Figure 2.** Perception of dentists interviewed towards the place for discard of amalgam residues.

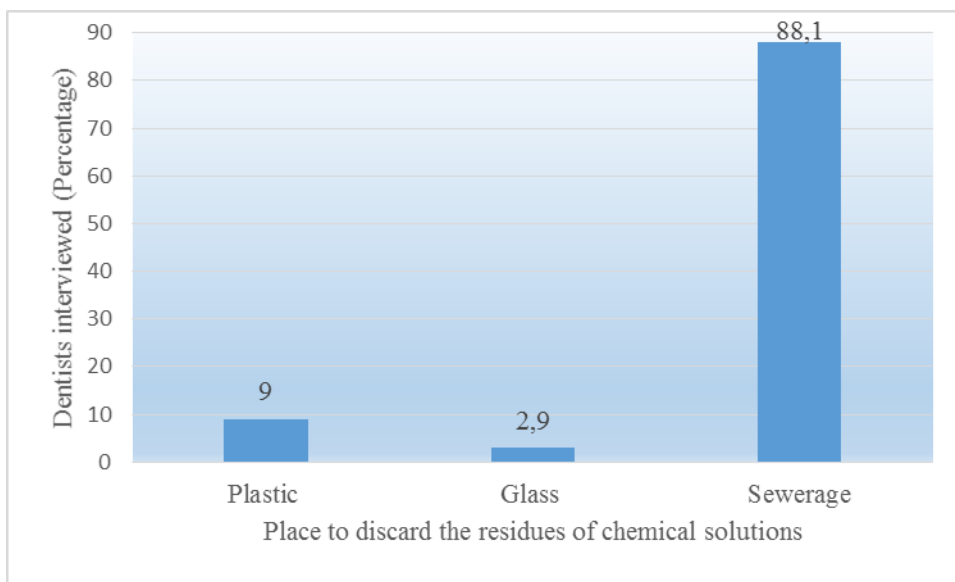




From the total of respondents, 12.1% stated that they did not perform intraoral radiographic exams in their offices, 48.6% stated they performed up to 5 exams per week, 22.6% 6 to 10 exams per week, 11.7% 11 to 15 exams per week, and only 5.0% performed more than 15 exams per week. Most dentists performing radiographic exams in their offices declared that the mean period for changing the radiographic processing chemicals was 5 days. These professionals unanimously used portable dark rooms from commercial brands for radiographic processing, which contained only three cup-shaped recipients without covers, with 250-ml capacity for radiographic processing solutions. Among these, 43.3% declared that they did not fill the developer recipient up to the acceptable level, i.e. about 1cm below the upper border of the recipient (level that allows total film immersion in the solution). On the other hand, for the fixer recipient, the respondents stated that it was filled up to the acceptable level.

Also concerning the radiographic processing, some respondents discarded the residues of chemical solutions (developer, fixer and washing water) used in their work environment in specific, properly identified plastic (9.0%) or glass (2.9%) recipients with cover. However, the majority of participants (88.1%) discarded these residues in the sewerage. Only 2.7% of those declared that they neutralized the radiographic processing solutions previously to discard in the sewerage (FIGURE 3).

**Figure 3.** Attitudes of dentists interviewed towards the place for discard of chemical solutions of radiographic processing.



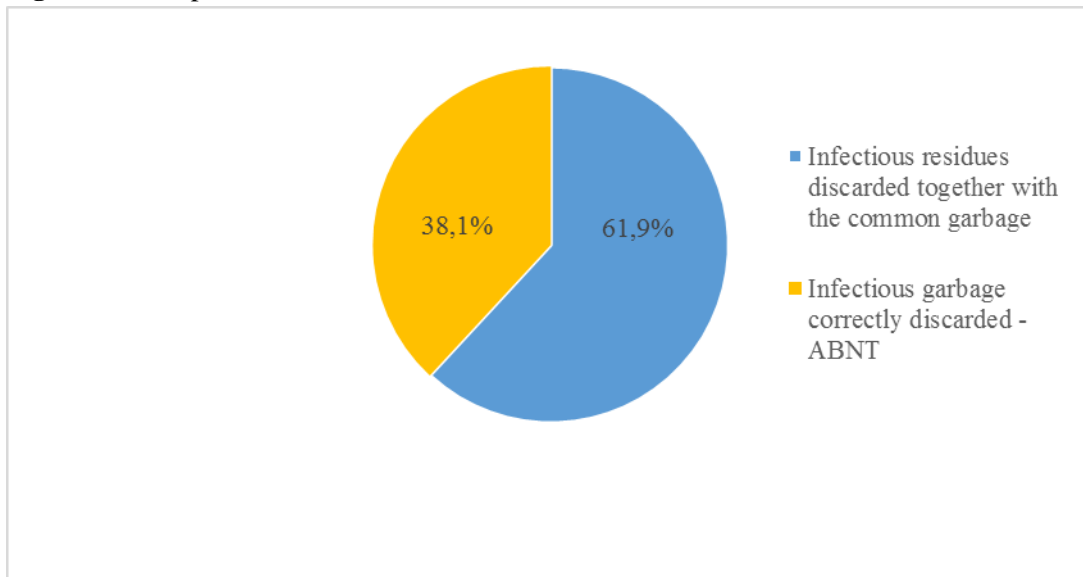
The present results also revealed that in a great number of offices (79.1%) there was no system of sewerage treatment for chemical residues, and the other 20.9% did not

know if there was sewerage treatment for chemical residues. Besides, 74.5% of respondents did not know if the city where their offices were located had a sewerage treatment system for chemical residues. The remaining 25.5% stated that their city did not have any type of system with this objective.

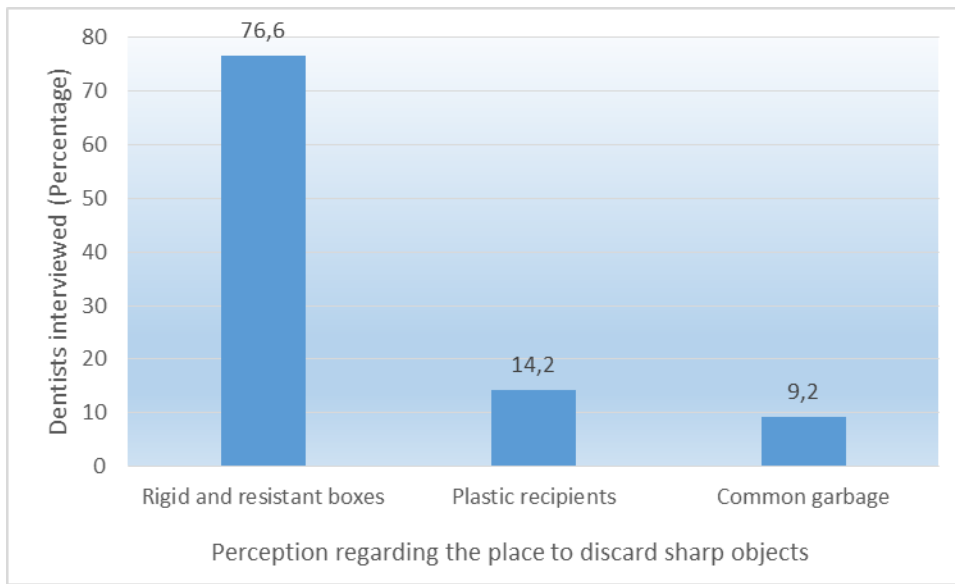
Regarding the plastic and paperboard parts of radiographic film packages, 96.2% of participants declared that they discarded them in common garbage. The remaining stated that the parts were separated for recycling. Concerning the lead foil backing present in the radiographic film packages, 74.8% of respondents affirmed they were discarded in common garbage, 17.6% separated them in specific recipients, and the remaining 7.6% kept them for future sale.

Only 38.1% of participants answered that they believed the infectious garbage is correctly kept in opaque white plastic bags identified according to the recommendations of the Brazilian Association of Technical Norms; 61.9% of them believed that the infectious residues were discarded together with the common garbage (FIGURE 4). Figure 5 shows that, regarding the sharp objects, 76.6% of professionals stated that they believed that in most offices these were kept in rigid and resistant boxes, 14.2% believed that these were discard in plastic recipients, and 9.2% believed that the majority of dentists discarded sharp objects in the common garbage.

**Figure 4.** Perception of dentists interviewed towards the discard of infectious residues.



**Figure 5.** Perception of dentists interviewed towards the place for discard of sharp objects.



In relation to the common residues (paperboard, plastic, and glass), 92% of respondents believed that these were discarded in the common garbage in most offices, without separation for recycling.

From the dentists interviewed, 67.4% declared they were aware of the correct practices for separation and discard of residues produced in their offices and other 46.4% stated that their employees also have this knowledge. Further 33.1% affirmed that their employees were unaware of the correct practices for separation and discard of residues, and 20.5% declared they did not know if their employees had this type of knowledge. Also, 88.3% of these professionals believed that dentists in their offices did not have policies to minimize the generation of residues; concerning this aspect in their own offices, 91.2% declared they also did not have residues management plans.

## 5. DISCUSSION

The residues produced in health services potentially endanger the health and the environment due to the presence of biological, chemical and radioactive materials and sharp objects, therefore requiring special care for appropriate discard. The amount of such residues generated depends on the type and size of the health center, besides the number of patients attended, services offered, and the clinical procedures adopted. The results evidenced that, in the majority of offices, most residues generated corresponded to sharp objects (28.9%), followed by infectious materials (20.1%), amalgam rests

(18.4%), radiographic film packages (17.1%), and radiographic processing chemicals (15.5%).

Concerning the perception of dentists towards the discard of residues produced in procedures with amalgam in other dental offices, most respondents believed they were discarded in hermetically closed and identified recipients (61.1%). These findings are in agreement with the study of Tonello et al. (2007), in which 65.4% of respondents stated that amalgam residues were discarded in closed recipients.

Regarding the radiographic processing, 43.3% stated they did not fill the developer up to 1cm below the upper border of the recipient, level in which the film would be totally immersed. Conversely, for the fixer recipient, all respondents declared that this was filled up to the acceptable level, i.e. 1cm below the recipient's border. The explanation of this information would be that dentists generally fill the developer recipient about 1/3 to 2/3 of its total capacity and then lean the recipient for both providing a greater surface amplitude and totally immersing the radiographic film. This has regularly occurred in Brazilian dental offices, in an attempt to save the developer solution, because the amount of time that the film would be immersed in the solution varied from 1 minute and 30 seconds to 2 minutes, in the average. However, the dentists were not aware of the degradation time of the developer because they left the recipients uncovered, which would allow the contact with oxygen, therefore causing faster degradation rapidness due to the smaller amount of liquid. On the other hand, the period of time during which the film was immersed in the fixer was more than 2 minutes. Consequently, 100% of dentists decided not to save this solution by diminishing its amount in the clinical practice.

Also regarding the radiographic process, it was observed that the majority of respondents (88.1%) discarded the residues of radiographic processing solutions (developer, fixer, and washing water) in the sewerage, and only 2.9% declared they performed neutralization of these solutions previously to discard. Besides, in a great part of dental offices (79.1%), the professionals affirmed that there was no sewerage treatment system for chemical residues. In relation to the plastic and paperboard parts and the lead foil backing that comprise the radiographic film packages, 96.2% and 74.8% of respondents respectively stated that they discard them in common garbage. These results are in agreement with the study of Fernandes et al. (2005), where they reported that, in general, the effluents (developer and fixer solutions and washing water) and the residues (parts of radiographic film packages) generated by services performing image diagnosis, mainly small-sized establishments, were discarded in the environment without any appropriate treatment. The authors further mentioned that other establishments sold the fixer and radiographic film package residues to other services and discarded the developer and washing water in the sewerage, without treatment. Others have signed contracts with supplier companies of electrolytic separators to recover the silver from the used fixer solution. However, the remaining effluents were discarded in the sewerage, without treatment.

Most professionals interviewed (61.9%) believed that the infectious garbage was disposed together with the common garbage. Regarding the sharp objects, 76.6% of professionals declared they believe that most offices had rigid and resistant boxes; 14.2% believed these residues were discarded in plastic recipients, and 9.2% believed that most dentists discarded the sharp objects in common garbage. These data may also be compared to the study of Tonello et al. (2007), in which 74.4% of dentists discarded the sharp objects in the Descartex, 6.4% discarded them in common garbage and 19.2% in other places, e.g. plastic recipients. Similar results were found in the study of Pedrosa et al. (2006), who reported that only 20% of the infectious garbage was properly packed in identified opaque white plastic bags according to the BATN, and 67% of offices discarded the sharp objects in properly labeled recipients with rigid walls.

In relation to common residues (paperboard, plastic, glass), 92.9% of respondents believed that in the majority of dental offices they were discarded in common garbage, therefore without separation for recycling. According to Scarlato et al. (2003), all establishments should define management policies to promote the reutilization and recycling of common residues generated in this type of service, consequently contributing to minimize the damages to the environment.

According to Sissino et al. (2005), special attention should be given to the Health Service Residues, due to their high contamination risk. Thus, their management and discard should represent a major question because of the necessity to diffuse the knowledge, develop human resources, besides the legal and normative processes involved, aiming to minimize the impacts caused to both health and environment.

According to the present data, in the respondents' perception, a relatively high index of appropriate discard of residues originated from amalgam procedures and sharp objects was found. Therefore, it may be assumed that most professionals would be concerned with both their own and their professional team contamination. However, the majority still performs inappropriate discard of both the radiographic processing chemicals and radiographic film packages. According to the respondents' perception, it is also suggested that infectious and common residues are inappropriately discarded, therefore contaminating the water (sewerage system) and soil, showing a lack of awareness regarding the norms of environment preservation.

Although the present results are not totally ideal, 67.4% of respondents declared they had knowledge on the correct practices for separation and discard of residues produced in their offices, and 46.4% stated that their employees also had this knowledge.

Marangoni (2006) highlighted the importance of education of the professionals working in health centers, since the training and promotion of awareness of these professionals is fundamental for the correct treatment and discard of residues generated in this type of environment.

Therefore, the concern with the appropriate management of residues generated in health care units has increased in the last years, and several technologies related to their treatment appear every year. However, the establishment of a management plan for health service residues only to fulfill the legal demands would not solve the problem of their generation; it is also necessary to minimize the generation of residues (Sissino et al., 2005). From the results obtained in this study, it was observed that most respondents (88.3%) believed that other professionals in their dental offices did not have policies to minimize the residues generated; moreover, they themselves did not have such management plans (91.2%). Also according to Sissino et al. (2005), the smaller the amount of residues generated, the smaller will be the cost of their treatment, discard and related problems; however, from the aforementioned results, it can be observed that alternatives aiming to reduce the residues generation are still scarce.

Although many studies have thoroughly addressed the problem of health service residues generation and discard, aiming to make it accessible for both health professionals and the general public, the lack of articles in the literature studying the knowledge, attitudes and perception of professionals of any health area, including Dentistry, impaired the comparison of the present results. We therefore suggest that further studies should be conducted to provide new references that may contribute for the development of this area.

## 6. CONCLUSIONS

The data obtained in this study revealed that, in general, the dentists interviewed were unaware of the correct procedures for the discard of health service residues, since there was both negligence in these practices by many of them and the perception that other professionals also performed incorrect discard of residues generated in their work environment, even though most professionals stated they were aware of the correct management and discard of residues produced in health centers. It should be noticed that the inappropriate disposal of these residues could seriously endanger the environment and affect the quality of life of both the current and future generations. Therefore, further studies should be conducted to provide new references that may contribute to disseminate the knowledge and promote the awareness, aiming at changing the attitudes towards the discard of health service residues.

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