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Diagnosis of the perception of dentistry professionals about radiographic waste and their risks

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Abstract
Health service waste (RSS) from dental practice deserves attention in its management, as many materials generate environmental impacts. Professional misconduct due to lack of information can have drastic consequences. The aim of this work was to make a diagnosis about the perception of dental professionals regarding the disposal of waste. The methodological procedures were elaborated in the survey of data carried through a structured virtual questionnaire where the pre-selected professionals who used as their units of activities were oriented to answer. The collected data were entered into a statistical program to analyze the variables and variations between them. The results pointed to a lack of knowledge of the professionals analyzed, in relation to the legislation in force in the country, on the disposal of waste. Conclude that dentists can comply with the current control rules regarding the disposal of these wastes.

Keywords: tailings, sustainability, environmental impact, green dentistry

1. Introduction

Concern for the environment is growing worldwide, but we must keep in mind that we cannot understand the problems of our time, such as ecosystems, that is, biodiversity, in isolation, we must immediately verify a series of problems, which damage the biosphere and compromises the planet's sustainability.

An environmental issue has always raised great concerns, these accelerated, mainly, from the industrial revolution, unskilled period in the world or economic progress until the expense of the exploitation of natural resources and an expressive urban growth, almost always disorderly [1].

Analyzing the conservation of the environment as an essential factor for well-being, an environmental health visa detected environmental risks that can interfere with human health. The risk to the environment is the probability of adverse effects, due to the presence of chemical, chemical, or biological agents that cause potentially dangerous conditions [2].

Uncontrolled contamination and degradation of ecosystems, such as terrestrial and aquatic, gradually affects biodiversity, causing irreparable damage to future ones. The consumption of products by people, in a disorderly manner, has a tendency aligned with population growth, gradually decreases, or decreases the lack of control, or some items disappear, used for sustainable development. A qualification in the education of beneficiaries using common assets is necessary, because without this, any measure that adopts the management and administration of common resources will have the expected effect.

Reducing the use of materials that are difficult to absorb by nature, taking care in the excessive use of water and energy, reusing water after proper treatment, incinerating residues such as gloves, caps, paper, cotton, plastic suckers, covers of radiographic films for generation energy, removal of silver from the radiographic film, recovery of silver from fixing solutions used in the processing of radiographs, reuse of lead films and the correct disposal of waste through specialized companies, must be measures adopted by all associates [3].

The disposal of Solid Waste Health Services (RSSS) has received, in recent decades, special attention from the competent sanitary authorities, since the existence of contaminated residues, chemical residues, among others, is capable of causing a great impact on the environment, when discarded incorrectly. The commitment of health managers aims to solve, transform health institutions to defend sustainable practices to the environment, stimulating socio-environmental actions and, at the same time, the more conscious use of material resources, avoiding waste, in addition to seeking to allocate more financial resources [4].

New techniques in Dentistry have led the dental professional to seek more and more help from radiographic resources for planning and diagnosis. The increase in this complementary means of diagnosis leads to an increase in tailings such as radiographic films and their components, revealing and fixing solutions, which without the correct disposal, contaminate the soil, freshwater sources, and groundwater. Thus, dental practice can provide aggressive behavior to the environment, so there is a need to assess the degree of knowledge and commitment of dentistry professionals regarding the preservation of the environment, in relation to legislation, recycling, reuse and disposal of these wastes.

The concentration of heavy metals beyond what is acceptable for disposal in the solution used in the fixation

step may constitute a risk factor for the health of aquatic and terrestrial organisms, through the contamination of soil and surface and groundwater. Among the adverse effects caused by the toxicity of heavy metals, we can mention the damage to the central nervous system, liver system, hematopoietic system, renal system and skeletal system [5].

This work aimed to evaluate dental surgeons in the city of Recife, identifying the radiographic waste management procedures, the disposal of these rejects, in relation to the processing substances and the disposal of lead and plastic films, and then proposing an awareness and orientation to oral health professionals about the importance of the correct handling, storage and disposal of radiographic waste produced in professional practice.

2. Materials and Methods

2.1. Definition of Study Area

The research was carried out with dental surgeons who work in private dental offices in the city of Recife. According to the 2010 Census, the city had 1,537,704 inhabitants, and 2019 has an estimated population of 1,645,727 inhabitants [6].

The city of Recife has eight health districts in which 10 dental surgeons were selected per health district to compose the sample of this study.

2.2. Population / Sample

The research was applied to dental surgeons enrolled in Regional Council of Dentistry (CRO), who work in private offices, in the city of Recife, distributed in the eight health districts. Professionals were randomly selected, through telephone contact previously maintained and who agreed to participate by answering a questionnaire sent by email together with the Free and Informed Consent form.

2.3. Data Collection

It was carried out through a structured questionnaire, with dichotomous answer format, represented by a finite list of some members of the target population, containing questions related to the year of graduation of the professional responsible for the establishment, the degree of environmental awareness of all professionals working in the environment, and questions related to the disposal of radiographic waste. The questionnaires were sent to 80 Dental Surgeons, in the proportion of 10 per Health District. The Questionnaire used was based on the article by [7] and modified for use in data collect.

2.4. Statistical Analysis

The data collected from the Survey were entered into a database of the SPSS2.0 System. Pearson's Chi-Square statistical test was used to analyze the variables and associations between them, considering the significance level of 5% ($p <= 0.05$).

2.5. Risk Analysis

The Risk Analysis was performed based on the assessment of the activities developed by the Professionals during their work routine (intraoral radiographs) and the handling of products and substances potentially contaminating the environment and the health of these professionals. Risks involving this activity were verified through a worksheet adapted to describe the study variables and classify each activity in relation to its potential for risk to the environment, which is understood as a probability of adverse effects, due to the presence of agents physical, chemical or biological causes of potentially dangerous conditions.

Table 1: Types and Levels of Risks.

Types of Risks	Levels of Risks
High	4
Average	2
Low	1

***Source*:** The Authors (2020).

3. Results & Discussion

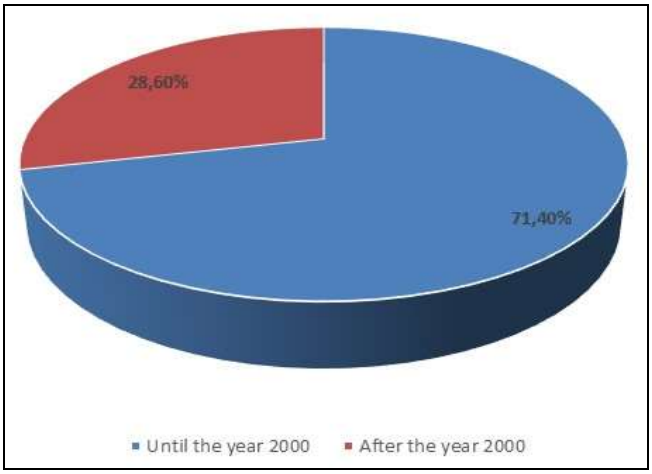
3.1 Statistical Analysis

The results obtained were based on sending 80 questionnaires to the target audience, with 49 answered, so that the degree of perception and commitment of the interviewed professionals in relation to the disposal of lead films and revealing and fixing substances could be assessed. The collected data were entered into a database of the SPSS2.0 System. Pearson's Chi-Square statistical test was used to analyze the variables and associations between them, considering the significance level of 5% ($p <= 0.05$). The Figures from 01 to 14 are the results of the questionnaires applied to obtain primary data for research and complement the information related to the study variables.

Of the interviewees, 71.4% answered that they finished their graduation after the year 2000, while 28.6% concluded their graduation by the year 2000 (Figure 1). The time of graduation can influence the decision making in relation to the discards of waste from radiographic films, due to the lack of information in the curricula prior to the year 2000, which did not emphasize the importance of concern for the environment or the Environmental Legislation. So, the ignorance that the disposal of the lead film, the plastic that surrounds the radiographic film as well as the potential contaminants of the revealing and fixing substances, can negatively influence the environment, causing damage to it.

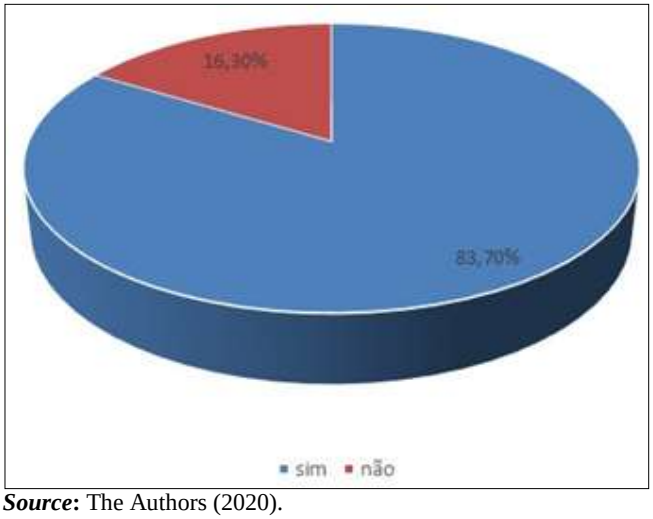
In relation to Figure 2, from the graph on the recognition that Dentistry can harm the environment, 83.7% of the interviewees agree that Dentistry contributes to contamination and degradation of the environment, however, 16,3% stated that Dentistry does not contribute to environmental degradation.

Solid Health Residues (RSS), which are those generated in services related to the care of human or animal health, have received, in the last decades, a strong attention from the Health Authorities, because the existence of contaminated or potentially contaminating residues may be capable of cause a great impact on the environment, when disposed of incorrectly.



***Source*:** The Authors (2020).

Fig 1: Year of completion of the respondents' graduation course.



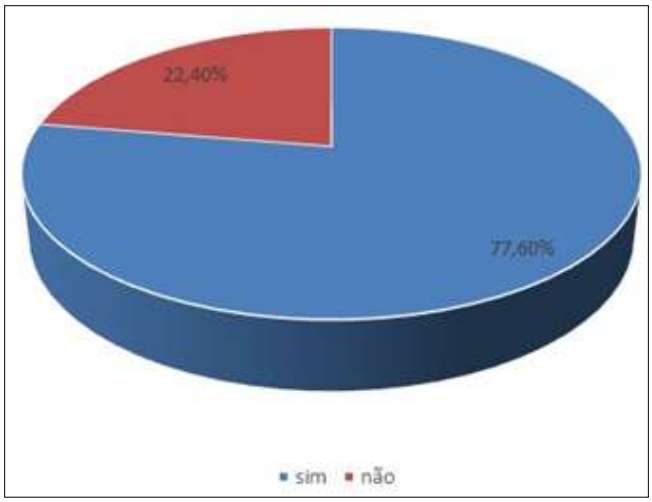
***Source*:** The Authors (2020).

Fig 2: Graphic on the recognition that dentistry can harm the environment.

Nowadays, new techniques in Dentistry have led professionals to seek more and more help in radiographic resources for planning and diagnosis. The increase in this complementary means of diagnosis leads to an increase in tailings such as radiographic films and their components, revealing and fixing solutions, and which, without the correct disposal, may contaminate the soil, freshwater sources and groundwater, making it necessary know the legislation, recycling, reuse and disposal of these wastes, as described by [8].

Of the Dental Surgeons interviewed, 77.6% stated that their direct employees, such as Oral Health Assistants, who worked under their technical supervision, had knowledge about the correct management of health waste, however, 22.4 % stated that their assistants did not understand the importance of the correct handling of waste (Figure 3).

Oral Health Assistants are professionals of great importance for the proper functioning of the dental office and often their complementary training is provided to the Dental Surgeon who works with this professional. Thus, it is essential to inform and train these auxiliaries in relation to the concentration of heavy metals beyond what is acceptable for the disposal of solutions used in the processing stages of radiographic films, which may constitute a risk factor for the health of organisms. aquatic and terrestrial, through the contamination of soil and surface and groundwater. Among the adverse effects caused by heavy metal toxicity, we can mention the damage to the central nervous system, liver system, hematopoietic system, renal system, and skeletal system, as described in the studies by [5].



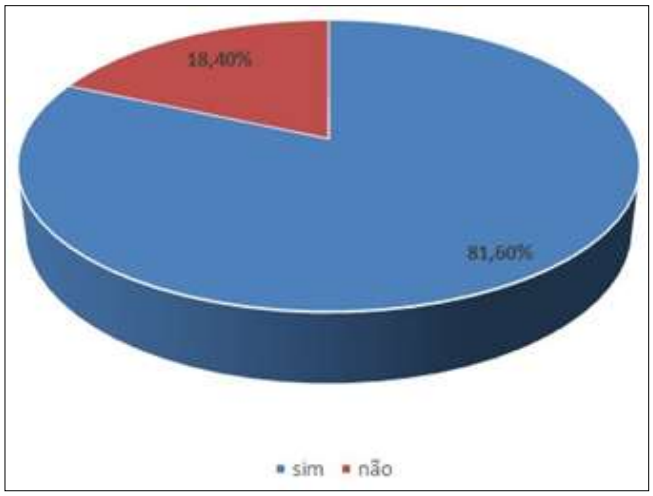
***Source*:** The Authors (2020).

Fig 3: Graphic about the knowledge of clinic staff regarding the correct management of waste.

According to Figure 4, it was observed that 81.6% of the interviewees admitted that they collected the films used for proper disposal, while 18.4% discarded them in the collection of common garbage. Despite being in the minority, as observed in this study, this attitude of inadequate disposal by Dental Surgeons, can cause problems in relation to the environment, corroborating the studies described by [9], when they stated that there are many gains from the use of radiology for dental practice, but the rejects generated in the use of this practice are treated incorrectly, since they are disposed of inappropriately. [10] determined that in case the radiographic film contains lead film and black paper, it should not be disposed of in ordinary waste.

In the survey carried out by [7], only 48% of respondents passionately believed that X-ray films would be a dangerous waste, while 36% were unsure. Only 56% of Dentists collected X-ray films separately to be disposed of at local waste collection agencies, and only 23% of the population studied, delivered the substances for recycling.

[9] showed that to obtain the conventional radiographic image, it is necessary to use the radiographic film, which is composed mainly of emulsion and base. The gelatin that forms the emulsion is impregnated with crystals of halogenated salts (bromide or iodide) of silver. The base is a support of plastic material on which the emulsion is placed. A black, opaque paper wraps the intraoral radiographic film, who is packaging also features a lead blade, to protect it from secondary radiation, and a plastic wrap.



***Source*:** The Authors (2020).

Fig 4: Graphic about the appropriate destination for radiographic films by the offices.

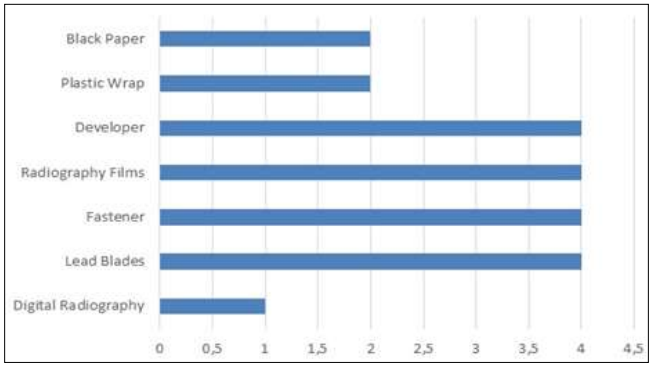
In the studies reported by [11], they described that each film produces 0.8 g of lead, 0.5 g of paper and 0.9 g of plastic as a residue, therefore, knowledge on the part of the Dental Surgeons of these contaminants contained in the radiographic film so that they can dispose of their waste correctly.

[12] claim that a biomedical waste management program cannot be successfully implemented without the devotion, motivation, willingness, cooperation and participation of all sectors, employees of any health establishment. Developing a system and culture through training, education and persistent motivation of professionals and dental staff is a more imperative component of waste management plans, therefore it is necessary to identify existing recycling programs according to what was described by [13], where they stressed that "recycling" is the best way to think about ecology. However, "Rethinking" is the first step to being green and "Reducing" and "Reusing" are more effective than "recycling".

It is essential to conserve the environment for the well-being, for the physical and mental health of people and in this way environmental health aims to detect these risks. Thus, it can be said that the risk to the environment is the probability of adverse effects, due to the presence of physical, chemical, or biological agents that cause potentially dangerous conditions triggered by any activity.

Figure 5 shows the risk levels of materials discarded inappropriately in the Risk Worksheet, where the types of Risks in High, Medium, and Low were specified, assigned according to the damage caused due to incorrect disposal. These Risk Types were measured with values of 4, 2 and 1, respectively, according to Table 1.

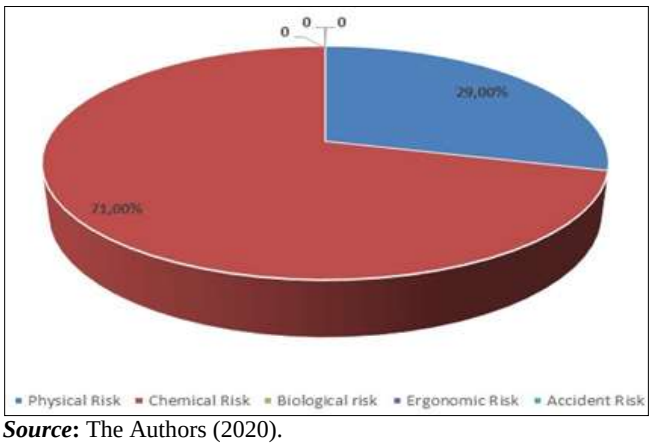
Regarding the activity developed by Dental Surgeons related to the performance of intraoral radiographs, which are part of a diagnostic routine through complementary exams, it was observed that this activity can generate Environmental Risks, since radiographic films involved in a plastic wrapper, which should be discarded along with the lead film, after radiographic takes on patients. In addition, to evaluate the radiographic image, it will be necessary to process the films, using the revealing and fixing substances.



***Source*:** The Authors (2020).

Fig 5: Risk levels of discarded materials.

It was then possible to verify, according to Figure 6, that these activities can be considered of high and medium risks to the environment, depending on the way they are handled and discarded by the Professionals. Since the risks generated are considered physical (29%) in relation to the use of X-rays and chemicals (71%) represented by the contaminants in the developer and fixing solutions containing heavy metals and silver, which must be discarded in special containers so as not to contaminate the sewage networks and water sources and rivers. According to [9], the radiological materials used, when not properly disposed, produce environmental and health risks for the population. The residues of these materials, including those left in the chemical solutions used during radiographic processing, are considered toxic to humans. The risk to the environment is the probability of adverse effects, due to the presence of physical, chemical, or biological agents that cause potentially dangerous conditions.



***Source*:** The Authors (2020).

Fig 6: Risks produced by incorrect disposal.

The concentration of heavy metals beyond what is acceptable for disposal in the solution used in the fixation step may constitute a risk factor for the health of aquatic and terrestrial organisms. Due to the toxicity of heavy metals, damage to the central nervous system, liver system,

hematopoietic system, renal system, and skeletal system can be mentioned, among the adverse effects caused [14].

With the results obtained in this research, it is observed that the ecological Dental Surgeon does not need to be an environmentalist, so that one can perform Green Dentistry or more ecologically sustainable. Thus, in a proactive approach, this professional will allow Dentistry to succeed in a time of growing environmental concern through the knowledge of environmentally protective legislation. Dental Surgeons are increasingly concerned about the impact that Dentistry can cause on the environment and taking voluntary measures to reduce the production and the environmentally hostile release of waste should be part of their daily practices.

4. Conclusions

The dental professionals surveyed, demonstrated to have knowledge of the polluting potential that the work activity carried out without the environmental awareness can cause to the environment and health of the population.

Despite this knowledge, many do not adopt in their establishments, conducts that will avoid the harmful effects caused by these contaminating conducts.

Dentistry professionals need to adapt and follow the regulatory rules in force in the country in relation to environmental standards, as well as to become aware of the risks related to their professional activities in relation to contamination and environmental degradation, caused by the incorrect disposal of Radiographic Waste generated in their health units and thus be able to practice Green Dentistry aimed at protecting and conserving the environment, contributing to a healthier professional practice, also preserving future generations.

Professionals need to adapt and follow the laws and regulations in force in the country, as well as become aware of the risks related to their professional activities in relation to their health and those who work in their health unit, the contamination and environmental degradation caused by disposal of radiographic waste generated in their health units.

Based on the responses obtained with the association of the variables used in the research, it can be concluded that the professionals who completed their courses after the year 2000, who use digital radiographs, may be causing less damage to the environment because they understand that this technology does not it needs processing of the radiographic film and therefore also does not perform the manipulation of the revealing and fixing substances.

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