



# A qualitative descriptive case study on home medical waste management in Brazil

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## Abstract

This work presents a survey on the management of the home medical care waste (HMCW) from the municipality of Caruaru, an important medical and economic center in the Brazilian Agreste. The cross-sectional study was conducted on 67 stakeholders (health professionals and patients/caregivers), who were interviewed in the work environment (headquarters of the home medical care and/or residence they assisted). The results revealed that more than 55% of the caregivers are of the female gender and more than 30% present a first-degree family bond with the patient. The estimated mean generation of HMCW was of 1.68 kg/patient per month, with segregated collection and proper disposal of sharp materials only (0.8 kg per month  $\approx$  1%). The remainder of the HMCW is discarded together with the common waste generated in the residence. The lack of standardization in both caregiver guidance and the training of health professionals is a limiting factor for the correct management of HMCW. The municipality should integrate HMCW management to the regular medical waste management to comply with the current legislation, protecting the environment and public health.

**Keywords** Developing countries · Home medical care · Medical waste management · Primary health care

## Introduction

Home medical care (HMC) is a multidisciplinary service which involves a series of procedures performed by health professionals in the domestic environment, encompassing from the short-term care to complex and long-term activities, such as the advanced treatment of chronic diseases [1]. Given population aging and the increase in the number of people in need of ongoing care, HMCs have been giving

an important support to the health systems in the reduction of the saturation in hospitals and in the improvement of the patients' life quality [2], especially in the developing countries.

According to Zikhathile and Atagana [3], South Africa acknowledges HMCs as a strategy to relieve the burden on health services, while maintaining the necessary care for the community. In Brazil, 1157 public HMC teams act in the national territory, by multi-professional groups (doctors, nurses, physiotherapists and nursing technicians) and home caregivers [4]. In Japan, with the rise in life expectancy, home care has become a basic requirement for the population, reaching 4655 HMC offices in 2016 [5]. In the United States, more than 2.1 million home care workers provide personal assistance, in home and community environments [6].

Despite the countless benefits, the growing trend of home health service provision has resulted in the inappropriate discard of potentially harmful waste, resulting from the procedures, especially in less developed countries. According to the World Health Organization, medical waste is defined as all waste generated in health facilities, research centers, laboratories of medical procedures and smaller and scattered sources, such as home medical care waste (HMCW), and it

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stands out due to the potential risk that a portion of waste (10–25%) poses to health and the environment [7].

Although the basis of discussion on medical waste management is related to the spaces that provide health services (hospitals, clinics and similar), since they are the main producers, there is a growing concern regarding home health care which, sometimes, are complex, prolonged and capable of generating medical waste. When not managed correctly, medical waste can be a vehicle for the spread of infections and the transmission of diseases, by direct and indirect contact, in the environment [8]. HMCW can enter the flow of the municipal solid waste, transforming common waste into potentially infectious, resulting in an increase in the cost of the treatment and discard. Ikeda [5] highlights that the rates of infectious medical waste collection derived from HMC, in big Japanese cities, were low compared to the small cities. Ikeda et al. [9] highlight that, after 13 years, despite improvements in the collection of HMCW, educational actions for the management of this waste are still needed.

There are still few studies on HMCW management. Miyazaki et al. [8] demonstrate accidents suffered by people who work with collection, when transporting HMCW in Japan. Markkanen et al. [10] show that the diverse practices of discard and the reuse of sharp waste (for cost savings or convenience) have intensified the dangers for caregivers, waste handlers and community members in the USA.

HMCW management represents a challenge that is still bigger to the developing countries, considering the limitations of technical, financial and human resources, besides the lack of investment and clear policies [11, 12]. As a consequence, the studies of Hangulu and Akintola [11], Kang'ethe [13] and Zikhathile and Atagana [3] show the inappropriate discard of HMCW together with domestic waste, in open places, buried or burned.

In Brazil, medical waste management is regulated by the Brazilian Health Surveillance Agency [14] and by the National Environment Council [15]. The Brazilian legislation holds the medical waste service provider (considered as waste generator), either private or public (municipality), responsible for the appropriate management and disposal of medical care waste (MCW). The generators of MCW must prepare a document (management plan) showing all steps of management (segregation, storage, collection and transport, treatment and discard), according to MCW typology (whether dangerous by composition—biological, chemical, radiological risks or if sharp—or not dangerous), considering the prevention of work accidents, impacts on public health and damages to the environment [14]. Despite the current legislation, MCW management in Brazil is still alarming, since a good part of the waste has inappropriate disposal. According to ABRELPE [16], the main destinations of MCW in Brazil are: (i) incineration (43.4%); (ii) autoclaving (21.6%); (iii) microwave (4.8%); and (iv)

sanitary landfills, septic ditches or dumpsites, without previous treatment (30.2%).

The legislation described above for MCW management is also applied to HMCW management. The MCW produced in households must be managed (stored, identified, collected, treated and disposed) in a correct way by the service provider, being it either private or public (municipality) [14, 15]. Nonetheless, in municipal HMC, the disposal of HMCW together with domestic waste (with the collection of only the sharp waste by the HMC teams, at the moment of service) is a very common situation, as shown by Alves et al. [17], Cordeiro et al. [18], Silva et al. [19] and Siqueira and Consoni [20].

The described overview shows a real need for research on HMCW management, given the importance and the growth of the service which complements primary health care, in Brazil [4], especially, in medium and large cities. Caruaru, a medium-sized municipality, considered the largest medical center in the region of the Central Agreste in the state of Pernambuco (Brazil), has a network composed of three HMC teams to meet a population of 365,278 inhabitants [21]. Caruaru is one of the most important municipalities that compose the textile chain in Brazil, with the 6th highest GDP in the state of Pernambuco. Given its strategic importance, Caruaru has become an attractive municipality for the migration of people from surrounding municipalities who seek job opportunities in the textile sector and better medical care conditions, overloading the city's infrastructure. Given the exposed, the municipality of Caruaru was used as the place for the performance of a survey on the management of the HMCW from public health services.

In addition to the important contribution to the research on the management of this type of waste, the results of this work can guide service provision, assisting public authorities to formulate plans and strategies for the correct management of HMCW.

## Materials and methods

### Study area

Caruaru, located in the Northeast region of Brazil, is the most populous municipality in the interior of the state of Pernambuco, with an estimated population of 369,343 inhabitants in 2021, distributed in a territory of 923 km<sup>2</sup> [22]. With the Human Development Index (HDI) of 0.677 and Gross Domestic Product (GDP) of 7.14 billion [21], Caruaru was selected for the study, for its prominence as one of the most important economic, cultural, academic, tourist and medical-hospital centers in the region.

Caruaru, with 517 public health units (general hospitals, specialized hospitals, clinics, basic health units,

among others), is the second largest medical referral center in the State of Pernambuco, only behind the capital [21]. Widely distributed in the Brazilian municipalities, HMCs are inserted in the public health units as a modality integrated to the network of basic health units in the country. Figure 1 shows the comprehensiveness of the three HMC units, within the urban zone of Caruaru.

Each HMC team in Caruaru (HMC1, HMC2 and HMC3) is composed of one doctor, one nurse, one physiotherapist and three nursing technicians. The teams provide complementary services to those performed in fixed health units, such as dressings, drug administration and collection of material for exams. The frequency of HMC visits is weekly, and it can be daily, based on the user's demands. HMC acknowledges the caregiver, who can be a family member or a friend, as a key actor in the continuity of home health care.

## Research design

The study used a cross-sectional design to obtain quantitative and qualitative data, applying questionnaires, secondary data, interviews with the health professionals and field visits (headquarters of the HMC teams and assisted residences). The study encompassed the three HMCs in the municipality of Caruaru, with all health professionals (18 health professionals) and all caregivers/patients (49 caregivers/patients), as shown in Fig. 1, who were receiving home visits in the

period from October to December 2019. In this period, structured (questionnaire) and semi-structured (with open questions) interviews were performed, described in the section “Data collection and analysis” below.

## Data collection and analysis

As a tool for data collection, interviews with open questions and of multiple choice (questionnaires) were used. The interviews were developed based on literature review, as well as national [14, 15] and international guidelines on medical waste [7], according to the target group (HMC health professionals and caregivers/patients).

The interviews of the health professionals were subdivided into three sections, with questions referring: (i) to the sociodemographic characteristics (multiple choice—gender, profession, work history, professional qualification); (ii) to the communication and training relationships between the HMC teams and the caregivers (open questions/multiple choice); and (iii) to the knowledge, attitudes and practices of HMCW management and characterization (open questions/multiple choice). The interview of the caregivers/patients addressed sociodemographic questions (gender, age, schooling, occupation) and the main management practices of the waste generated in daily care (open questions/multiple choice). All interviews were conducted personally and individually. The health professionals answered in the

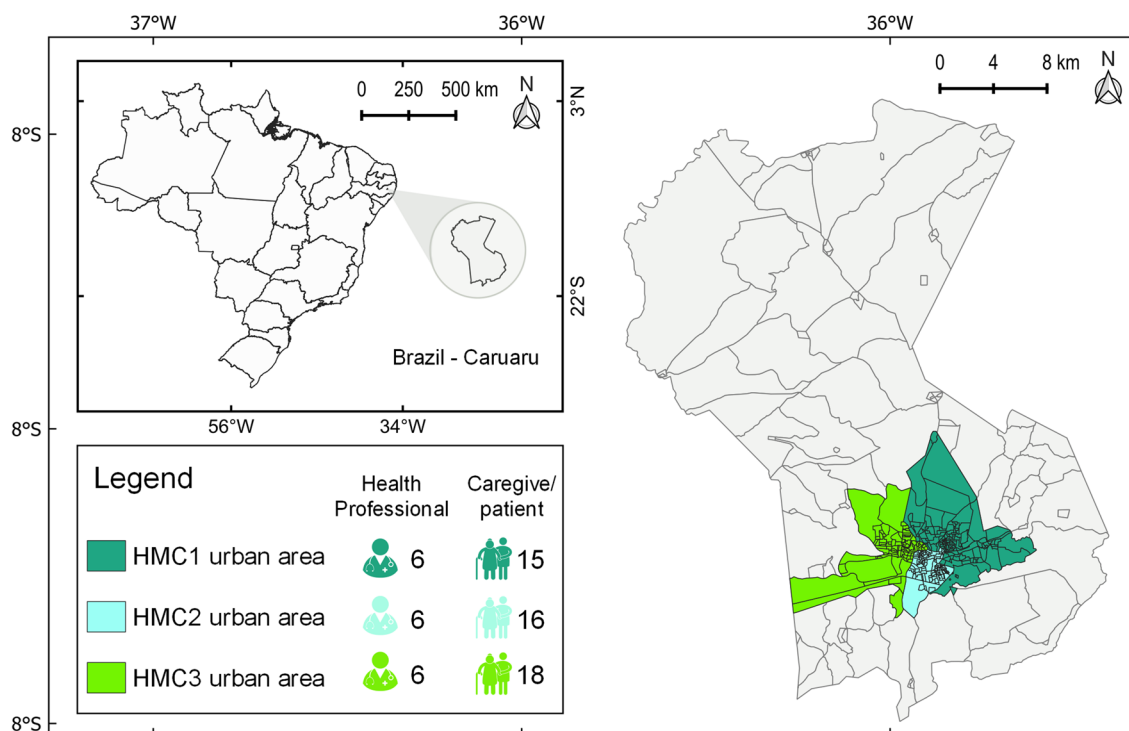


Fig. 1 Location of the municipality of Caruaru and distribution of the HMCs

workplaces of each HMC and the caregivers, in the patients' residences, during the visits with the HMC health teams.

At the time of the visits to the residences for the interviews, the practices in service provision and medical waste management were observed. Monthly, the HMC teams request a list of materials (medical-hospital supplies, supplies and medicines necessary to perform the home medical services) to the Health Secretariat of Caruaru. Based on the data provided in the materials lists, it was possible to estimate, albeit indirectly and conservatively, the amount of waste generated at each HMC, in the period of study. For this, the amount of material requested was considered, as well as the weight of each item, obtained by direct weighing (on an electronic scale) or on the packaging information.

### Ethical considerations

The ethical approval was obtained by the Research Ethics Committee (CET) of the Federal University of Pernambuco (CAAE: 13,311,719.0.0000.5208). Before data collection, the consent form informing the purpose of the study, the free decision to participate or refuse and the guarantee in relation to the data for research purposes was made available to all participants. This procedure was necessary so that, within the ethical standards, the integrity and dignity of the people involved in the study were preserved. All respondents were informed they could withdraw from the study at any time.

## Results and discussion

### Sociodemographic characterization of those involved in the research

Table 1 shows the sociodemographic characteristics of those involved in the research. Most of the caregivers is of the female gender, with percentages superior to 86% in HMC1 and HMC3. Regarding the age group, 66.7% of the caregivers of HMC1, 50% of HMC2 and 55.6% of HMC3 were between 40 and 59 years old.

A significant number of the caregivers have first-degree family bonds (daughters/sons) with the patients in HMC1 (46.7%) and HMC3 (61.1%). In HMC2, most of them were the patient's spouse (43.8%). Home care has, as a criterion for the inclusion of patients, the presence of the caregiver in the daily activities, so there will be no rupture of the care provided by the HMC. In this study, most of the caregivers were exclusively dedicated to the patient, having declared they did not work outside home, especially in HMC1 and HMC2, which presented a percentage equal or superior to 80%. The prevalence of patients considered elderly (above 60 years old), according to the Brazilian legislation [23], in the three HMCs, 73.3%, 62.5% and 88.9, respectively,

validates the need for palliative care and the importance of the home medical care services.

Regarding the level of schooling, the percentage of the caregivers who did not enter or did not complete high school in HMC1 (80%), HMC2 (56.3%) and HMC3 (55.6%) reinforces the need for a greater encouragement to conduct an educational and illustrative work for the care with the patient's health. The creation of support networks, by actions of education and knowledge on health and waste management, are important mechanisms to strengthen the interaction among caregivers, patients and home health professionals, considering that the care practices and waste management remain, after the visits of the HMC team. Zikhathile and Atagana [3] verified that, in South Africa, most of the home caregivers had not completed high school; nevertheless, around 60% had complete primary education, and thus they could be educated in terms of home care and the risks associated to medical waste.

Regarding family income, the predominance of families with an income of up to one minimum wage was observed in all HMCs, 50% of which in HMC3, the highest percentage, followed by HMC1 with 46.7% and HMC2 with 37.5%. The average income of the families was of 1.64 minimum wages, a value close to the result found by IBGE [22], for the average monthly wage in the municipality of Caruaru, of 1.7 minimum wages.

Regarding health professionals, a predominance of the female gender is observed in all HMCs, except for HMC3. Half of the health professionals of HMC1 and HMC3 had 5–10 years of experience providing this service. HMC2 had professionals with working time from less than 1 year (33.3%) to more than 10 years (16.7%).

All health professionals who claimed they had specializations in the areas of professional practice in HMC1 (33.3%), HMC2 (50%) and HMC3 (50%) were graduated (Table 1). It is highlighted that one graduated professional in HMC1 and all professionals at the technical level did not mention specializations or complementary courses in the field of graduation.

### Medical waste generation and management practices in the HMCs

The procedures derived from home health care (including those performed by the HMC teams and those performed by the caregivers) demand equipment, materials and medicines that, according to the legislation, must be supplied by the healthcare provider [24]. The Health Secretariat of the municipality of Caruaru provides the inputs monthly requested by the HMC teams for the provision of the service at home, as presented in Fig. 2.

The types and amounts of materials requested vary according to the procedures and the clinical profile of each

**Table 1** Sociodemographic characteristics of the respondents

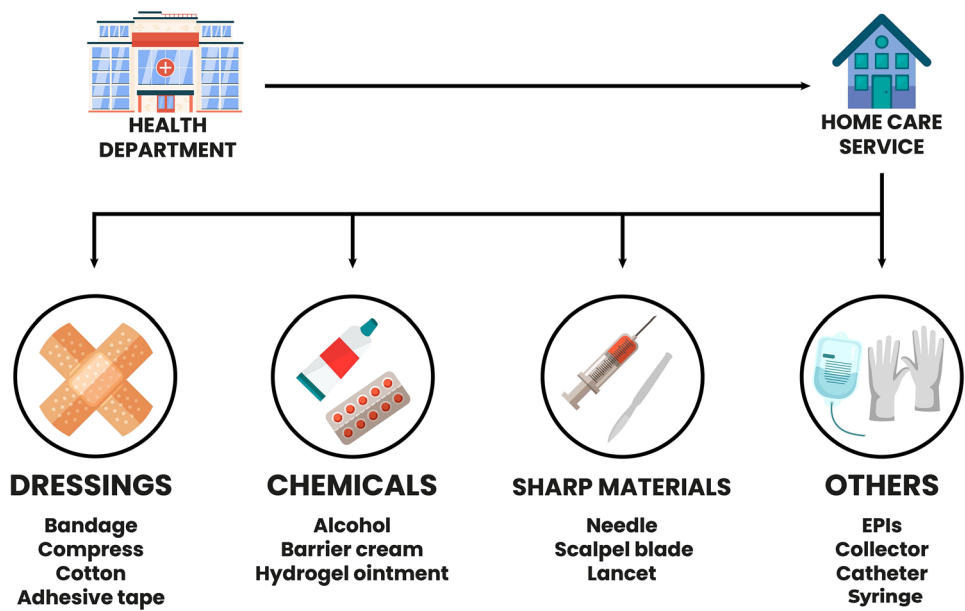
	HMC1		HMC2		HMC3	
	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%
Caregiver						
Gender						
Female	13	86.7	9	56.3	17	94.4
Male	2	13.3	7	43.8	1	5.60
Age of the caregivers						
18–39	3	20.0	2	12.5	4	22.2
40–59	10	66.7	8	50.0	10	55.6
≥ 60	2	13.3	6	37.5	4	22.2
Age of the patients						
18–39	1	6.70	1	6.30	0	0.0
40–59	3	20.0	5	31.3	2	11.1
≥ 60	11	73.3	10	62.5	16	88.9
Relationship with the patient						
Friend	2	13.3	1	6.30	0	0.0
Spouse	3	20.0	7	43.8	3	16.7
Daughter/Son	7	46.7	5	31.3	11	61.1
Others	3	20.1	3	18.8	4	22.4
Occupation						
Do not work outside home	12	80.0	14	87.5	12	66.7
Work outside home	3	20.0	2	12.5	6	33.3
Level of schooling						
Did not enter/conclude high school	12	80.0	9	56.3	10	55.6
Complete high school	2	13.3	4	25.0	4	22.2
Complete/incomplete higher education	1	6.70	3	18.8	4	22.2
Family income (MW–minimum wage)						
Up to 1 MW	7	46.7	6	37.5	9	50.0
From 1 to 2 MW	5	33.3	4	25.0	3	16.7
From 2 to 3 MW	3	20.0	5	31.3	5	27.8
From 3 to 4 MW	0	0.0	1	6.30	1	5.60
Health professional						
Gender						
Female	6	100	5	83.3	2	33.3
Male	0	0.0	1	16.7	4	66.7
Working time in the HMC						
< 1 year	0	0.0	2	33.3	1	16.7
1–5 years	3	50.0	1	16.7	2	33.3
5–10 years	3	50.0	2	33.3	3	50.0
> 10 years	0	0.0	1	16.7	0	0.0
Specialization course						
Yes	2	33.3	3	50.0	3	50.0
No	4	66.7	3	50.0	3	50.0

patient. In the period of study, the inputs requested by the HMC teams were very similar, in quality and quantity, demonstrating that the patients have equivalent needs.

Based on the lists of requested inputs, it was possible to estimate the amount of waste generated, monthly. Table 2 demonstrates that the materials for dressing (gauze and bandages) and gloves were the most requested inputs in

terms of mass (kg) and, consequently, the waste derived from their use, considered potentially infectious by the Brazilian legislation, are the most produced by each HMC. Alves et al. [17] demonstrated that the inputs used in dressings (46.6%) and sharp material waste (22.2%) were the main wastes generated from home care in the municipality of Goiânia (Brazil). Cordeiro et al. [18] also highlighted the

**Fig. 2** Inputs requested for service provision at each HMC



**Table 2** Monthly mean of the amount of the materials requested by each HMC

	Quantity of the monthly material								Total (mean) %
	HMC1		HMC2		HMC3		Total HMC		
	Units	kg	Units	kg	Units	kg	Units	kg	
<b>Infectious</b>									
Gloves	1606	8.6	2727	15.4	920	5.5	5253	29.5	35.8
Gauzes	740	11.5	630	7.5	812	9.6	2182	28.6	34.7
Syringes	14	0.1	18	0.2	16	0.1	48	0.4	0.5
Catheters	53	0.4	15	0.1	0	0	68	0.5	0.6
Test strips	70	0	100	0.1	80	0	250	0.1	0.1
Urine collection bag	3	0.2	5	0.4	2	0.2	10	0.8	1.0
Enteral feeding tube	12	0.3	15	0.3	3	0.1	30	0.7	0.8
<b>Total</b>	<b>2498</b>	<b>21.1</b>	<b>3510</b>	<b>24</b>	<b>1833</b>	<b>15.5</b>	<b>7841</b>	<b>60.6</b>	<b>73.5</b>
<b>Chemicals</b>									
Essential fatty acid	10	1.2	7	0.8	26	3.1	43	5.2	6.3
Hydrogel	34	0.9	27	0.7	8	0.2	69	1.7	2.1
Barrier cream	3	0.2	7	0.4	6	0.4	16	1	1.2
<b>Total</b>	<b>47</b>	<b>2.2</b>	<b>41</b>	<b>1.9</b>	<b>40</b>	<b>3.7</b>	<b>128</b>	<b>7.8</b>	<b>9.5</b>
<b>Common</b>									
Infusion device	0	0	20	0.4	18	0.4	38	0.8	1.0
Ethyl alcohol	1	0.9	1	0.9	1	0.9	3	2.7	3.3
Bandages	24	2.9	33	3.6	28	3.1	85	9.5	11.5
Serum bottle	6	0.1	0	0	0	0	6	0.1	0.1
<b>Total</b>	<b>31</b>	<b>3.9</b>	<b>54</b>	<b>4.9</b>	<b>47</b>	<b>4.3</b>	<b>132</b>	<b>13.1</b>	<b>15.9</b>
<b>Sharps</b>									
Lancet	70	0.2	100	0.3	80	0.2	250	0.7	0.8
Scalpel blade	0	0	0	0	30	0	30	0	0.0
Needles	14	0	18	0	16	0	48	0.1	0.1
Intravenous infusion device	6	0	3	0	0	0	9	0	0.0
<b>Total</b>	<b>90</b>	<b>0.2</b>	<b>121</b>	<b>0.3</b>	<b>126</b>	<b>0.3</b>	<b>337</b>	<b>0.8</b>	<b>1.0</b>
<b>Total</b>	<b>2666</b>	<b>27.4</b>	<b>3726</b>	<b>31.2</b>	<b>2046</b>	<b>23.8</b>	<b>8438</b>	<b>82.4</b>	<b>100.0</b>



strong presence of inputs used in dressings and sharp materials in home care in Ribeirão Preto (Brazil).

The teams from HMC1, HMC2 and HMC3 demanded, on average, 27.4 kg, 31.2 kg and 23.8 kg of materials per month, respectively. The materials used in the procedures become wastes with potential risk, because of the presence of biological agents (in surgical gloves, bandages, compresses, catheters etc.), chemical substances (in bottles and medicine remains) and sharp materials (blades, needles and lancets). Using the data from Table 2 and considering, conservatively, that all materials which were used in home care were converted into waste, a production of 1.83, 1.95 and 1.32 kg/patient/month in HMC1, HMC2 and HMC3, respectively, can be estimated, based on the number of patients assisted by each HMC in the period, with a total mean of 1.68 kg/patient/month and total production of 82.4 kg/month. The materials with a possible presence of biological agents represent 73.5% of the waste produced daily by HMC (Table 2). According to the World Health Organization [7], biological waste must always be considered as a waste with potential presence of pathogenic microorganisms, which happens because the presence or absence of pathogens cannot be decisive at the moment the waste is produced or discarded.

Except for the sharp waste, collected after the procedures performed by the HMC team, all residues (used gloves, probes, gauze and cotton, as well as leftover medication) were left in the residences for disposal by the family. Since there was no selective collection for these materials, the disposal used to be performed together with ordinary waste which, subsequently, was collected by the municipality and sent to sanitary landfills for non-hazardous household waste.

Regarding to the sharp materials, there is a particular concern because of the capacity of transmitting diseases and the occupational risk for all individuals who handle or come into contact with the waste. Matee and Manyele [25] highlighted the sharp waste as the most lethal and dangerous among the health waste, given their capacity of lacerating the skin and causing infections. Therefore, despite representing, in terms of mass, a smaller percentage (1%) (Table 2) among the home medical waste, sharp materials occupy a place of prominence, not necessarily by the amount generated, but by the potential risk they present to the environment and public health. Only the sharp waste, used at the moment of the visit of the HMC teams, were stored in rigid collectors (specific for sharp waste) and collected for destination together with other health service wastes generated by the municipality. Other sharp waste, used in the daily procedures of the family, such as those of self-administration of insulin and self-monitoring of blood glucose, were also discarded together with the ordinary domestic waste. The practice of collection of only sharp waste, generated in the service of the HMC teams, is also shown in the study of Siqueira and Consoni [20] in HMCs in the Metropolitan Region of São

Paulo, Brazil. The potentially pathogenic waste, when incorrectly discarded together with the common waste produced in the residences, results in contamination of the common waste, increasing the volume of potentially dangerous waste.

In countries such as South Africa, Ghana and Botswana, HMCW is discarded together with the common domestic waste, burned or buried [3, 12, 13, 26]. Sonmez et al. [27] verified that 84.1% of the caregivers used to discard home medical waste together with domestic waste, in the city of Kahramanmaras (Turkey). It is also highlighted that the inappropriate discard of home medical waste poses a risk to the health of waste pickers and garbage collection workers. In Japan, municipal collection workers were concerned about accidents when collecting or transporting waste, where 33.9% of the 59 municipal governments have reported accidents and almost all of them have experienced accidents with needles [8].

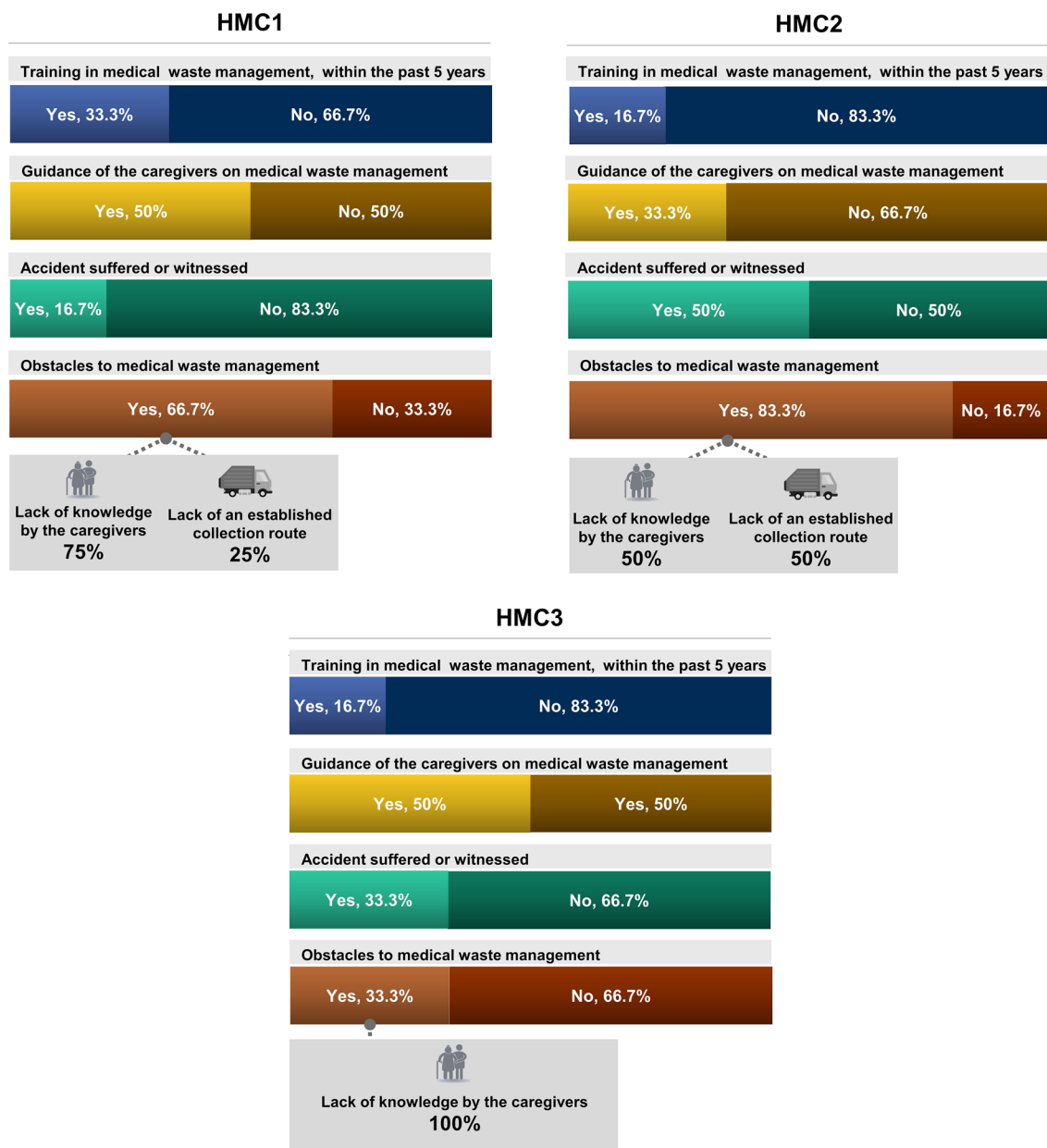
The data obtained in the visits and interviews reveal that a part of the HMCW is eventually discarded as ordinary domestic waste, transforming the waste into potentially dangerous. Furthermore, the lack of specific containers for the storage of HMCW in the residences makes segregation difficult. As a result, there is a failure to comply with the global policies of the World Health Organization which claim that, when the patients are sent for recovery in their own residences, the health service provider must provide to the patients the resources necessary for the correct storage, collection and discard of the HMCW [7].

The interviewed health professionals also claimed to have difficulties in using the HMC car to transport the technical team, the inputs and, at the same time, the sharp waste generated in the residences they visited. A similar challenge was discussed by Ikeda ([28] in Japan, indicating the concerns of the nurses in relation to possible injuries and bad smells of the transported waste. Kang'ethe [13] also reported the physical difficulties of health professionals in transporting, on foot, health waste to clinics.

### Qualification for the management of home medical care waste

Figure 3 shows a summary of the perception, awareness and management of HMCW. More than 65% of the HMC professionals reported they had not received any qualification/training for HMCW management, in the last 5 years. Many of these professionals are in the HMC teams for less than 5 years, although they routinely deal with this type of waste. Most of the professionals who have received qualification/training for HMCW management were nursing technicians.

Nursing technicians are also a majority among the HMC professionals and, besides being on the front line, they perform the greatest part of the visits. In a study performed in Shiraz, South of Iran, Lakbala and Lakbala [29] report that



**Fig. 3** Results of the answers by the HMC professionals

all interviewees (doctors, paramedic teams, nurses, assistants and other workers, such as cleaning and administration staff) were aware of the policies on medical waste in hospitals, regardless of their level of schooling. Odonkor and Mahami [30] verified that a high level of knowledge and the practice of a safe disposal of biomedical waste are related to a higher incentive to training programs and not, necessarily, the degree of schooling.

Although HMC teams do not collect HMCW, 50%, 33.3% and 50% of the health professionals of HMC1, HMC2 and HMC3, respectively, informed they provided some guidance to the caregivers in relation to the storage

of HMCW, such as the use of gloves when handling the waste, plastic bag and individual bin in the patient's room, to prevent the waste generated in home care from being mixed with the waste produced in the other domestic environments. Although more than 30% of the HMC professionals used to guide the caregivers regarding HMCW management, there is a lack of standardization of the procedure among the HMCs themselves. The lack of guidelines for HMCW management results in the adoption of specific actions by the health professionals, which derive from their level of knowledge on the subject.



According to Hangulu and Akintola [26], the lack of funding, training and clear policies on HMCW results in the management practices of this waste staying, sometimes, at the discretion of the health professionals. Furthermore, the lack of published reports on the damage associated with the flow of hazardous waste in residences contributes to the negligence in managing this type of waste, especially in developing countries [12].

In the HMCs of Caruaru, the small number of professionals trained for the guidance on HMCW handling, together with a low degree of instruction of the caregivers (more than 50% did not enter/conclude high school), suggest the need for a program of permanent education, and extensive to all HMC professionals, caregivers and patients. The training of the human resources involved in MCW management is mandatory and must be included in the management plans for this type of waste in Brazil [14]. The preparation of a plan for medical waste management must be developed by the health teams or managers, so it can be implemented to assist all those involved in the service, including caregivers, since they receive inputs from the health teams and handle waste without the presence of home care professionals, during daily care [24].

Figure 3 also shows that 16.7% of the HMC1 professionals, 50% of HMC2 and 33.3% of HMC3 have witnessed or suffered accidents in HMCW management, especially with sharp materials, at the time of home care. All professionals who have witnessed or suffered accidents in the domestic work environment were nursing professionals, 80% of whom were nursing technicians, and 20% nurses. Marziale et al. [31] identified, by the electronic protocol records of the network for the prevention of accidents at work, that the health professionals, especially those of nursing, suffer accidents 21.4% of the times, performing the discard of sharp materials.

Regarding the main barriers for the correct HMCW management, the health professionals highlighted: (i) lack of a route for the collection and transport of HMCW, for 25% (HMC1) and 50% (HMC2). According to Sonmez et al. [27], the training of caregivers, although necessary, becomes insufficient without a collection system provided by the municipalities, especially when the caregivers handle the waste without the presence of the home care professionals. Miyazaki et al. [8] highlight the establishment of improved rules for the collection and transport of HMCW, besides the standardization of the service and cooperation of health workers, municipal governments and environmental agencies in Japan; and (ii) assuming the public power performs the collection, the lack of knowledge by the caregivers on the risk of the medical waste for most of the HMC health professionals may be an obstacle to the correct waste management.

Markkanen et al. [10], in a study performed in the United States, reported the importance of intervention at

the beginning of the system for the disposal of sharp materials at home, demonstrating that many patients, especially the diabetics, reuse sharp materials, such as needles, for cost savings or for convenience. This practice represents an occupational risk for both the users and the home care professionals who find these types of materials unexpectedly unprotected in the bed linen, cushions, chairs and tables of the assisted residences.

Ikeda [32] highlights that the schooling of nursing professionals is a key element in the guidance of the caregiver/patient in relation to health waste. In Japan, more than 75% of the public and private professionals advised their patients about segregation and storage, and almost 50% advised them regarding the discard of health waste. The work from Stokes et al. [33], in surgery clinics of the University of Utah (USA), indicated that the patients in the post-operative period, who received a kit for the discard of opioids and an educational booklet, started to discard it correctly after the incentive.

## Conclusion

The study provided an overview on HMCW management, showing management practices, estimates of waste generation and knowledge of the parts involved in the process. The home health caregiver is, predominantly, of the female gender, between 40 and 59 years old, with low level of education, with a first-degree family bond and takes care of elderly patients (above 60 years old).

The mean generation of HMCW was estimated in 1.68 kg/patient/month, based on the materials requested for home care. The health teams collect the sharp waste generated during home care to discard it together with the medical waste generated in the municipal hospitals and health centers. The other HMCW produced, during or after assistance, is discarded by the caregivers as home waste. The lack of standardization in the guidance of caregivers and in the training of health professionals, even when they present a higher degree of education, is one of the limiting factors to the correct management of HMCW.

A higher educational incentive, training programs and a higher involvement of the stakeholders in the creation of an awareness of the risks inherent in the inappropriate handling and disposal of HMCW are some of the measures to improve the management of this waste, preserving the health and safety of professionals, families and patients. The patients/caregivers could be advised to separate the waste for the home care team to collect during the visits. Furthermore, a greater involvement of the municipal managers in the standardization of HMCW management and a well-structured collection must be established in the municipality, for all people involved to know their roles and responsibilities.

The data and observations resulting from this research refer to the survey period. Despite this possible limitation, this study presents real data that can be used by municipalities in proposing guidelines for the correct management of HMCW in Brazil.

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