

Environmental Challenges of a Brazilian Basic Health Unit in Managing Sharp Waste Produced by Diabetics in Domestic Use

Simone Aquino, Instituto de Pesquisas Energéticas e Nucleares, Brazil*

Cristiane das Graças Dias Cavalcante, Associação Saúde da Família Municipal, Brazil

Maria Antonietta Leitão Zajac, Faculdades Oswaldo Cruz, Curso de Ciências Farmacêuticas, Brazil

Evandro Luiz Lopes, Universidade Nove de Julho, Brazil

ABSTRACT

The goal of this study was to analyze the management and reverse logistics of sharp wastes, such as needle syringes and lancets, from domestic use by insulin-dependent diabetics, which were attended by the Brazilian Unified Health System. This is an exploratory case study, carried out by from data collected from 233 insulin-dependent diabetics and interviews with a health professional from October 2014 to September 2015. It was estimated that, in one year, 68% of insulin users received standard biosafety boxes below the necessary quantity for the disposal of needles, syringes, and lancets. Around 1,300 kg of sharp wastes were generated and only 1,831 boxes were distributed, showing a deficit in the reverse logistic system and indicating that sharp residues were incorrectly disposed of in residential garbage. A new Brazilian model to distribute the standard biosafety boxes to diabetics to guarantee the correct environmental disposal of sharp wastes is necessary.

KEYWORDS

Diabetics, Domestic, Environmental, Logistic Reverse, Residues, Sharp, Waste

INTRODUCTION

Among the environmental topics discussed, the public control of urban and medical waste has gained notoriety, making it necessary to understand the role of Reverse Logistics (RL). As an example, in order to control the spread of an epidemic, the effective management of rapidly increased medical waste through establishing a temporary RL system is of vital importance, mainly in this COVID – 19 pandemic period (Yu, Sun, Solvang, & Zhao, 2020).

In both public and private health management, the waste generated by health service establishments deserves special attention in terms of their control and final disposal. However, disposal of medical waste from home, and for that matter, solid waste, varies tremendously around the world (Krisiunas, 2011).

Medical Waste Management (MWM) has become a critical issue as it poses potential public health risks due to its potential environmental pollution/hazards, and one of the challenges associated with MWM is the lack of policies and regulations (Awodele, Adewoye, & Oparah, 2016). According to the United States Environmental Protection Agency - EPA (2017) sharps disposal by self-injectors is not typically regulated, and self-injectors do not always know the safest disposal methods.

In Brazil, the legal guidelines about health waste disposal do not include management of the disposal of household produced (EcoDebate, 2011). The Resolution n. 222 of National Agency of Health Surveillance (Anvisa in portuguese) states that the Management of Residues of Health Services (RHS) is a set of management procedures. It seeks to minimize the production of health waste and disposal of any waste generated in a manner that is safe and efficient, aiming at the protection of workers, the preservation of public health, natural resources and the environment (Anvisa, 2018). The RHS are classified in groups, according to their nature and risks, in agreement with the Resolution n. 222 (Anvisa, 2018): group A (infectious waste); group B (chemical waste); group C (radioactive waste); group D (universal or common waste) and group E (sharps waste).

Diabetes Mellitus (DM) is a high-level, global-level chronic disease, and the number of people with diabetes has more than doubled over the past three decades. The use of hypoglycemic agents and a daily insulin injection are necessary because insulin is a hormone that regulates sugar in the blood that (when not controlled) severely damages several organs and systems (Telo, Cureau, Souza, et al., 2016).

The generation of E-residues is directly related to insulin-dependent diabetics. After the self-monitoring of blood, insulin-dependent diabetics also generate in their homes the residues of sharp wastes, which result from glycemic monitoring with lancets and insulin injections (Brazilian Society of Diabetes, 2009).

The International Diabetes Federation (IDF) reported that Brazil had about 14.2 million people with diabetes in 2015, but estimates show that 24.8 million people have glucose intolerance and generate sharp wastes. It is expected that by the year 2040 this will increase by 60%, rising to 48.8 million people with diabetes (IDF, 2015). In Brazil, it was responsible for 5.3% of deaths in 2011, with a mortality rate of 33.7 deaths per 100 thousand inhabitants (Iser, Stopa, Chueiri, et al., 2015).

A study carried out with Brazilian diabetics pointed out that the application of insulin at home was practiced by 88.5% of diabetics interviewed. Regarding blood glucose monitoring at home, about 80% of patients stated that they performed the test with a needle (lancet) for the collection of blood to be deposited on a reagent strip, which measures and reads on digital equipment the blood glucose level. After use, the lancet is also classified as a sharps waste (André, 2012). Ishtiaq, Qadri, Mehar, et al. (2012) reported that of 375 patients that used insulin in Pakistan, the majority of the patients discarded such used devices (syringes, 92%; pens, 75%; and lancets, 91%) in the household garbage collection bin.

It is noteworthy that insulin and necessary materials (needles, syringes and lancets) used by diabetics are distributed, at no financial cost, by the Brazilian Public Health System for insulin therapy in home, which are acquired from a public medical post known as Basic Health Units (BHU).

The Capillary Glycemic Self Monitoring (CGSM) is a public Brazilian program for diabetic citizens was initiated by the Municipal Health Office of São Paulo in 2005, and its two fundamental approaches for assessing glycemic control are the monitoring of glycosylated hemoglobin and the self-monitoring of glycemia. CGSM aims to register and attend the municipalities with insulin-dependent DM, allowing continuous access to the materials – strips, lancets, and syringes – that guarantee the CGSM, through the availability of capillary glycemia check devices (Secretaria Municipal de Saúde de São Paulo [SMSSP], 2017).

The Federal Brazilian Law n. 11,347 (2006) supports the free distribution of drugs and all materials necessary for diabetic patients enrolled in diabetic education programs. For insulin-dependent patients, they should be registered in the CGSM program and the supplies should be made available to them, according to medical request. Outflows should be recorded in the unit's computerised inventory control system, such as syringes (50 IU or 100 IU) and the 3-litre (L) container or box for sharps, in addition to NPH and Regular Insulins (SMSSP, 2017).

The registration and monitoring of the patient at BHUs ensures not only the availability of the monitor unit apparatus (for capillary glucose), but also the monthly scheduled delivery of lancets for finger-stick, reagent strips for glucose in the blood, syringes with needles and a collector container (disposable cardboard box) of 3 litres (L) for sharps disposal, as well as insulin (diabetic's kit), which are delivered according to scheduling and the needs of each diabetic in the BHU (SMSSP, 2017).

At a BHU, the Integrated Health Care Management System (called SIGA in Brazil) is operated by a software that enables the gathering of information about diabetic patients, such as the appointment of exams and consultations, as well as the articulation between units.

The CGSM is inserted in the SIGA and allows users to follow: the assistance from the inclusion, the location of the BHU (where the patient was initially registered), the amount of disposable material (lancets and syringes) that is taken monthly, the Diabetes Mellitus (DM) type, the accompanying physician and transfer allowance to the DM patient, while maintaining his/her history (SMSSP, 2017).

To provide best practice in integrated health care management, the BHU should also be a collection center for residues generated at home and should also perform RL post-use. Pinto, Fonseca, Santana, Morais and Souza (2011), when examining insulin-dependent diabetics who had used supplies for more than five years, realized there was a lack of guidelines, particularly for the management of disposable material, after the use of insulin. The authors also confirmed that diabetics had received orientations that focused only on the disease, not on sharp wastes management at home.

Therefore, to verify how the Responsible Technician nurse of the BHU manages the RL of sharp wastes generated in households by insulin-dependent diabetics enrolled in the CGSM programme in the SIGA system, as well as estimating the amount of type E residues generated in homes by collecting dispensed boxes from a BHU located in the North side of the city of São Paulo, we were led to the following research question: How does the CGSM programme contribute to the monitoring of the RL of sharp wastes generated at home by the insulin-dependent diabetics citizens of a BHU in São Paulo city?

Besides understanding the Brazilian CGSM programme, this study also aimed to measure the amount of waste generated during one year of follow-up care to diabetics registered in one Brazilian BHU.

METHODOLOGICAL APPROACH

Wang, Huang and He (2019) proposed a bi-objective mixed integer program combined with a Grey prediction model for reverse logistics network design of medical waste, which aims at minimizing both operating cost and environmental risk. The two objective functions were combined with a weighted sum and the model was validated with a real-world case study in Shanghai, China.

For the present study, the search was developed in a Brazilian BHU located in São Paulo city, belonging to the North Health Coordination of the Municipality of São Paulo. This BHU has a model of health care called Family Health Strategy (FHS), composed of seven teams, each team comprising of 1 physician, 1 nurse (technical responsible), 2 nursing assistants and 6 community health agents (Brazilian Decree n. 2,488, 2011; CEInfo, 2012). The project is following the research ethics guidelines of the National Health Council, by registration in the Brazil platform with approval n. 1,753,533.

The study was drawn from multiple sources of evidence, which included data from direct observation, interview, as well as searches in public and primary health system archives. This case study offers exploratory, descriptive and direct observation and seeks to acquire greater familiarity with the phenomenon of managing sharps waste through a documentary survey. The primary data was collected from the SIGA software, which stored records of the CGSM program. Of the total number of diabetics (n=350) enrolled in the CGSM programme, the selection criteria for the study required diabetics over 18; most of them performed more than 4 returns per year and took the complete kit containing insulin, syringes, lancets and the boxes (n=233). Diabetics looking for only one or two items separately were not considered.

The study period to collect the data about the amount (per month) of syringes (S), lancets (L) and boxes (B) for sharps provided for each patient by the CGSM was 29 October 2014 to 30 September 2015. For the bibliographical research, the following descriptors were used in the study: puncture residue, E-residue, insulin, syringes, needles, discard, household waste, health care waste.

The present study adopts, in the first phase, a qualitative approach, by obtaining information about the existence of the RL of the sharp materials distributed to patients by the BHU. A questionnaire based on a semi-structured script was applied to the chief and technical responsible (TR) nurse at the BHU;

it was also based on references and their respective theoretical assumptions for elaborating questions, based in a complex theoretical concepts (Martins & Pelissaro, 2005) presented in detail in Table 1.

In the second phase, this study aimed to investigate whether the CGSM programme would estimate the waste generated at home during over a year by 233 patients that were monitored monthly for the distribution of the syringes and lancets, as well as the dispensing of the standard cardboard box to collect the residues in their homes.

Data were put onto an Excel spreadsheet, and the SPSS computer software package was used to analyze the data. The hypothesis was that the monthly distribution of the 3 L standard cardboard box would be enough for the environmentally correct disposal of syringes and lancets by each of the patients in their homes and a p-value <0.05 was considered statistically significant.

Considering the maximum filling limit of up to 2/3 of the box according to Anvisa (2018), this study concluded that the ideal safe sharps disposal practices, with the total volume of S + L per filled box, would be 160 units, within the maximum allowed limit, since the disposal was of closed packages with 60 syringes and bags of 100 lancets. The weight of the full box was measured on an electronic digital scale and the maximum input limit per cardboard box corresponded to the value of 0.28 kg, regardless of the weight of the box.

RESULTS AND DISCUSSION

The profile of respondent was described as a 28-year-old woman with a complete third-level education, an undergraduate degree in nursing (5 years) who also had post-graduate degree. She has been working in the public service at a BHU and managing the service since 2011. She stated that the scope of

Table 1. Construct theoretical assumptions about RHS

Author	Theoretical presupposition
Brazilian Decree n. 2,488 (2011)	Predicts 3000 to 3500 patients aided by the Family Health Strategy (FHS).
Federal Brazilian Law n. 11,347 (2006)	Predicts the number of awareness campaigns needed to reach this population.
Federal Brazilian Law n. 11,347 (2006)	Predicts the number of inputs (syringes, lancets, insulin, and boxes) that will be distributed to diabetics and estimates the waste generated.
Secretaria Municipal de São Paulo (2017), Silva, Santana and Palmeira (2013)	Public power has shared responsibility for the product life cycle and its reverse logistics.
Pinto et al. (2011)	To prepare the diabetic for the correct disposal of E-waste and provide the collection container ready for use.
Resolution n. 222 (Anvisa, 2018)	Improper handling of perforated waste may increase the risk of accidents.
EcoDebate (2011), Majumdar et al. (2015), Costello and Parikh (2013)	The BHU is the proper location of RL for the collection container of sharps to be close to the patient's home.
André et al. (2012)	A qualified person must collect the collection container of sharps per person.
Tapia (2009), Majumdar et al. (2015)	The awareness of diabetics about the management of waste generated is one of the goals of RL.
Castro et al. (2014)	It is essential to know how much of the sharp supplies are provided by BHU or how many used syringes and lancets do not return to RL. This is valuable information for public waste management.
Mendes et al. (2012), André (2012), Bouhanick, Hadjadj, and Weekers (2000, p290)	Know how a professional manages the collection of waste delivered in plastic bottles.
Resolution n. 222 (Anvisa, 2018).	Occupational risks with health waste according to current legislation.
André (2012), Govender and Ross (2012)	Future perceptions of nurses on new strategies for the management of sharps waste generated at the home of insulin-dependent diabetics.

this BHU reaches a population of about 21,000 people, and 1,400 out of these people are carriers of Diabetes Mellitus, 350 of whom are insulin users enrolled in the CGSM programme of her BHU. The data presented was in accordance with the records of CEInfo, since the FHS team works with the families that live in its area of coverage and serves an average of 950 families, out of a population of 21,160 people, of whom 1,445 are diabetic, and 350 of these regularly use insulin and are enrolled in the CGSM programme (CEInfo, 2012). The perceptions of TR nurse and challenges about the RL of diabetic patient waste is demonstrated in Table 2.

Regarding the distribution of the cardboard box for the E-waste, the respondent stated that the BHU offers a 3 L box (according to the Brazilian standard) per diabetic, for discarding syringes, needles, and lancets after domestic use. The nurse also affirmed that the cardboard box is offered from 90 to 99% of the time. As to the box being provided ready for the use by insulin-dependent patients, the nurse pointed out that in less than 10% of the cases it is offered already mounted for the patient. The TR nurse herself admits the complexity in the cardboard box mounting for diabetic citizens.

During patient care, only in 9% of the cases is the maximum filling capacity of the cardboard box reported as being reached. Besides, the TR nurse emphasized that she had never reported the box filling limit. Contaminated sharps containers should be discarded when the filling reaches 2/3 of its capacity or when the filling level is five centimetres away from the edge of the cardboard box based on the RDC n. 222 (Anvisa, 2018). According to the respondent, the insulin-dependent patient is advised, from 90 to 99% of the time, on how to dispose of the cardboard box containing the contaminated E residues and about the RL.

Table 2. HSSWMP challenges and RL failures observed at BHU

Difficulties found in diabetic patient care	TR nurse answers
Quantification of the boxes to RL at BHU	We have already had situations where the boxes did not arrive at BHU, or there were delays in supply, in these situations we provided only the necessary supplies, such as syringes and insulin, for the control of diabetes. However, most of the time the boxes are available, but just in the volume of 3 L per patient.
Mounting the cardboard box	Preparing the cardboard box is not an easy procedure, even with the instructions described on the label, which may influence the improper storage of the sharps. We have already distributed the disassembled boxes, but we found them thrown in the trash outside near our BHU.
RL of the used cardboard box	We always advise, as far as possible, that after completing the box the patients should bring it back for final disposal at BHU. Some of the people with diabetes get the boxes, but they do not return with E-waste, so we know that there is a part of these sharps that are discarded in the household waste.
Quantification of the boxes used after RL	We only quantify the output or dispensing of the boxes when the diabetics consult and bring the medical request for insulin, needle syringes and lancets. We do not take into account the number of syringes per quantity of boxes needed for the disposal, and we offer a unit (box) of 3 L per patient. We do not compute the number of boxes filled or used per patient per month. We only collect for incineration, without counting or quantifying.
Diabetic Education Program	Diabetic patient counseling occurs at the time of the dispensation. My suggestion is related to the proper control and supervision of the use of sharp cutting residues, especially the care at the beginning of the patient's inclusion in the CGSM program, e.g., insulin application, assembly and monitoring of capacity and how to allocate the waste in the BHU. It would be nice to promote campaigns and lectures on care with the waste that they generate in their homes.

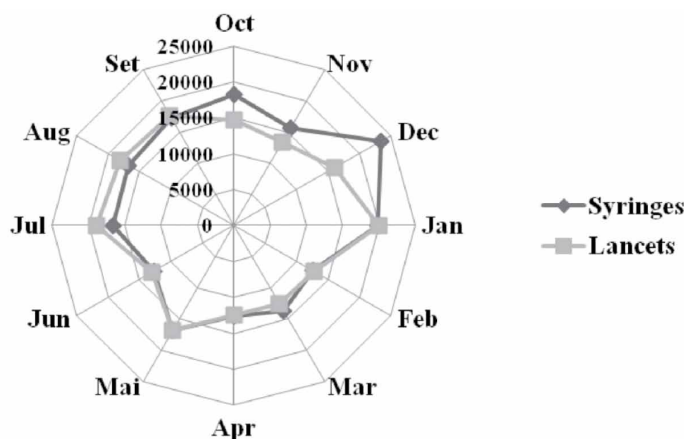
About the collection of boxes filled with sharp wastes by professionals (nursing assistants, nurses, and doctors) during the home visits made to these patients, the TR nurse responded that none of these three professionals made the collection at home. In Brazil, the Regulatory Standard NR n. 32/2005 provides health and safety at work in health services and states that, whenever transportation of the segregation vessel may compromise the safety and health of the worker, appropriate technical means should be used, in order to preserve their health and physical integrity (Brazilian Decree n° 1.748, 2011). Majumdar, Sahoo, Roy and Kamalanathan (2015) have reported that it is necessary to develop educational programmes that contemplate the awareness of users, which can help improve the management of waste from insulin-dependent patients.

In terms of the number of boxes with contaminated material with E-waste that are quantified in BHU (after their use by diabetics), the TR nurse replied that she only received the boxes for disposal, without quantifying them. The number of boxes was recorded when dispensing units at the time of the distribution of the kit. During documentary research in the SIGA system, no recording was found on the quantification of the boxes used or after the RL procedure. The record of the input of used containers would be helpful in following the waste management and verifying its effectiveness as well as minimizing health and environmental risks, as pointed out by Castro, Guimarães, Lima et al. (2014).

Concerning receiving sharp wastes in plastic bottles, the TR nurse responded that it has been receiving about 10% of the cases. An employee of the BHU does the transfer of the contaminated waste in a plastic bottle to a larger cardboard box according to Brazilian laws, destined for final disposal, and it is collected by an authorized company for incineration. However, when a health care professional transfers syringes and lancets from plastic bottles to larger boxes, there is a high risk of puncture injury. This practice is in disagreement with Brazilian Decree n. 1,748 (2011), which provides the elaboration and implementation of a plan for preventing risks of accidents with sharps and to reduce the exposure of biological agents, so as to ensure the workers' protection, safety and health of workers. Health workers' accidents with sharp materials involved needles containing blood as the principal causative agent and, among the most cited reasons, there are insufficient numbers collecting boxes (Dias, 2013).

According to the Brazilian Law n. 12,305 (2010), social control is characterized as a set of mechanisms and procedures that guarantee information and participation of the society in matters related to solid waste. Regarding the suggestions of the TR nurse on the care of boxes generated at home, the respondent stated that an education programme to diabetic patients is essential for the management of waste generated in their homes and for execution of the correct RL to the BHU. From the CGSM data, it was possible to measure the monthly quantity of syringes and lancets during the study period (Figure 1).

Figure 1. Record of the syringes and lancets provided monthly between October 2014 and September 2015



The data collected in this period showed that 186,252 lancets (L) and 196,130 syringes (S) were distributed. The total sum of the syringes and lancets dispensed within the period of one year presented the total value of 382,382 disposable materials (S + L). Considering the maximum weight of 0.28 kg per filled box, the sum of the weight in one year (kg/year) was 1,365.65 kg (Table 3).

Table 3. Monthly distribution of materials and total weight generated per month (2014 to 2015)

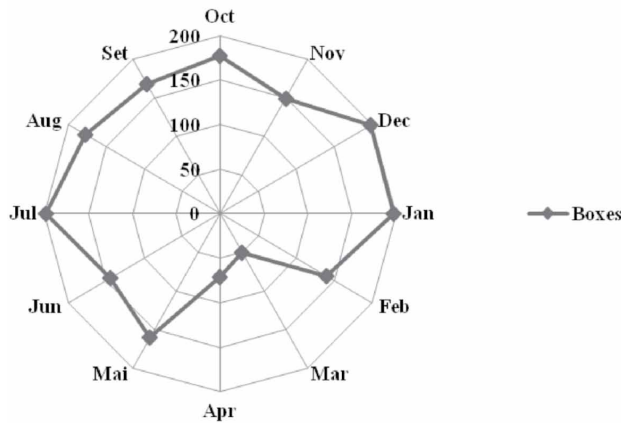
Month	Syringes (units)	Lancets (units)	Total inputs (S+L)	Weight in kg
Oct	18200	14645	32845	117.32
Nov	15745	13326	29071	103.83
Dec	23450	15997	39447	140.89
Jan	19891	20003	39894	142.48
Feb	12560	12778	25338	90.5
Mar	13659	12535	26194	93.55
Apr	12557	12493	25050	89.46
Mai	16820	16859	33679	120.28
Jun	12608	12997	25605	91.45
Jul	16687	18945	35632	127.25
Aug	16697	18088	34785	126.23
Set	17256	17586	34842	122.43
Total	196130	186252	382382	1365.67

According to the Brazilian Association of Public Cleaning and Special Waste Companies (2017), São Paulo observed a rate of health waste of 2.29 kg/inhabitant/year in 2015 and 2.27 kg/inhabitant/year in 2016. The sharps waste amount generated, according to this study, was 5.8 kg/diabetic/year. This was a higher amount than the Medical Waste (MW) generated at Mobile Prehospital Care (MPC) services, as demonstrated by Mendes et al. (2015) in a study in the State of São Paulo that reported a production of sharps waste in ambulances of 0.10 kg per 8 days (4.5 kg/year).

In a district-level hospital in South Africa each month, the 132 insulin-dependent patients received 850 needles, and there was no record of any sharps being returned to the hospital for disposal (Govender & Ross, 2012). In this study, therefore, the BHU dispensed in a year an 841 syringes total to 233 diabetics but, similarly to the African health system, no control of the waste returned to the unit was recorded.

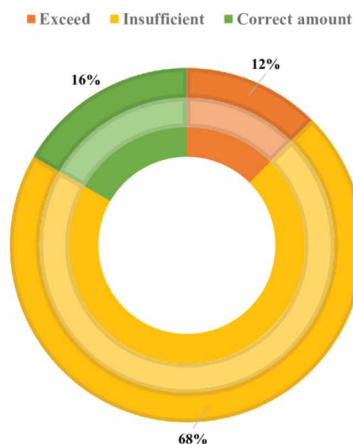
The CGSM records show that in the dispensing of boxes in the BHU, regardless of the syringes and lancets amount to the patients, the delivery of only one box unit of 3 L was a common practice, independent of the total volume of packages. This number of boxes is not enough for the packaging of diabetics' residues. Figure 2 shows the dispensing of the boxes by the BHU in the period from 2014 to 2015, totaling 1,831 units.

Figure 2. Registration of boxes to waste E monthly dispensed between October 2014 and September 2015



There was a highly significant difference in the number of boxes received by 23.6% (55/233) patients at the BHU dispensed methods ($p < 0.001$), as patient n. 232 who received 10 boxes less for all period and 44.8% (100/233) with a significant difference in the smaller amount of boxes received ($p < 0.05$), demonstrating that 68% of diabetics were using boxes in an insufficient quantity to collect sharps waste in their domestic environment. This unbalanced distribution could trigger the use of plastic bottles by diabetics in their houses. Of all patients treated at the BHU in that period, 16% received boxes in a number correctly quantified according to insulin treatment, but on the other hand, 12% of all received more than they needed (Figure 3).

Figure 3. Percentage (%) of boxes dispensed in the period between October 2014 and September 2015



In the present study, one can see that there is no RL record about waste boxes used by patients at home, nor the measurement by weight, without an implanted RL system for inputs used per month. The collection of filled waste is voluntarily carried out by insulin-dependent diabetics, and after receiving the boxes, there is only direct segregation for the company that collects health waste from the BHU.

Health education is a primordial tool for nurses to understand the teaching process that these professionals perform with the users, the training of individuals with health needs regarding self-care and making them multipliers of knowledge about health-related issues. Therefore, health unit teams must demand and develop protocols, with norms to be followed for the distribution and disposal of syringes, lancets, insulin and reagent tapes, in order to supply correctly the delivery of boxes and its control in the return to BHU, for disposal without risks to the environment and professionals.

In the Brazilian UHS there is no control of RL of sharp domestic wastes produced by diabetics. Support for the TR nurse is essential for local or region waste health management with practical information to both the patients and the other BHU members, to conduct the RL of residues used by the insulin-dependent patients enrolled by CGSM to their proper destination. The domestic practice of packaging plastic bottles is in disagreement with Brazilian Law, which states that waste from group E-waste should be discarded separately at the place of its generation immediately after use or the need for disposal in containers with the parameters referenced to in the Brazilian standard NBR 13,853/1997 (Anvisa, 2018). Also, according to Brazilian Law, the volume of the boxes must be compatible with the daily generation of waste and should be discarded upon reaching 2/3 of its capacity.

The first step in the local management and the correct RL is the adjustment of box distribution according to the individual demand of syringes and needles per patient enrolled in the BHU. The authors suggest the following distribution, based on the capacity of the boxes (Table 4).

In this present study, it was shown that the CGSM programme allowed for estimating of the proportion of boxes distributed to diabetics for proposal of a dispensing flow model according to the RL, thus facilitating quick visualization of the correct relation of the number of boxes to be distributed with regard to the volume returned by patients attended at UHS.

In Brazil, the sharp residues generated by diabetics at home is a challenge, since there is no standardized regulation for this purpose to citizens. Despite recommendations for the management of waste generated in-home care, companies and professionals that provide such assistance fail to manage them correctly due to infrastructure or lack of knowledge. At least 1 million syringes used by diabetics have been disposed of daily in ordinary household waste (Souza & Zanetti, 2000). A study with diabetics pointed out that 61.5% of the subjects stated that they received some guidance

Table 4. The adjusted quantity of 3 L boxes to dispensation per patient month

Number of boxes	Syringes (units)	Lancets (units)
1	From 30 to 60	From 30 to 100
2	From 60 to 120	From 101 to 200
3	From 121 to 180	From 201 to 300
4	From 181 to 240	From 301 to 400
5	From 241 to a 320	From 401 to 500

on the disposal, but they discarded syringes, needles (65.2%) and lancets (52.2%) in plastic bottles, sending them to some service health care (André, 2012).

Disposal of plastic bottle syringes was reported by 57.8% of the diabetics interviewed in a study by Mendes, Veiga, Maria and Takayanagui (2012) and 15.4% of them said they broke the needles and discarded them as general waste, posing risks to the health of the population and the environment. In the city of Campinas (upstate São Paulo), a survey showed that 51.4% of the people disposed of the syringe and insulin needle in household waste and 34.3% took it to the BHU in plastic bottles or common boxes (Tapia, 2009).

The use of plastic bottles in households may be associated to the insufficient distribution of boxes per month. According to a study carried out in France by Bouhanick, Hadjadj, and Weekers (2000), 93.5% out of the 1070 diabetic patients reported not having received information on suitable containers for the disposal of the material used, half said they threw the materials in the cardboard box and one-third used plastic bottles.

The present study showed the behaviour of some insulin-dependent diabetics in using plastic bottles to dispose of cutting waste rather than the box and the possibility of contamination to the health worker (due to hepatitis B, C and other diseases) through contact with sharp residues. Behaviour and preventive actions should be discussed between diabetics and health professionals that are directly related to primary care. Studies that have tried to explain waste prevention behaviour through statistical models or testing of the behavioral theory have generally found that their models have only weak explanatory power (Fell, Cox, & Wilson, 2010).

According to Ishtiaq et al. (2012), one possible reason for the smaller impact of education on the safe disposal of sharps could be a lack of ability to apply the knowledge, which has implications for the effectiveness of education and the translation of knowledge into practice. Patients might be aware of the need for the disposal of sharps in a sharps box, but if they are not aware of where to obtain sharps boxes and how to dispose of them, they would not be able to use them. Busy physicians may not have the time or detailed knowledge about the safe disposal of syringes.

Brazilian Law n. 12,305 (2010) also instituted the shared responsibility of waste generators: from manufacturers, importers, distributors, traders, citizens and owners of urban solid waste management services in waste RL and post-consumer packaging. The overall picture focuses on three main factors, such as *the environment*: earth, air, water, and ecosystems; *the social impacts*: people, health, and culture and; *economics*: profits, savings, and efficiency. Transformation toward sustainable societies both globally and locally is possible and scalable. On one end of the scale, we have the individual. Therefore, the best way to deal with environmental issues is to guarantee the participation in decision-making of all citizens involved in the process (Pereira & Pereira, 2011).

The development of the single-use disposable syringe was a major milestone for diabetic care, as well as health care and injection safety (Krisiunas, 2011), but according to Mendes et al. (2012), the lack of a proper disposal programme and monitoring of the RL of RHS can lead to damages to the public health and the environment. Krisiunas (2011) pointed out that the single-use devices and the various next-generation products, including diabetes care products, have spawned an interesting contribution to the global waste stream.

According to Govender and Ross (2012), insulin-dependent diabetic patients in South Africa are not educated on safe sharps disposal methods, leading to the unsafe disposal of needles. Appropriate education on the correct disposal of sharps should be an integral part of their diabetic counseling. Doctors, nurses, and pharmacists should all take responsibility for educating and reinforcing information about correct sharps disposal methods. Patients should be advised to either discard sharps into puncture-resistant containers placed into their household refuse or return them in secure containers for disposal by the dispensing institutions (Govender & Ross, 2012).

In Pakistan, a study with 375 diabetics showed that about half of the patients (n = 185) reported being educated by their physicians about the disposal of sharps. Patients that were instructed by a physician or could read/write English were less likely to dispose of syringes and needles in the household garbage (Ishtiaq et al., 2012).

The Diabetes UK (2017), issued recommendations that all needles and lancets used by diabetic patients be placed into a puncture-resistant container before discarding into household waste. Numerous countries have implemented various programs related to the collection of injection devices to reduce the potential risk of environmental and occupational exposures to sharp devices, such as insulin syringes and lancets (Diabetes UK, 2017).

To managing waste generated by diabetes, allergies, or another medical condition in the home, the Division of Environmental Health (DEH) of the Department of Environmental Conservation in Alaska offers the contact of local pharmacy, medical service provider, health clinic, or hospital for disposal options. In most cases, the health care provider will accept home health waste and can treat and dispose of the waste. A second disposal option is to contact a local medical waste disposal company. They sometimes accept home medical waste at little or no charge. "Mail back companies" are a third disposal option. They typically provide the waste container, a box for mailing, and shipping costs (DEH, 2019).

According to Virginia Department of Environmental Quality (2019), the identification of regulated medical waste as well as those items that are exempt from regulation is important for the understanding of the regulation of disposal of medical devices. For example, household sharps (needles, lancets, insulin pens and other sharps generated at home through self-care, rather than under the care of a healthcare professional or at a healthcare facility) are not regulated medical waste when they are disposed of in a sealed, rigid container (such as a detergent bottle) labeled for home use, as described in the Virginia Department web site in Management of Household Sharps flyer.

The EPA in the United States created a document in web site that suggests safe options states and local governments can provide citizens for safe needle disposal (EPA, 2019). In Australia, The New South Wales Ministry of Health or NSW Health has the NSW Health Policy Directive PD2008 004 Community Sharps Disposal, which gives explanation about services to be provided at public hospitals and authorized outlets of the Needle and Syringe Program (NSP) for the disposal of used needles, syringes and other community sharps resulting from the self-management of medical conditions and injecting drug use by members of the public (NSW, 2019).

CONCLUSION

Domestic sharp wastes need to be disposed of correctly to reduce the environmental impacts and risks to human health. However, at the Brazilian BHU studied, the control of dispensed boxes is not in agreement with the consumption of syringes by the diabetic citizen, demonstrated as having insufficient dispensation in 68% of the cases. Besides, there is control of this dispensation in the output only, but with no record and analysis in the return of the boxes used whatsoever. The return of syringes in plastic bottles to the BHU is the result of an insufficient distribution of boxes and a lack of proper guidance.

The limitation of the study is that only one BHU was evaluated from 450 basic health unit existents in São Paulo city. However, for the one Brazilian BHU studied, the results are the basis of plan to a first step for a new strategy for RL of domestic sharp wastes, as the guidelines of WHO show for the local district evaluated. The authors suggest a comparative study in the whole public health system or basic health assistance service to diabetic citizens to evaluate the CGSM programme and the management of sharp waste in the city of São Paulo.

The data from the present study demonstrated that it was possible to estimate the correct number of boxes for each diabetic patient, according to the number of used syringes and lancets, starting from records obtained from the CGSM programme. The role of public health authorities is to provide the number of cardboard boxes according to the daily use of insulin, to avoid the use of plastic bottles by diabetics and prevent environmental contamination. Therefore, it is the responsibility of the Brazilian municipal public health agencies to improve the CGSM programme to allow for the record of the boxes filled with sharp wastes at the BHU. It is also important to integrate the communication with other BHUs, since the diabetic could leave its residue at other BHUs in the city of São Paulo.

Health professionals, policy-makers and other relevant stakeholders should work together to raise awareness citizens around the proper domestic medical waste. They can then work towards implementing and promoting educational waste disposal methods to the insulin-dependent diabetic which do not result in waste on the environment. In addition to this, the role of the TR nurse is fundamental for the development of a permanent training schedule and a professional team. Care must be taken for orientating diabetics to be more aware of the risks of accidents with sharp residues and the preservation of the environment and encouraging the RL of the wastes generated in their homes.

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