

Solid health waste management: A process analysis at the hospital area

Ana Larissa Bendelaqui Cardoso¹, Ingrid Luna Baia Viana², Jamille da Costa Salvador³, Julianne Silva de Lima⁴

¹Nurse, Specialist in Surgical Center Nursing, Sterile Materials Center and Hospital Infection Control Center, Carlos Chagas Institute (INCAR), Tucuruí, Pará, Brazil.

²Sanitary and Environmental Engineering Student (UFPA), Tucuruí, Pará, Brazil.

³Nurse, Specialist in Mental Health and Palliative Care (UNYLEYA), Professor at the Gamaliel Faculty of Theology, Philosophy, and Human Sciences, Tucuruí, Pará, Brazil.

⁴Biologist, Doctor in Animal Science (UFPA), Belém, Pará, Brazil.

Abstract—This systematic review describes the scientific production about Solid Health Waste Management (SHWM) in hospitals, seeking publications in the period from 2015 to 2020, to have a synthesis of the importance of SHW management and strategies practiced in hospital facilities, analyzing the perception of health professionals about the management of these wastes. The articles obtained demonstrate that health professionals, although they have some knowledge of the legislation, are constantly living with the inadequacies in the management of SHW, resulting in risks to the health of both employees and the environment, and it is necessary to seek management measures aimed at professional training for correct management..

Keywords—Waste Management, Environmental Health, Solid Waste.

I. INTRODUCTION

With the new consumption patterns of industrial society, since the second half of the 20th century, waste production has expanded assiduously to levels exceeding the planet's absorption capacity. Also, the diversity of products with components and materials of difficult degradation and greater toxicity is growing; characterizing one of the challenges of the environmental issue, to ensure the maintenance of the quality of life of the current population and the existence of future generations (ANVISA, 2006/07; Silva, 2011).

The health industry has a significant contribution, equivalent to a value that exceeds the mark of 2.4 million tons of waste per year, in addition to being configured as a potential energy consumer. Therefore, the task of hospitals goes beyond physical limitations and must perform safe practices to promote the health not only of their patients and professionals but also of the environment where they are (Harris et al., 2009).

Although the generation of health services waste (SHW) is small about urban solid waste, it is expressive when analyzing the potential risk conferred to them, as a consequence of the existence of pathogenic organisms

and/or their toxins, chemical products of diverse nature (drugs, chemotherapy, solvents, among others), as well as radiological risks. The problem of SHW is also decreasing in other aspects, such as the combination of waste of different natures, discarded on public roads, and/or inadequate distribution in landfills, not always sanitary or controlled (Schneider & Stedile, 2015).

Thus, inadequacies in waste management in contemporary society significantly compromise the health of the population and the environment in which they live, such aspects reflect on physical health risks (infectious and degenerative diseases), mental health (anxiety crises, panic crises, depression) and social disintegration (social isolation, exacerbation of violence, among others) (Siqueira & Moraes, 2009). Improper waste management exposes the health of workers (direct hazards) and the population (indirect hazards) (Mathur et al, 2011; Babanyara, 2013).

These premises point to the inherent association between health, environmental health, environment, and health service waste (SHW), which can generate adverse reactions on the environment and organisms. From this perspective, the Ministry of Health stresses that

"environment and health are interdependent and inseparable" (Brazil, 2007).

The definition of Environmental Health associates the aspects that encompass human health and quality of life, established by physical, chemical, biological, social, and psychological elements in the environment, exposing determining factors for the maintenance of health (PAHO, 2001). Given the facts mentioned, solving the problem caused by these residues derives from the need to correct the public health policies and legislation published in the Official Gazette of the Federal Republic of Brazil, such as the RDC No. 306, of Anvisa, which provides on the Technical Regulation for the management of health service residues, and the Resolution of the National Environmental Council No. 358, of April 2005, on the treatment and final destination of health service residues and makes other provisions to achieve the sustainable development of the environment and the preservation of health as a whole.

Given the contingency, it is pertinent to analyze the impacts and characterize the process of Solid Waste Management of Hospital Health, seeking the deepening of the theme to reduce the negative impacts with the non follow up of the norms recommended by the competent agencies. Thus, the present study was designed to describe the scientific production about the Management of Solid Residues of Hospital Health in the bibliographic and documental context (legislation) published in periodicals between 2015 and 2020, indexed in the databases of LILACS, BDENF, CAPES and WORLD WIDE SCIENCE.

II. THEORETICAL FRAMEWORK

According to RDC ANVISA no. 306/04 and Resolution CONAMA no. 358/2005, all services related to human or animal health care, including home care services and fieldwork; analytical laboratories for health products are defined as generators of solid health waste (*SHW*); mortuaries, funeral homes, and services where embalming activities are performed, forensic services, drugstores and pharmacies, including those of manipulation; teaching and research establishments in the health area, zoonosis control center; distributors of pharmaceutical products, materials, and controls for in vitro diagnosis, mobile health care units; acupuncture services, tattooing services, among other similar services.

Although the direct responsibility for the *SHW* is of the health services establishments, as they are the generators, by the principle of shared responsibility, it extends to other actors: to the public power and the collection, treatment, and final disposal companies. The Federal Constitution, in

its article 30, establishes the competence of the municipalities to "organize and provide, directly or under concession or permission, public services of local interest, including public transport that is essential" (ANVISA, 2006).

The National Survey on Basic Sanitation (NSBS), conducted in 2000 by IBGE, shows that most Brazilian municipalities do not use an appropriate system to carry out the collection, treatment, and final disposal of *SHW*. From a total of 5,507 Brazilian municipalities surveyed, only 63% perform the collection of the *SHW*.

The Southeast is the region that most carries out the collection of *SHW* in Brazil, totaling about 3,130 t/day. Next comes the Northeast, with 469 t/day, then the South, with 195 t/day, the North, with 145 t/day, and finally the Center-West, with 132 t/day. Regarding the final destination, about 56% of the municipalities have their *SHW* on the ground, and 30% of this total corresponds to landfills. The remainder is deposited in controlled landfills, sanitary landfills, and special landfills (ANVISA, 2006).

By correctly classifying the residues generated in health units, it is possible to separate them according to their composition (chemical, physical or biological), state of matter, origin, place of generation, and potential for contamination (Cussiol, 2008). This separation makes it possible for the generator to properly handle its waste, also, the segregation at the time and place of generation reduces the volume of materials that need differentiated management (CONAMA, 2005), which enables cost reduction in management.

The waste management process must be part of the standards of every establishment that generates Health Services Waste, taking into account all steps, including generation, conditioning, internal storage (waste room), external storage (waste shelter), internal treatment, and final internal disposal. The internal management of waste involves the above-mentioned steps that occur within the generating establishment and shall be adequately controlled so that there is no waste of materials that can be reused or recycled, and so as to avoid improper handling of infectious waste.

However, according to the Collegiate Directorate Resolution (RDC) No. 306/044 (ANVISA, 2005), the solid health waste management plan (*SHWM*) at the time of preparation shall be compatible with the rules on collection, transportation and final disposal of the waste generated, established by the local agencies in charge, covering the management stages, which comprises the action of managing the waste in its aspects from generation to final disposal, based on the following guidelines:

- Segregation: Consists of the separation of waste at the time and place of its generation, according to its physical, chemical, and biological characteristics, its physical state, and the risks involved.
- Conditioning: Consists of the act of packing the segregated waste in bags or containers that avoid leakage and resist puncture and rupture actions. The capacity of the packaging containers must be compatible with the daily generation of each type of waste.
- Identification: Consists of the set of measures that allows the recognition of the residues contained in the bags and containers, providing information for the correct handling of the *SHW*.
- Internal Transport: It consists of the transfer of the residues from the generation points to the place destined for temporary storage or external storage with the purpose of presentation for collection.
- Temporary Storage: It consists of the temporary storage of the containers containing the residues already conditioned, in a place close to the generation points, aiming to speed up the collection within the establishment in order to optimize the displacement between the generating points and the point destined to the presentation for external collection.
- Treatment: Consists in the application of a method, technique, or process that modifies the characteristics of the risks inherent to the waste, reducing or eliminating the risk of contamination, occupational accidents, or damage to the environment.
- External Storage: Consists of the storage of the waste containers until the external collection stage, in an exclusive environment with easy access for the collecting vehicles.
- External Collection and Transportation: Consists in the removal of the *SHW* from the waste shelter (external storage) to the treatment unit or final disposal, using techniques that ensure the preservation of the conditioning conditions and the integrity of the workers, the population and the environment, and must be in accordance with the guidelines of the urban cleaning bodies.
- Final disposal: disposal of solid waste, generally in the soil previously prepared and duly licensed.
- Chemical treatment: method of disinfection using a chemical agent;
- Microwave: method of decontamination by the emission of waves at high or low frequency, with a temperature around 95 and 105 °C, in this procedure the residues need to be prepared being previously crushed and humidified;
- Incineration: a method that burns the residues, provides volume and weight reduction in addition to eliminating the risks of contamination.

III. CONTINUING EDUCATION

The continuing education program, provided for in RDC ANVISA no. 306/04, aims to guide, motivate, raise awareness, and permanently inform all those involved in the risks and appropriate management procedures, in accordance with the precepts of waste management. According to RDC ANVISA no. 306/04, the services generating *SHW* must maintain a program of continuous education, independent of the employment relationship of the professionals.

An indispensable factor for the correct management is the environmental and sustainable education of solid residues. Education must be used as a tool for individuals to reflect on the issue of changes in attitudes regarding the correct disposal of waste and the valorization of the environment (Gusmão, 2000).

Continued health education is of great importance in terms of the acquisition and renewal of knowledge of professionals. This not only encompasses those working in the area, but also the entire population and community, which in general, ends up benefiting from improved care and optimization of care, due to these educational programs developed within the various health units (Marandola et al., 2009).

Permanent education, based on the principle of significant learning, considers that the educational process is dynamic, continuous, and that besides people's knowledge, it also brings social advances. The training processes of health workers should be structured from the problematization of the work process, aiming at changing professional practices and work organization, based on the health needs of individuals and populations, institutional management, and social control in health (ANVISA, 2004).

With regard to the forms of treatment of available health service waste, Pereira (2009) quotes:

- Autoclave steam: sterilization method that consists in releasing steam at high pressure and temperature;

IV. METHOD

In this research, a systematic qualitative review of the literature was performed, which consists of a form of synthesis of the results of studies alluding to a given problem, analyzing their contributions. Classified as exploratory, it is characterized by exploring or analyzing a problem for better understanding (Andrade, 2004; Malhotra & Robert, 2005).

To achieve the proposed objective, a retrospective bibliographic survey was conducted from 2015 to 2020, using the Latin American and Caribbean Health Sciences Literature database (LILACS), Nursing Database (BDENF), Higher Education Staff Improvement Coordination (CAPES) and WorldWideScience.org, using the descriptors: "hospital health solid waste management" and "hospital waste".

In this way, publications on the subject were published during this period, which may later contribute to the evaluation and monitoring of the development of this field of study. The Regional Portal of the Virtual Health Library was adopted because it contemplates one of the largest and most important indexes of the scientific literature, which includes relevant databases in the health area, such as LILACS and BDENF.

The bibliographic survey was conducted from February to May 2020, through direct consultation on the above-mentioned online platforms. The study sources were included according to the following criteria: scientific articles published between 2015 and 2020, Portuguese

language, English, which contemplated the following topics: management of hospital health services waste, health professionals' actions in *SHWM*, nurse knowledge related to health waste, observational studies.

As exclusion criteria, we chose not to use articles that did not correspond to the study object; incomplete texts; articles that were not available in full online; that did not provide sufficient information for the subject.

After the end of the survey, the reading and categorization of the articles began, concomitantly with the elaboration of sheets, that is, the articles were read and, according to the themes developed in them, were categorized according to the following topics: year, title, author, journal, methodological approach, and theme. Therefore, the analysis of the records was carried out.

V. RESULTS AND DISCUSSION

There were 68 articles distributed in the databases: BDENF - 04 articles (5.90%), CAPES - 25 articles (36.76%), LILACS - 06 articles (8.82%), and WORLDWIDE SCIENCE - 33 articles (48.52%). After applying the inclusion criteria, the final sample totaled 09 articles (Figure 1), being later organized and characterized, according to Table 1.

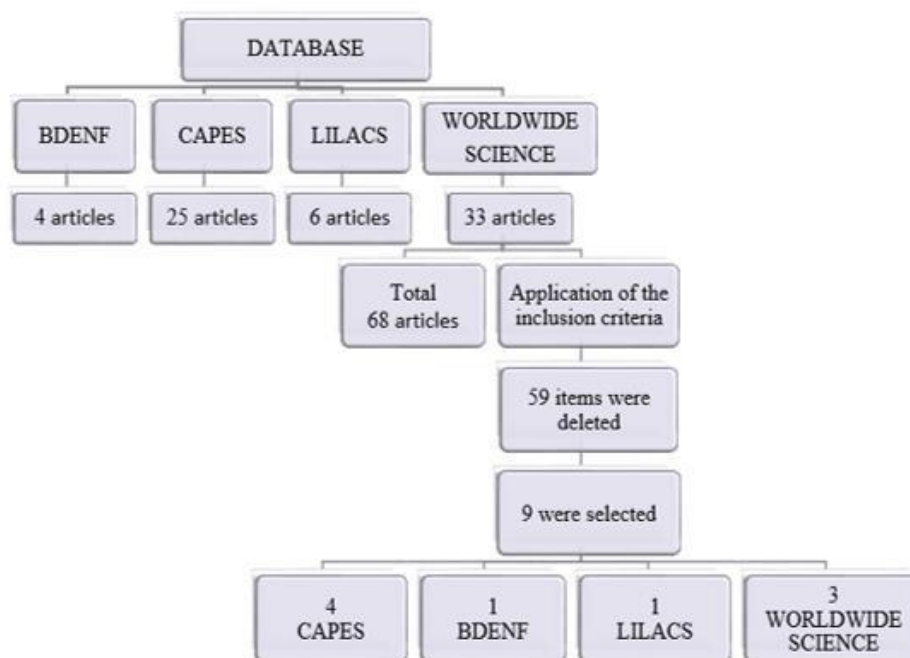


Fig.1: The selection process of the articles used in the review.

Table 1: Qualitative data from the systematic review

Author / Database / Year	Title	Methodological Approach	Overview
Mesquita, M. G. R. <i>et al.</i> BDENF 2015	Safety and Sustainability in the Management of Healthcare Waste at Hospital Units	Translational, descriptive and exploratory research	Protocol elaboration and correlation of the practice in the light of scientific evidence in the hospital scenario, through translational, descriptive and exploratory research, with the Hospital Universitário do Rio de Janeiro/RJ as scenario.
Pinheiro, L. A.; Silva, E. R. CAPEs 2016	Studies on Solid Waste from Health Services and Environmental Education	Integrative Literature Review	Investigation of the national scientific production, appreciating in the reports of training and realization of the qualification of the professionals in hospital scope, for the practices of management of the residues generated in their work activities.
Soares, L. S. V.; Madureira, A. S. CAPEs 2018	Scenarios that Challenge the Emergency Implementation of the National Solid Waste Policy: an Environmental and Health Issue	Analytical Cross-sectional Study	Reflection on the possible obstacles existing in the National Policy on Solid Waste that prevent the real confrontation of sustainability and the proper management of solid waste in Brazil.
Zajac, M. <i>et al.</i> CAPEs 2016	Class "D" Waste Reverse Logistics in Hospital Environment: Monitoring and Evaluation of Recycling at the Children's Hospital Cândido Fontoura.	Quali-quantitative approach, characterized as a research-action	Analysis and elaboration of an evaluation model, training and measurement of common waste segregation, for adequate segregation of Health Services Waste (HSW) that depends on the training and awareness of employees involved in generating HSW.
Rizzon, F. <i>et al.</i> CAPEs 2015	Challenge in Waste Management in Public Health Services	Exploratory research, characterized as action research.	Exploratory research in a small town, describing the analyzed management processes and critical points found at each stage, making a parallel with the current legislation, addressing the management challenges, appropriate processes and risks inherent to mismanagement.
Costa, T. F. <i>et al.</i> LILACS 2018	Intra-Hospital Management of Hazardous Chemical Waste Handling by Nursing	Quantitative, descriptive study	Evaluation of the management stages of hazardous chemical waste - formaldehyde and orthophthaldehyde, handled by the nursing team, from descriptive research and data collection, which provide important guidelines for the preparation of the Management Plan for Hazardous Chemical Waste from hospital care.

Kist, L. T. <i>et al.</i> WORLD WIDE SCIENCE 2018	Diagnosis of Hospital Waste Management in Vale do Rio Pardo-Rio Grande do Sul, Brazil.	Quali-quantitative research, bibliographical and field	Practical application of management tools in health units, to close gaps between practice and management of solid wasteful health care, by monitoring actions with available resources and providing adequate deadlines and dates, which result in systemic compliance with current legislation.
Negreiros, R. V. <i>et al.</i> WORLD WIDE SCIENCE 2018	Solid Health Waste Management at a University Hospital in the Northeast of Brazil.	Quantitative, descriptive and transversal research	An active policy of guidance regarding the handling of waste in health, through permanent education, promoting training and educational actions, since it deals with hazardous health waste.
Oliveira, E. L. <i>et al.</i> WORLD WIDE SCIENCE 2018	Environmental Performance in Healthcare Establishments: A Case Study of Hospital Naval Marcílio Dias, Rio de Janeiro - RJ.	Bibliographic survey, field survey, interviews and analysis of collected data.	Evaluation of the environmental performance of Hospital Naval Marcílio Dias, considering the eco-efficient measures already established in the hospital and collected data through documentary survey and interviews with employees in the environmental management sector.

Each selected article deals with the issue of waste management in health facilities from the perspective of the professional who acts directly or indirectly in the process. It is significant the articles that present application of questionnaires, as well as the search for simplified methodologies, not lagging, and continuing education practices that encourage the professional to treat the classification and conditioning of solid health waste (*SHW*) as a necessary and positive daily habit.

Mesquita *et al.* (2015) corroborate the evidence-based practice in hospital activities, constituting the sampling by professionals from the multidisciplinary team who work in waste management, based on testing and re-testing as an observational interposed technique, elucidating the respondent's world perceptions without imposing the researcher's vision.

Negreiros, *et al.* (2018) presented results of the questionnaire survey applied to the multidisciplinary team, showing that 96% of the professionals indicated knowledge of the importance of residue management and about 52% of the nursing team admitted knowledge of the current norms on *SHW* classification, with the lack of information regarding adequate management as the main difficulty found by the team, the lack of training and time (generally insufficient due to excessive work) as factors for not performing the correct management, which according to Costa *et al.* (2018) may cause several health problems in the team itself, as well as the environment.

Pinheiro & Silva (2016) in an integrative review draw attention to the lack of knowledge on the part of the administrative body regarding the form of classification and segregation of the *SHW* when compared to the health team, pointing out the lack of routines and frequency of training, and sometimes the lack of interest in participation. Zajac *et al.* (2016), when analyzing the effectiveness of training on level D solid hospital waste (those that do not offer biological, chemical or radiological risk), showed the effectiveness of monitoring, guidance, and adequacy of the hospital administrative sector to achieve significant results in reducing the volume and consequently the costs of treatment of these wastes. With this, the author reiterates the breaking of the paradigm surrounding the disposal of hospital waste, exposing the possibility of recycling non-hazardous materials, if properly managed through the solid health waste management program (*SHWM*).

Inadequate storage for long periods in containers without proper identification, as described by Rizzon *et al.* (2015), may lead to occupational accidents, due to the disposal in the wrong place of infections, or even the contact of the surrounding external community with contaminated effluents that, without prior treatment, may drain into the sewers, causing damage to health and the environment. Negreiros, *et al.* (2018) reaffirm the need to maintain solid waste management correctly, paying attention to biosafety measures during the handling of these wastes.

Soares &Madureira (2018) emphasize that to maintain adequate control of the *SHW*, it is necessary to formulate and implement public policies by analyzing the results and designing the policy itself, based on research that ensures the effectiveness of these plans. Rizzon et al. (2015) taking into account the complexity of the local social, economic, ecological, political, and cultural levels, the formulation of environmental policies is a basic step of success in the environmental management process. It is necessary to consider the elements that affect the implementation of the policy and, thus, a more complete assessment can be made when checking the structure (objectives, tools, and agents) used to adjust the existing processes.

Another important aspect, highlighted by Soares &Madureira (2018), refers to management solutions that can optimize costs, enable innovative and efficient technologies and promote long-term partnerships that can achieve the waste policies of municipalities (especially those with fewer resources). It is worth mentioning that it is necessary to adapt and reformulate from time to time to create an operating system that does not fall into discrepancy.

In this context, continuing education is necessary, Kist et al. (2017) encourage lifelong learning, so that the legal regulations regarding adequate management by health professionals can be effectively implemented to change the practices that constitute the current institutional situation. This process of change can be achieved through the action of managers, whose task is to spread knowledge and awareness of the individual and collective risks of inappropriate waste management among hospital staff.

Pinheiro & Silva (2016) observed inadequate practices even after the training for the *SHW* program, making it clear that the occurrence is not only due to lack of information from professionals, but also unidirectional training, focused on compliance with the legislation, which do not present satisfactory results. Oliveira et al. (2018) introduce the realization of training campaigns and environmental education that can involve all employees, focusing on specific environmental aspects of each department, to encourage both the team and visitors, to participate in practical and sustainable actions, disseminating the importance of following the correct management of *SHW*, so that it becomes routine.

Thus, when new improvement measures are determined, Kist et al. (2017) ensure that a new cycle is repeated frequently to complete the recommended continuous improvement process, where the use of protocols or tools such as the PDCA (Plan, Do, Check, Act), introduces a unique, effective and dynamic aspect, in

the structuring of the planning, efficient execution, monitoring of steps aimed at maintaining the quality of services and action so that the whole system does not stagnate remaining only on paper so that finally there is a narrowing of the gap that currently exists between the practice and the management of solid hospital waste.

VI. CONCLUSION

In the current context, solid waste consists of various materials capable of recovery. Therefore, it would be relevant to have strategies for the reuse of these materials, capable of generating income and work, as well as making it possible to mitigate the extraction of natural resources and save energy that is essential for safer ecological and social care.

In the reality we live with, related to solid waste management, it is imperative to act in the direction of intra-institutional policy involving a healthy environment model. There is a certain difficulty in the applicability of *SHWM*, which requires more effective proficiency of the legislation together with the rupture of dogmas in order to ensure a better quality of care and minimize the risks to health and the environment.

Among the possible strategies of impactation and effectiveness, we can mention continuing education. This has positive repercussions in the context of *SHW*, but in order to make it interesting and effective, it must be dynamic, including practical attractions, which do not become tiresome or time-consuming so as not to generate disinterest or changes in the work routine of employees. Besides having the participation of the team, it is interesting to introduce the users of the health system, because it is conducive to the integration of learning. For the effectiveness in the training, one must work on changing the behavior of the professionals involved in the *SHW* process, in order to promote the idea of reusing common waste, reducing the final volume (and consequently the costs with *SHWM*), preserving the quality of services, the integrity of the employees' health and the environment, because, with the correct adequacy in the management of these waste, the probability of leftovers coming into contact with sewage or open areas is reduced.

REFERENCES

- [1] Andrade, M. M. Como preparartrabalhos para cursos de pós-graduação – noçõespráticas. São Paulo: Atlas, 2004.
- [2] BRAZIL ANVISA, Agência nacional de vigilânciasanitária, (2006). Gerenciamento dos Resíduos de Serviços de Saúde. (2 ed.). Brasília: Anvisa. ISBN 85-334-1176-6.

- [3] BRAZIL ANVISA. Agência Nacional de Vigilância Sanitária. Resolução da Diretoria Colegiada – RDC nº 306, 07/12/2004. Aprova o regulamento técnico para o gerenciamento de resíduos de serviços de saúde – December, 2004.
- [4] Babanyara, Y. Y. (nov. 2013). Poor Medical Waste Management (MWM) Practices and Its Risks to Human Health and the Environment: A Literature Review. Available at SSRN: <https://ssrn.com/abstract=2361647>.
- [5] BRAZIL, Resolução da Diretoria Colegiada - RDC nº 33, 25/02/2003. Regulamento Técnico para o gerenciamento de resíduos de serviços de saúde – March, 2003.
- [6] BRAZIL, Ministério da Saúde. Subsídios para construção da Política Nacional de Saúde Ambiental. Brasília: Ministério da Saúde; 2007.
- [7] BRAZIL CONAMA - Conselho Nacional de Meio Ambiente. Resolução nº 358/05, 29/04/2005. Tratamento e disposição final dos resíduos dos serviços de saúde e outras providências - May, 2005, p. 63-65.
- [8] Costa, T. F.; Felli, V. E. A.; Sanchez, M. C. O.; Ferreira, S. C. M.; Silvino, Z. R. & Souza, D. F. (out. 2018). Gerenciamento intra-hospitalar dos resíduos químicos perigosos manuseados pela enfermagem. *Revista Enfermagem Uerj*, [s.l.], vol. 26, p 1-23. <http://dx.doi.org/10.12957/reuerj.2018.19376>.
- [9] Cussiol, N. A. M. Manual do Gerenciamento de Resíduos de Serviço de Saúde. Belo Horizonte: Fundação Estadual do Meio Ambiente, 2008.
- [10] Gusmão, O.S.; Setúval, F.A.R.; Novaes, A.B.C.; Dias, S.M.F. (2000) Reciclagem artesanal na UEFS: estratégia educacional na valorização do meio ambiente. In: Congresso Nacional de Meio Ambiente na Bahia. Salvador: UFBA. p 56-58.
- [11] Harris, Nikela BSN, RN; Pisa, Linda BSN, RN; Talioaga, Sandy BSN; Vezeau, Toni PhD, RNC Hospitals Going Green: A Holistic View of the Issue and the Critical Role of the Nurse Leader, *Holistic Nursing Practice: March-April 2009* – vol, 23 - Issue 2 - p 101-111. doi: 10.1097/HNP.0b013e3181a110fe
- [12] Kist, L. T.; Rosa, F. R da; Moraes, J. A. R.; Machado, E. L. (dec. 2018). Diagnosis of hospital waste management in Vale do Rio Pardo-Rio Grande do Sul, Brazil. *Revista de Gestão Ambiental e Sustentabilidade – Geas*, São Paulo, 7(3), p 554-569.
- [13] Mahler, C. F. & Moura, L. de L. (2017). Resíduos de Serviços de Saúde (RSS): Uma abordagem qualitativa. *RISTI - Revista Ibérica de Sistemas e Tecnologias de Informação*, (23), p 46-60. <https://dx.doi.org/10.17013/risti.23>.
- [14] Malhotra, N. K. & Robert, B. T. Introdução à pesquisa de marketing. Tradução de Robert Brian Taylor. São Paulo: Pearson Prentice Hall, 2005.
- [15] Marandola, T. R. & Rocha, C. M. (jun. 2009). Educação Permanente em Saúde: Conhecer para Compreender. *Londrina: Revista Espaço para a Saúde*, 10(2), p 53-60.
- [16] Mathur, V.; Dwivedi, S.; Hassan, M.; Misra, R. (2011). Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. *Indian J Community Med*. 36(2), p 143-145. doi:10.4103/0970-0218.84135.
- [17] Mesquita, M. G. R.; Paes, G. O. & Nascimento, N. D. do (jan. 2015). Segurança e Sustentabilidade no Gerenciamento dos Resíduos de Saúde em Unidades Hospitalares. *Revista de Enfermagem*. Recife, 1(9), p 248-252.
- [18] Negreiros, R. V.; Araújo, F. N. F.; Silva, V. F.; Souza, P. M. de. (may 2019). Gerenciamento de resíduos sólidos de saúde em hospital universitário do Nordeste Brasileiro. *Revista Brasileira de Geografia Física*, [S.l.], 12(1), p. 239-251. <https://doi.org/10.26848/rbge.v12.1.p239-251>.
- [19] Oliveira, E. L. de; Viana, V. J.; Castañon, A. B. (set. 2018). Performance ambiental em estabelecimentos de saúde: Um estudo de caso do Hospital Naval Marcílio Dias, Rio de Janeiro – RJ. *Revista de Gestão Ambiental e Sustentabilidade – Geas*, Rio de Janeiro, 7(3), p 520-538.
- [20] OPAS - Organización Pan-Americana de la Salud. Indicadores básicos de salud ambiental para la región de la frontera México – Estados Unidos. Washington: OPAS, 2001.
- [21] Pereira, S. S. Panorama da gestão dos resíduos sólidos de serviços de saúde na cidade de Campina Grande/PB: um enfoque da percepção ambiental apresentada por profissionais da saúde. Programa Regional de Pós-Graduação em desenvolvimento e Meio Ambiente – PRODEMA UFPB. Campina Grande – PB, 2009.
- [22] Pinheiro, L. A.; Silva, E. R. da. (jan. 2016). Estudos sobre resíduos sólidos de serviços de saúde e educação ambiental. *Revista Internacional de Ciências*, Rio de Janeiro, 6(1), p 21-29.
- [23] Rizzon, F.; Nodari, C. H.; Reis, Z. C. dos. (2015). Desafio no Gerenciamento de Resíduos em Serviços Públicos de Saúde. *Revista de Gestão em Sistemas de Saúde*, [s.l.], 4(1), p 40-54. <http://dx.doi.org/10.5585/rgss.v4i1.141>.
- [24] Schneider, V. E.; Stedile, N. L. R. Resíduos de serviços de saúde: um olhar interdisciplinar sobre o fenômeno. Caxias do Sul: Educs, 2015.
- [25] Silva, E. N. C. da. Gerenciamento de resíduos de serviços de saúde: adaptação transcultural e validação do instrumento “Health-Care Waste Management - Rapid Assessment tool” para a língua portuguesa no Brasil. Curso de Ciências na área de Saúde Pública e Meio Ambiente, Escola Nacional de Saúde Pública Sergio Arouca, Rio de Janeiro, 2011.
- [26] Siqueira, M. M.; Moraes, M. S. (2009). Saúde coletiva, resíduos sólidos urbanos e catadores de lixo. *Cien Saude Colet*, 14(6), p 2115-2122.
- [27] Soares, L. S. V.; Madureira, A. S. (2019). Cenários Que Desafiam a Implementação Emergencial da Política Nacional de Resíduos Sólidos: Uma Questão Ambiental e de Saúde. *Revista de Direito e Sustentabilidade*, [s.l.], 4(2), p 74-89. <http://dx.doi.org/10.26668/indexlawjournals/2525-9687/2018.v4i2.4954>.
- [28] Zajac, M. A. L. Fernandes, R. O.; David, C. J.; Aquino, S. (2016). Logística Reversa de Resíduos da Classe D em Ambiente Hospitalar: Monitoramento e Avaliação da Reciclagem no Hospital Infantil Cândido Fontoura. *Revista de Gestão Ambiental e Sustentabilidade*, São Paulo, vol. 5, p 78-93.