INTERNATIONAL JOURNAL FOR INNOVATION EDUCATION AND RESEARCH
ISSN: 2411-2933

Journal URL: https://scholarsjournal.net/index.php/ijier

DOI: https://doi.org/10.31686/ijier.vol11.iss2.4075

Impacts of COVID-19 pandemic on solid medical waste management in a hospital environment

Denise Regina da Costa Aguiar[1], Marli Lúcia de Oliveira[1], Dora Inês Kozusny-Andreani[1], Leonice Domingos dos Santos Cintra Lima[1]

[1] Master's Program in Environmental Sciences, Universidade Brasil, Fernandópolis, Brazil

Abstract

In the context of the COVID-19 pandemic, the increase in the generation of solid health-care waste can be understood as a factor related to the incidence of SARS-CoV-2 cases and its impacts on society. This investigation aimed to verify the consequences of the increase in solid health-care waste as well as the response practices to the handling of these materials in times of a pandemic. A documentary analysis regarding the generation of solid health-care waste was developed at the Hospital de Clínicas of the Federal University of Uberlândia located in Uberlândia/Minas Gerais, Brazil. The results showed that the increase in the generation of solid health-care waste increased significantly in the hospital. The study suggests the implementation of a continuing education program for the health professionals of the institution, in order to reinforce knowledge about the management of solid health-care waste.

Keywords: Hospital Waste Management; Handling; SARS-CoV-2; Public Health.

1. Introduction

In the context of the COVID-19 pandemic, the increase in the generation of Solid Medical Waste (SMW) can be understood as a factor related to the incidence of cases of the SARS-CoV-2 virus and its impacts on contemporary society.

The activities carried out in environments that provide health services are potentially SMW generators, which in many cases do not adequately treat the generated SMW. The observed reality points to the need for planning about SMW, especially in hospital institutions, which involves everything from management processes, SMW generation to its final disposal.

In Brazil, the environmental legislation is strict with regard to the existence of implantation systems for the treatment of SMW, with the need to open an environmental licensing process at the competent body.

Although there are norms and resolutions that deal with the correct disposal of SMW, Brazilian legislation is still incipient, thus, current legislation is insufficient to meet the growing demand for generating SMW in contemporary society. For this reason, discussing sustainability in hospital environments is a relevant and current issue, considering the responsibility of these places in terms of guaranteeing care and public health.

In view of this, it is of great importance that all sectors responsible for the generation of SMW have knowledge and planning about the correct handling and disposal of these wastes, due to their potential for environmental contamination.

At the end of 2019, the world was faced with the SARS-CoV-2 virus. Three months later, in March 2020, the World Health Organization (WHO) declared that the COVID-19 virus was causing a pandemic, due to its high transmissivity (WHO, 2020). In Brazil, COVID-19 has already caused more than 659,000 deaths since the beginning of the pandemic until March 2022.

In view of the above, this work aimed to verify the consequences of the increase in SMW, in the hospital environment, as well as the response practices on the handling of these materials in times of the COVID-19 pandemic.

2. Literature Review

2.1 The Issue of Solid Waste in Brazil

Law no. 12.305, of August 2, 2010, instituted, in Brazil, the *Política Nacional de Resíduos Sólidos* (PNRS)– Solid Waste National Policy–, which was regulated by Decree no. 7.404, of December 23, 2010. The Solid Waste National Policy is seen as an important legislation for Brazilian basic sanitation, as it aims to minimize and/or solve endemic problems related to solid waste, as well as its harmful effects on the environment. The Solid Waste National Policy also established new guidelines that deal with the need to manage SMW properly (Decree no. 7.404, 2010).

SMW is understood as materials originating from human and animal health care, which can include assistance at home, hospitals, morgues, funeral homes, pharmacies, acupuncture and tattoo clinics, among others. It is made up of sharps, radioactive, chemical, biological instruments and common waste, which resemble urban waste. Therefore, the generation of SMW takes place in different sectors and through the provision of services from different establishments, which results in a large amount of waste that requires a final destination appropriate to their specificities (Brazilian Health Regulatory Agency [ANVISA], 2018).

Hospitals are places considered to be major sources of solid waste, especially chemical and biological solid waste. From this perspective, the proper disposal of the generated SMW is essential to guarantee public health. However, what happens in practice is the incorrect disposal of both common and disposable waste as well as infectious waste. Some studies indicate that continuing education and awareness of health professionals emerges as an important strategy for changes in this scenario (Granja, 2011).

It is noteworthy that, *a priori*, the SMW management process is subject to existing logistical difficulties, where accidents can occur during its packaging, as well as displacement and transport to landfills where this waste will be dispensed. As a result, hospital environments that generate SMW must consider management as a continuous and exclusive step, acting with strategic responsibility (Rezende, 2006).

However, current legislation dealing with SMW is based on a set of rules and resolutions established by the *Conselho Nacional do Meio Ambiente* – CONAMA [National Environment Council] and ANVISA, as well as by rules of the Brazilian Association of Technical Standards (ABNT), along with the Solid Waste National Policy (Decree no. 7.404, 2010), so that this set of legislation has the objective of guiding procedures for the

generating environments to carry out the correct management of SMW, avoiding harm to the environment and public health (ANVISA, 2004).

Currently, Resolution of the Collegiate Board (RDC) no. 222, of March 28, 2018, is in effect, which deals with the internal management of SMW (ANVISA, 2018a), as well as Resolution CONAMA no. 358, of April 29, 2005, which provides for the external management of SMW (CONAMA, 2005).

In accordance with Brazilian Norm (NBR) 10004/2004 (ABNT, 2004), solid waste is classified as solid and semi-solid waste, depending on activities with industrial, domestic, commercial, agricultural, service and hospital origin. Hospital waste is classified according to the norm as solid waste, so that it has specific and adequate management to meet the demand for correct management (Costa & Fonseca, 2009).

According to the NBR 12808 (ABNT, 2016), although it represents a portion of urban solid waste, SMW is of notable importance, as it is potentially harmful to the environment, being especially problematic for public health. In turn, this waste can be classified according to four SMW groups: A – Biological; B – Chemical; C – Radioactive; D – Common; and E – Sharps.

The health effects of individuals affected by this disease are not fully known and, although COVID-19 does not result in many serious cases, this has been one of the biggest concerns, considering that there are many cases that resulted in deaths from this problem. In this regard, it became necessary to adapt activities respecting social distancing, that is, to carry out activities and actions in isolation, so that many physical spaces were inserted in the virtual environment, connecting people in a globalized society that faces an unprecedented pandemic (Applegate & Ouslander, 2020).

The Brazilian Unified Health System (SUS) has been facing overcrowding of patients hospitalized due to COVID-19, thus the daily work situation of health professionals has been largely hampered by the lack of adequate infrastructure, as well as working conditions that often deviate the salubrious conditions for the performance of activities. Therefore, these professionals encounter problems in their professional activities such as the danger of exposure to viruses, lack of sufficient tests to diagnose COVID-19, lack of supplies and medication; lack of adequate equipment; insufficient number of human resources; high demand and extensive workload, among other aspects that involve the problem on the conditions of these individuals (Assunção & Pimenta, 2020).

2.2 Solid Medical Waste

SMW is not considered homogeneous or hermetic, being liable to pose serious risks in the short to long term, both to the individuals who handle it and also to the environment, especially in cases where disposal is not carried out properly.

Resolution no. 222/2018 (ANVISA, 2018a) divided the generation of SMW into five groups, determined as: Group A: Biological Waste; Group B: Chemical Waste; Group C: Radioactive Waste; Group D; Common Waste; and Group E: Sharps waste.

According to Resolution no. 222/2018 (ANVISA, 2018a) and Resolution CONAMA no. 358/2005 (CONAMA, 2005), SMW is classified according to different aspects. This classification is organized according to characterization and specificities. Group A, characterized as biological waste (CONAMA, 2005),

is identified by the symbol of infectious components, with labels on a white background, drawing and outlines in black. Group B, characterized as chemical waste (ABNT, 2004), is identified by the risk symbol associated with chemical substances and contains risk phrases. Group C, characterized as radioactive waste (Comissão Nacional de Energia Nuclear [CNEN], 2020), is identified by the international symbol for the presence of ionizing radiation from trefoil on labels with a yellow background and black outlines. Group D, characterized as common waste (CONAMA, 2001), is identified by the symbol for recyclable materials. According to the classification of material for recycling, codes, colors and nominations must be discriminated. Group E, characterized as sharps waste – Resolution RDC no. 306, of December 7, 2004 (ANVISA, 2004), is identified by the constant infectious substance symbol, with white background labels, black design and outlines.

Resolution RDC no. 306, 2004 (ANVISA, 2004) established that the waste belonging to Group E is composed of sharp materials, such as blades and coverslips, spatulas, scalpels, drills, glass ampoules, needles, pipettes and other correlated items. Its packaging must be discarded separately, at the generation site, immediately after use or need for disposal, in containers, rigid, resistant to puncture, rupture and leakage, with lid, duly identified, in compliance with the parameters referenced in ABNT's NBR 13853/97 standard, being expressly forbidden to empty these containers for reuse (ANVISA, 2004, Plan 14.1).

Based on the recommendations of the Healthcare Waste Management Manual, the handling order should be: Segregation; Packaging; Identification; Internal Transport; Temporary Storage; Treatment; External Storage; External Collection/Transport and Final Disposal.

However, according to the nature of the healthcare waste, it is important to carry out other specific procedures during transport, handling and treatment, citing the example of transporting infectious waste and the transport of sharps waste (Martins, 2021).

2.3 COVID-19 and its Impacts on Public Health in Brazil

Due to the needs in relation to the COVID-19 pandemic, it was necessary for the health system to play its role, to expand the number of hospitals and beds in Intensive Care Units (ICUs), reformulate the process of the nursing network, redefine the medical system, the role of the various units and levels of care and the creation of new access points to the health system (Daumas et al., 2020).

In Brazil, in response to the pandemic, the health system had to be reorganized in a short period of time to assist an increasing number of patients with COVID-19. Hospitals faced some challenges, such as expanding ICUs and Intensive Therapy Units (ITUs), acquiring and/or renovating life-sustaining equipment (mainly ventilators and multi-parameter monitors), reorganizing hospital care, supply, cleaning and disinfection of Personal Protective Equipment (PPE) among other issues (Medeiros, 2020).

Brazil has implemented some strict coronavirus prevention measures related to social distancing during the COVID-19 pandemic, such as frequent use of masks, suspension of economic, social and/or cultural activities, closure of non-commercial and commercial establishments. In-person classes were suspended and social distancing was observed based on recommendations from the Ministry of Health. However, the rigor of these interventions varied according to the state or municipality, as no embracing national policy aimed at encouraging the adoption of these preventive measures was published or organized (Moraes, 2021).

2.4 The Generation of Solid Medical Waste in the COVID-19 Pandemic

In Brazil, urban cleaning and solid waste management are understood as essential services. The generation of solid waste was greatly impacted by the Covid-19 pandemic, directly affecting the work performed in solid waste management.

Due to the nature of the virus and its subsequent ability to disperse in materials, studies show results that associate the permanence of the SARS-CoV-2 virus with the type of surface, the ambient temperature, the relative humidity of the air and the strain. They also report that the persistence of SARS-CoV-2 varies from 2 to 9 days on different surfaces, and materials such as cardboard can be contaminated by the virus (cardboard – for 24 hours), stainless steel (able to survive up to 72 hours), aluminum (5 days), paper (5 days) and plastic (9 days) among others (Kampf et al., 2020; WHO, 2020).

The possibility of a viral presence has become, from this perspective, a source of concern related to the generation of solid waste. Solid waste management is based on the contingency plan for COVID-19. In Brazil, all reported cases of contamination by COVID-19 must follow the guidelines and recommendations presented by the WHO (2020).

According to the *Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais* (ABRELPE) – Brazilian Association of Special Waste and Public Cleaning Companies – since the outbreak of the COVID-19 pandemic, there has been an intensive increase in the production of solid waste. According to the institution, the significant increase demands that the bodies responsible for managing this waste maintain the effectiveness and quality of the services provided, as well as compliance with protocols and guidelines for good practices by service providers who work in this field of activities and who have the competence to act in waste management, focusing on proper management and the use of PPE to protect professionals involved in the management of SMW from the fight against COVID-19 (ABRELPE, 2020).

The management of hospital waste is seen as a series of management procedures, which must be planned and implemented taking into account the laws and regulations in force, as well as the technical and scientific knowledge about solid hospital waste, with the aim of safely forwarding and efficiently transferring solid waste to appropriate locations, with a view to protecting public health and preserving the environment and natural resources (Costa & Fonseca, 2009).

Segregation is the process responsible for the separation of solid waste at the regional site, according to its specificities and physical, chemical, and biological characteristics, physical state and risks involved. Segregation is an essential procedure for the management of SMW, as it aims to reduce the volume of waste to be treated and disposed of, which guarantees the protection of public health as well as preserving the environment. Therefore, although all processes are equally important for the correct management of SMW, segregation is the stage in which the waste is treated and disposed of correctly, which guarantees, in fact, the correct destination of the SMW according to its needs and characteristics (CONAMA, 2005).

According to the WHO (2020), hospitals must guarantee the separation of solid waste, which must be followed by the spraying of sanitizing products, which must be prepared before being placed in double or triple bags, with a seal and identification of the virus that causes COVID-19, in addition to recommending that hospital waste should be incinerated when related to the COVID-19 pandemic, as the coronavirus and other types of

pathogens can survive for more than 72 hours on surfaces, which increases the risk of contamination of the population.

3. Methodology

This work consisted of a quantitative and qualitative research through secondary sources. The type of research merges both qualitative and quantitative approaches. Initially, the qualitative phase was conducted to understand the problem. The categories of these methods complement each other. The quantitative side sought to emphasize objectivity in data collection and analysis through statistics.

By joining the two methods, the researcher has a free approach to resort to the characteristics of the two research methods, to broaden and deepen the study. According to Knechtel (2014), the two research categories seek to consider the individual's point of view: the qualitative one is concerned with approaching the subject. In the quantitative approach, this approximation is given through instruments and empirical techniques (Knechtel, 2014).

For the development of the introduction and bibliographical review, this study was carried out through the search of academic papers, government references, national dissertations collected on the Scientific Electronic Library Online (SciELO) and Google Scholar platforms, references retrieved from the repository of the Federal University of Uberlândia (UFU), developed in 2020 and 2021 were also added. Such references are correlated with the theme including the COVID-19 pandemic in relation to the management of SMW.

In addition to the use of theoretical reference data, this study had a graph aiming to analyze the rate of PPE classified as infectious materials at the UFU's *Hospital de Clínicas*. The graph was elaborated through data obtained by the sector of statistics at the *Hospital das Clínicas de Uberlândia* (HCU).

In order to broaden the discussion, studies on SMW management at the HCU were found in the repository of the UFU and subsequently analyzed. The results obtained were tabulated and used to create graphs, using the Excel platform. The focus of the data analyzed was based on the amount of SMW generated, with emphasis on the incidence of the number of masks, so that in the integration of waste generated, only critical waste for certain job positions is accounted for.

4. Results and Discussion

4.1 Demand for PPE and Waste Generation in the COVID-19 Pandemic

The Regulatory Standard NR 6 (Coordenação de Estudos Legislativos [CEDI], 2005) provides for the consideration of PPE as any device, instrument or individual use product which is used by the worker, with the purpose of protecting the worker from risks likely to threaten safety and health at work. In this context, this equipment should be used by professionals as a method of preventing diseases that may arise from their exposure, in order to preserve their health integrity (ANVISA, 2018b).

Ilyas et al. (2020) identified a correlation between the increase in the number of active cases of SARS-CoV-2 and a significant increase in the generation of solid waste related to COVID-19. This same data was identified in the research conducted by Peng et al. (2020), who pointed out that the increase in solid waste generation is directly related to periods of increase in the incidence of active cases of SARS-CoV-2. The study also

identified that a patient hospitalized with COVID-19 generated about 1.4 kilograms (3.08 pounds) of solid waste per day, which can increase between ten and twenty times the amount of hospital solid waste generated every day. This scenario caused concern from an environmental point of view, with the need to promote ways to reduce the generation of solid waste.

4.2 The Generation of Solid Medical Waste at HCU-UFU

Through contact with the HCU-UFU Statistics Sector, data on the use of PPE at HCU-UFU was made available. According to the institution, the HCU-UFU Pharmacy Sector decided, in 2020, to implement the use of PPE use control, stipulating quotas for health professionals, as well as having the purpose of controlling the quota of materials' use and potential generation of solid waste.

The data provided consider the period from April to December 2020. Figure 1 shows the data on the use of PPE and the generation of infectious waste at the HCU-UFU during the year 2020.

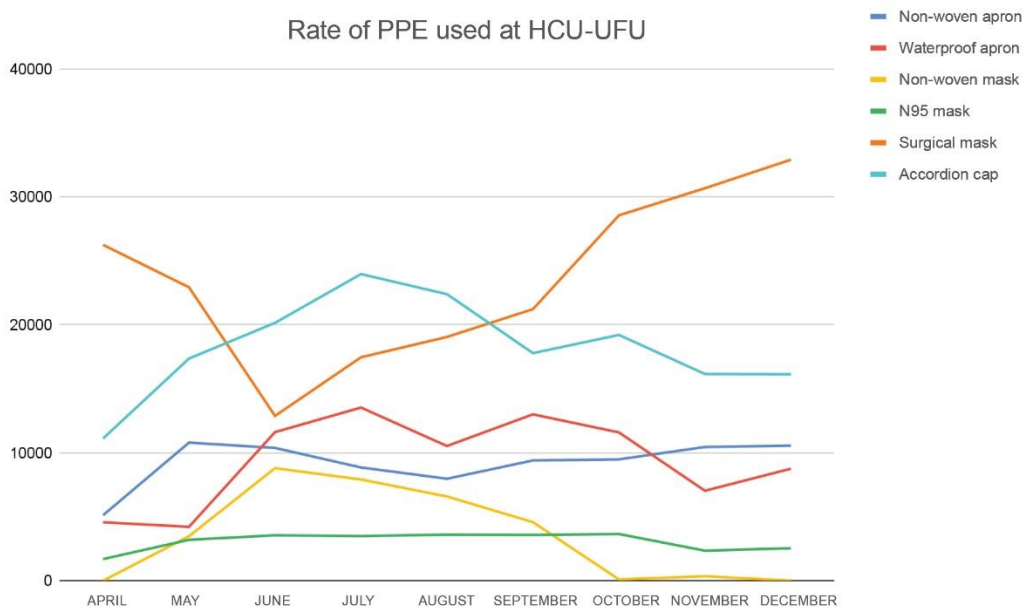

Figure 1. Rate of PPE used at HCU-UFU.

In accordance with the available data, it is possible to verify that the generation of SMW did not remain constant according to the type of solid waste generated, with a considerable variation of increases and decreases occurring. From the analysis of Figure 1, we can infer that throughout 2020 there were increases in waste generation that can be attributed to the different existing dynamics regarding solid waste management, demands and needs particular to the hospital reality.

It is worth noting the encouragement of the conscious use of materials by all professionals involved, which can be associated with a decrease in the total amount of waste generated. Regarding the context of the COVID-19 pandemic, the increase in the use of PPE is probably related to the significant increase in hospitalizations and the moving average of cases. Through the data collected, it can be seen that non-woven masks began to be requested from May 2020. Subsequently, a drop in the requirement for non-woven masks was identified, a

fact that may have been motivated by exchange of demand for disposable surgical masks. In turn, the use of disposable surgical masks[1] grew significantly throughout 2020.

These materials are considered infectious waste, belonging to Group A, as these materials have biological agents that have the capacity to cause some type of contamination and put the health of health professionals as well as users of the health system at risk. For this reason, they must be disposed of in accordance with what is established by technical standards, avoiding accidents, contamination and other risks to public health and, consequently, minimizing the environmental impacts related to the improper disposal of solid waste.

Dealing specifically with the SMW generated at the HCU-UFU, the present investigation could not have access to this data, since this information is not yet known by the Statistics Sector of the HCU-UFU. This lack of database, according to the institution, occurred during the year 2021, a period in which the company responsible for accounting for solid waste management at HCU-UFU was replaced by another private company that, to date, has not a list yet available with numerical information regarding the number of PPE discarded annually since the beginning of the COVID-19 pandemic.

On the other hand, it can be indirectly assumed that the disposal of SMW increased significantly since April 2020, considering that the demand for the use of PPE and, specifically, surgical masks steadily increased throughout the year. In agreement with the HCU-UFU Statistics Sector, the increase in SMW generated from April 2020 to the present is a fact, although numerical values in tonnage, type of waste and further information pertinent to the knowledge of solid waste management in the hospital are still not fully clarified.

4.3 Solid Medical Waste Management at HCU-UFU

Martins (2021) characterized the SMW management at HCU-UFU by analyzing the Solid Waste Management Plan of the HCU-UFU. According to the author, this Management Plan of the hospital pointed out that solid waste generated through outpatient and emergency care must be segregated immediately at the generation site.

When it comes to solid waste management at HCU-UFU, Vieira Neto and Rodrigues (2018) pointed out that it is necessary to promote an organizational culture in respect of the sustainable policy in the hospital, showing that continuing education is an important tool to promote environmental awareness in the daily lives of health service professionals and HCU-UFU users.

Regarding the generated sharps waste, these must be stored in 50-liter drums, made available at the generation site. In other sectors, waste distribution takes place in hospitalization rooms, bathrooms and common wards, where collectors with black bags previously identified as hazardous waste are available (Group A). In this context, Martins (2021) identified that the HCU-UFU performs the strategic allocation of solid waste collectors, correctly identifying them according to groups A, B, E and D, in order to assist in the correct disposal of solid waste from generated in the inner part of the hospital, respecting CONAMA Resolution no. 358/2005.

[1] Disposable surgical masks are produced with a material that filters particles smaller than common fabrics. It has a wire that allows a better adaptation to the contour of the nose area, minimizing crevices and increasing protection.

In view of the above data, some questions arise regarding the possibility of reducing the volume of waste generated from the COVID-19 pandemic, from the perspective of adequate management and enlightened knowledge of all health professionals involved in the management of solid waste. Bearing in mind that in the management of SMW there is a stage of waste segregation, in which the separation and direction for the final handling of the waste occurs, it is possible that there are aspects of the management of health services solid waste to be improved, in such a way that the total volume of common waste decreases considerably.

5. Final Considerations

In an establishment that provides health services, the Medical Waste Management Plan is an important way to promote sustainability and ensure that professionals and patients, as well as society as a whole, have access to public health safely. The generation of waste from health services is an important factor, considering that this waste is potentially harmful to the environment, human and animal health, being potentially infectious and harmful to nature.

From this perspective, in a context of a hospital environment, it is essential that the Management Plan to be considered of fundamental importance for the management, planning and execution in a responsible manner consistent with the resolutions. Therefore, it is necessary that health professionals are trained for this practice, acting with caution and respecting the protocols and legislation in force.

Through the review study carried out as well as the analysis of data made available by the hospital, it was possible to perceive the importance of the procedures regarding the correct management of SMW. In addition, it was possible to perceive that the training and continuing education of professionals involved with the hospital environment are essential and can prevent accidents at work, since the hospital environment is subject to occupational risks.

Thus, the importance of training and professional improvement of health workers is highlighted, so that these kinds of occurrences are extinguished and/or minimized in the work environment, valuing the safety and well-being of both professionals and patients. Furthermore, the need to implement training or actions aimed at the continuing education of professionals and other individuals involved in the health establishment is attributed to the correct management of SMW, bearing in mind that practices and attitudes can aid the prevention of accidents at work.

However, due to different political and budgetary realities according to the institution, whether public or private, there may be challenges regarding the correct training of professionals involved in the procedures and progressions involving the execution of SMW management. In this sense, it is important to improve discussions and promote actions that encourage and collaborate with strategic actions, promoting sustainability and public health, as well as improving the working conditions of individuals involved with the provision of health services.

According to Martins (2021), still with regard to the data collected from the investigated hospital, it should be noted that it has not yet managed to implement a continuing education system for all professionals regarding the handling of SMW. As future recommendations, it is suggested the implementation of a training program aimed at health professionals who are directly or indirectly involved in the processes and procedures for

identifying and segregating SMW, as well as other processes related to the correct management of this waste. In this sense, it is pertinent that new research to be developed with the purpose of relating the importance of implementing plans and strategies aimed at training and continuing education of professionals who work in hospitals.

6. References

1. Applegate, W. B., & Ouslander, J. G. (2020). COVID-19 presents high risk to older persons. *Journal of the American Geriatrics Society*, *68*(4), 681. https://doi.org/10.1111/jgs.16426
2. Associação Brasileira de Empresas de Limpeza Pública e Resíduos–ABRELPE. (2020). *Recomendações para a Gestão de Resíduos Sólidos durante a Pandemia de Coronavírus (COVID-19).* https://www.cnm.org.br/cms/images/stories/comunicacao_novo/links/RecomendacoesABRELPE_COVID19_23mar.pdf
3. Assunção, A. A., & Pimenta, A. M. (2020). Satisfação no trabalho do pessoal de enfermagem na rede pública de saúde em uma capital brasileira. *Ciência Saúde Coletiva*, *25*(1), 169-180. https://doi.org/10.1590/1413-81232020251.28492019
4. Brazilian Association of Technical Standards–ABNT. (2004, May 31). *ABNT NBR 10004*. Segunda edição. Resídios Sólidos – Classificação. https://analiticaqmcresiduos.paginas.ufsc.br/files/2014/07/Nbr-10004-2004-Classificacao-De-Residuos-Solidos.pdf
5. Brazilian Association of Technical Standards–ABNT. (2016, April 14). *ABNT NBR 12808*. Segunda edição. Resíduos de Serviços de Saúde - Classificação. https://www.normas.com.br/visualizar/abnt-nbr-nm/227/nbr12808-residuos-de-servicos-de-saude-classificacao
6. Brazilian Health Regulatory Agency–ANVISA. (2004). *Resolução RDC Nº 306, de 7 de dezembro de 2004*. Dispõe sobre o Regulamento Técnico para o gerenciamento de resíduos de serviços de saúde. https://bvsms.saude.gov.br/bvs/saudelegis/anvisa/2004/res0306_07_12_2004.html#:~:text=RESOLU%C3%87%C3%83O%20RDC%20N%C2%BA%20306%2C%20DE,res%C3%ADduos%20de%20servi%C3%A7os%20de%20sa%C3%BAde.&text=Regulamento%20da%20ANVISA%20aprovado%20pelo,1999%2C%20c%2Fc%20o%20Art.
7. Brazilian Health Regulatory Agency–ANVISA. (2018a). *Resolução RDC Nº 222, de 28 de março de 2018*. Regulamenta as Boas Práticas de Gerenciamento dos Resíduos de Serviços de Saúde e dá outras providências. http://antigo.anvisa.gov.br/documents/33852/271855/RDC+222+de+Mar%C3%A7o+de+2018+COMENTADA/edd85795-17a2-4e1e-99ac-df6bad1e00ce?version=1.0
8. Brazilian Health Regulatory Agency–ANVISA. (2018b). *Medidas de Prevenção de Infecção Relacionada à Assistência à Saúde*. ANVISA. https://www.gov.br/anvisa/pt-br/centraisdeconteudo/publicacoes/servicosdesaude/publicacoes/caderno-4-medidas-de-prevencao-de-infeccao-relacionada-a-assistencia-a-saude.pdf/@@download/file/Caderno%204%20-%20Medidas%20de%20Preven%C3%A7%C3%A3o%

20de%20Infec%C3%A7%C3%A3o%20Relacionada%20%C3%A0%20Assist%C3%AAncia%20%C3%A0%20Sa%C3%BAde.pdf

9. Comissão Nacional de Energia Nuclear-CNEN. (2020). *Norma CNEN NN 6.02*. Resolução CNEN 261/20 Maio/2020. Licenciamento de Instalações Radiativas. http://appasp.cnen.gov.br/seguranca/normas/pdf/Nrm602.pdf
10. Conselho Nacional do Meio Ambiente–CONAMA. (2001). *Resolução CONAMA nº 275, de 25 de abril 2001*. Estabelece o código de cores para os diferentes tipos de resíduos, a ser adotado na identificação de coletores e transportadores, bem como nas campanhas informativas para a coleta seletiva. http://www.siam.mg.gov.br/sla/download.pdf?idNorma=291
11. Conselho Nacional do Meio Ambiente–CONAMA. (2005). *Resolução CONAMA nº 358, de 29 de abril de 2005*. Dispõe sobre o tratamento e a disposição final dos resíduos dos serviços de saúde e dá outras providências. https://www.legisweb.com.br/legislacao/?id=102253
12. Coordenação de Estudos Legislativos–CEDI. *NR 6 - Equipamento de Proteção Individual (206.000-0/I0)*. https://www.camara.leg.br/proposicoesWeb/prop_mostrarintegra;jsessionid=node0s6rqm1ce1rty6kk7p6saseia6524329.node0?codteor=283053&filename=LegislacaoCitada+-INC+4695/2005
13. Costa, W. M.; & Fonseca, M. C. G. (2009). A importância do gerenciamento dos resíduos hospitalares e seus aspectos positivos para o meio ambiente. *HYGEIA*, 5(9), 12-31. https://doi.org/10.14393/Hygeia516924
14. Daumas, R. P.; Azevedo e Silva, G., Tasca, R., Leite, I. da C., Brasil, P., Greco, D. B., Grabois, V., & Campos, G. W. de S. (2020). O papel da atenção primária na rede de atenção à saúde no Brasil: limites e possibilidades no enfrentamento da COVID-19. *Cadernos de Saúde Pública*, *36*(6), 1-7. http://dx.doi.org/10.1590/0102-311X00104120
15. *Decree no. 7.404*. (2010, December 23). Regulamenta a Lei nº 12.305, de 2 de agosto de 2010, que institui a Política Nacional de Resíduos Sólidos, cria o Comitê Interministerial da Política Nacional de Resíduos Sólidos e o Comitê Orientador para a Implantação dos Sistemas de Logística Reversa, e dá outras providências. https://www2.camara.leg.br/legin/fed/decret/2010/decreto-7404-23-dezembro-2010-609830-norma-pe.html
16. Granja, V. (2011). *Proposta de gestão de resíduos sólidos urbanos com enfoque em Educação Ambiental para o município de Tio Hugo – RS*. [Undergraduate Thesis, Universidade de Passo Fundo]. UPF Digital Database. http://usuarios.upf.br/~engeamb/TCCs/2011-2/Viviane%20Granja.pdf
17. Ilyas, S., Srivastava, R. R., & Kim, H. (2020). Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. *Science of the Total Environment*, *749,* 1-12. https://doi.org/10.1016/j.scitotenv.2020.141652
18. Kampf, G., Todt, D., Pfaender, S., & Steinman, E. (2020). Persistence of coronaviruses on inanimate surfaces and their inactivation with biocidal agents. *Journal of Hospital Infection*, *104*(3), 246-251. https://doi.org/10.1016/j.jhin.2020.01.022

19. Knechtel, M. do R. (2014). *Metodologia da pesquisa em educação*: *uma abordagem teórico-prática dialogada.* Intersaberes.
20. *Law no. 12.305*. (2010, August 2). Institui a Política Nacional de Resíduos Sólidos; altera a Lei no 9.605, de 12 de fevereiro de 1998; e dá outras providências. https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2010/lei/l12305.htm
21. Martins, L. M. (2021). *Eficiência de treinamentos sobre riscos, classificação, segregação e transporte de resíduos hospitalares: uma experiência no Hospital de Clínicas da Universidade Federal de Uberlândia (HCU-UFU).* [Undergraduate Thesis, Universidade Federal de Uberlândia]. UFU Repository. https://repositorio.ufu.br/bitstream/123456789/33248/1/Efici%C3%AAnciaTreinamentosSobre.pdf
22. Medeiros, E. A. S. (2020). Challenges in the Fight against the Covid-19 Pandemic in University Hospitals. *Revista Paulista de Pediatria*, *38*, 1-2. http://dx.doi.org/10.1590/1984-0462/2020/38/2020086
23. Moraes, R. F. de. (2021). *Nota Técnica: A segunda onda da pandemia (mas não do distanciamento físico): COVID-19 e políticas de distanciamento social dos governos estaduais do Brasil*. IPEA. https://repositorio.ipea.gov.br/bitstream/11058/10442/1/NT_31_Dinte_ASegundaOndadaPandemia.pdf
24. Peng, J., Wu, X., Wang, R., Li, C., Zhang, Q., & Wei, D. (2020). Medical waste management practice during the 2019-2020 novel coronavirus pandemic: Experience in a general hospital. *American Journal of Infection Control*, *48*(8), 918-921. https://dx.doi.org/10.1016/j.ajic.2020.05.035
25. Rezende, L. R. (2006). Vulnerabilidade dos geradores de resíduos de saúde frente às Resoluções 358 CONAMA e RDC 306 ANVISA. *O mundo da saúde*, *30*(4), 588-597. https://doi.org/10.15343/0104-7809.200630.4.8
26. Vieira Neto, J. B., & Rodrigues, V. S. (2018). *Desafios no manejo dos Resíduos Sólidos de Saúde Recicláveis no Hospital de Clínicas de Uberlândia* [Paper presentation]. 9º Simpósio de Engenharia Biomédica – SEB, Universidade Federal de Uberlândia, Uberlândia, Minas Gerais, Brazil.
27. World Health Organization. (2020, Jan 12). *COVID-19 – China*. https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON233