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**The impact of COVID-19 on waste management: Societal responses to waste during the pandemic.**

João Machado Ferreira

MSc in Studies of the Environment and Sustainability

Supervisor: Sílvia Luís, Ph.D. - Invited Assistant Professor Iscte-Iul

Co-Supervisor: Maria Fernandes-Jesus, Ph.D. - Associate Researcher CIS-Iul

December, 2021



CIÊNCIAS SOCIAIS  
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*I dedicate this dissertation to my parents, my siblings and my four grandparents.*

*“The greatest danger to our future is apathy” – Jane Goodall*



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## Resumo

A pandemia do COVID-19 tem vindo a ter um forte impacto por todo o mundo, mudando o modo como vivemos as nossas vidas. Tal deve-se à ameaça que o vírus apresenta para a saúde humana, mas também ao impacto que tem na gestão de resíduos e consequentemente no meio ambiente.

Nesta dissertação procurou-se estudar os impactos que a pandemia tem vindo a ter na gestão de resíduos. Procurou-se, através de duas entrevistas elaboradas, compreender o papel que os governos municipais de Lisboa (Portugal) e Salto (Brasil) tiveram na gestão de resíduos durante a pandemia e se o processo de gestão tem sido adequado. Procurou-se ainda, através de dois questionários elaborados, compreender como a população destes dois países tem sido afetada e que possíveis impactos podem os comportamentos dos cidadãos ter neste processo de gestão de resíduos.

Os resultados mostram que ambos os municípios estudados e os respetivos países estão sujeitos a fatores como limitações geográficas, densidade populacional e diversidade social, que afetam diretamente o processo de gestão de resíduos, no entanto encontram-se semelhanças nas abordagens seguidas. Notou-se ainda que o modo de obter resultados positivos no processo de gestão de resíduos não depende unilateralmente da intervenção do governo nem do comportamento social, mas sim de uma cooperação entre ambas as partes. Por fim notou-se também que todos os países devem investir em planos de educação e consciencialização ambiental, de modo a que os cidadãos compreendam desde cedo o impacto que os seus hábitos podem ter no meio ambiente.

**Palavras-chave:** Gestão de resíduos; lixo infeccioso; pandemia; recolha separada de resíduos; Reciclagem.





## Abstract

The COVID-19 pandemic has been having a strong impact throughout the world, changing the way we live our lives. This is due to the threat that the virus poses to human health, but also to the impact it has on waste management and consequently the environment.

In this dissertation it was intended to study the way that the pandemic has been affecting waste management. With the elaboration of two interviews, it was intended to understand the role that the municipal governments of Lisbon (Portugal) and Salto (Brazil) had on waste management during the pandemic and if the management process has been adequate. It was also intended, with the elaboration of two questionnaires, to understand how the population of both these countries has been affected and which possible impacts can the citizens behavior have in this waste management process.

The results showed that both these municipal governments and their respective countries are subject to factors like geographic limitations, population density and social diversity, which directly affect the process of waste management, however there are similarities in the approaches followed. It was also noted that the way to obtain positive results in this waste management process does not depend unilaterally on the intervention of the government nor the social behavior, but the cooperation between both parts. Lastly it was also noted that all the countries must invest in environmental education and conscientization, so the citizens can understand from early on, the impacts that their habits can have on the environment.

**Keywords:** Waste management; infectious waste; pandemic; separate waste collection; Recycling.



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## **Introduction**

The outbreak of COVID-19 in late 2019 not only must be seen as a global health crisis but also as a highly impactful social and economic threat, that has a deep impact in everyday lives. Full countrywide lockdowns were implemented to ensure the virus would not spread so much and all of us were kept safe.

For a crisis of this nature the main concerns are to ensure the protection of human lives and the recovery of livelihoods, however a different problem emerged. As the world has seen a change in waste patterns, from the increase in healthcare waste used in medical facilities and in people's homes, to the increase in personal protective equipment like facemasks and rubber gloves, and also the change in household waste seen with the increase of online shopping and food delivery services. Proper waste management, including household's and healthcare centers, is an essential civic service in order to minimize possible secondary impacts upon health and environment (Sharma et al., 2020).

The fact that COVID-19 is an extremely infectious disease has presented difficulties to waste management, since household waste might now be a source for spreading the virus.

The increase in waste shows signs of concern due to the fact that the greater amount might be difficult to deal with safely, but also because of the risk of infecting people through fomites. Failure to properly manage these new quantities and types of waste, generated from health facilities and households, might be a threat to human health and also the environment.

The subject of this thesis is the impact that the COVID-19 pandemic has been having on waste management. The purpose is to understand in what ways and at what extent has the pandemic caused by the COVID-19 been affecting waste management and consequently the environment. To properly understand these two studies were conducted, preceded by a detailed literature review.

With the literature review it was intended to provide a theoretical background to the issue of the impacts that pandemic is having on waste management around the world. This macro perspective would be a key element to understand if this is in fact a serious problem that could be a threat to both human health and also to the environment, or if it was just a localized issue. It was also intended to understand the specifications of the COVID-19 virus, since this would help to understand in what ways could the waste be affected. It was important to understand if there was any change in the nature of the waste during the pandemic and depending on where

it would be produced, from hospitals to households with infected people, how it had to be handled, transported and disposed.

This literature review helped to establish the information that was needed for the elaboration of the studies, and also to reach the final results.

For a subject such as the one of this dissertation's, which studies a global issue, it was decided that the best way to achieve the results was to focus on two countries and proceed with a deeper analysis of each, so Portugal and Brazil were the two countries selected. There are clear differences between both of these countries, such as the geographic dimensions and the population density, however, there is a positive element in the language they share (Portuguese) which provides a sense of proximity. Although the respective results from these countries might differ from one another, it is possible to identify common factors.

The first study consisted in two separate interviews with government representatives of cities from both Portugal and Brazil. The cities chosen were, Lisbon for the Portuguese case and Salto for the Brazilian case. These interviews featured two professionals who have an active part in municipal waste management and its purpose was to have an insight about the ways that waste management is being handled on a municipal scale.

All countries and cities are different from one another. Each has its specific organization, social background and economic capacities. Accepting that, it was decided to have an analysis of these two different cities, of two different countries, to have a representative demonstration of how local governments have been responding to the pandemic in terms of waste management.

With these interviews it was intended to understand to a greater depth the difficulties felt during the pandemic and the several factors to be considered when dealing with a matter that it is part of our every day's life. With these interviews it was also intended to understand the impact that international organizations and developments regarding waste management during the pandemic had on their work and decision making.

Finally, it was intended to understand the impacts that the measures applied at a municipal scale had in the citizens, and whether they were effective or not.

The second study consisted on the elaboration of two questionnaires. These questionnaires were created to provide an intake on the perspective of society during this pandemic, and also to complement the first study. Both questionnaires are identical, however slightly adapted to the different contexts from each country.

Taking into consideration the results obtained with the interviews, where it was possible to understand the governments and the decision makers perspective, the results obtained through



these questionnaires helped to understand the point of view of the civilians, which is fundamental to reach a conclusion for this dissertation.

By studying the impacts that the pandemic has been having on waste management and analyzing the intervention and impact of both government representatives and civilians, it was intended to understand if this crisis has been properly handled, what elements might have influenced the process and eventually what could be done for a better performance.

The goal of this dissertation is to allow for a deeper understanding of the particularities of the Corona virus and the impact it has on waste management, and consequently our lives and the environment. It will also be possible to understand how governments and people are managing this issue and the impacts both these sides have on each other during the pandemic, in terms of waste management.



## CHAPTER 1

# Literature Review

The COVID-19 pandemic is a rather recent event and because it took such immense proportions, affecting the whole world, there is already a good amount of literature regarding this matter, most of it being newspaper and internet articles, and some governmental reports. In order to present reliable information, this literature review is based on literature published by official governmental websites and platforms, non-governmental organizations reports, such as the United Nations (UN), and on research papers indexed in high quality databases, such as Science direct.

For this literature review it was important to consider literature from multiple countries and credible sources because it was very important to find a common opinion around the world, that way classifying this as real problem instead of something only affecting on a regional level, which could suggest local mismanagement.

### 1.1. Types and quantities of waste

The lockdowns implemented throughout the world have affected the consumption patterns in almost every household, leading to a change in the type and quantity of waste being produced, such as the exponential increase of the use of face masks, gloves and sanitizers, most of these being single use products.

Different countries are being affected differently since their policies and infrastructures differ and the number of inhabitants is different as well. In some cases, the pandemic hit extremely hard, because of various reasons, therefore the quantity of waste is higher than in some other countries.

COVID-19 has led to a rapid increase in the amount of medical waste generated (UNEP, 2020). Tsai (2021), defines medical waste as the one which is produced in the course of medical treatment, medical testing, quarantine inspections or biological materials by medical treatment organizations.

Sustainable management of medical waste can be problematic, especially in emergencies such as the COVID-19 pandemic (Sarkodie & Owusu, 2020). Due to the modification to the existing waste facilities, in order to control the unusual medical waste produced during the pandemic, it requires adequate information on the amount of medical waste generated, waste

generation hotspots and available treatment facilities and capacities (UNEP, 2020). As a result of the rapid increase in volumes of waste, some waste management facilities and technologies were required to maximize existing infrastructures to accommodate the emergency.

The consumption of these single use products has increased due to the higher consideration of personal hygiene and convenience of use (Sarkodie & Owusu, 2020). This increase in waste amount shows a specific concern, other than difficulties in managing and discharging excessive quantities, which is that households that inhabit infected people might now be spreading hubs for the virus. Sharma et al. (2020) also believe that infectious waste is not restricted to hospitals and healthcare centers and people with minor symptoms or even asymptomatic might also generate contaminated waste in their households.

### **1.1.1. Quantities of waste**

As people are now producing more waste than before. Big amounts of infected household waste are now a possible threat to both public health and the environment. This waste needs to be handled and disposed properly, therefore it requires proper planning. Managing this new reality is challenging and might pose a threat to human health if the proper safety measures are not applied, and it might also pose a threat to the environment since these big amounts of waste have specific standards for disposal (Sarkodie & Owusu, 2020).

The composition of solid waste produced at households during the COVID-19 pandemic is similar to that which hospitals produce in normal circumstances, however the quantities generated during the pandemic exceed the usual quantities produced at hospitals and health centers, reaching up to 600% increase in places such as Hubei province in china, in the beginning of the pandemic (Das et al., 2021), while Malaysia saw an increase in medical waste of 27%, following the first outbreak of COVID-19 (Tsai, 2021). The quantities of household waste had also increase significantly, like the case of Japan, when in May 2020 household waste increased by 110% as compared to the previous year (Das et al., 2021).

In Barcelona (Spain), regarding hospital quantities, there was an increase in face masks and gloves of 350%, resulting in approximately 1,200 tons of medical waste, compared to the usual 275 tons (Sarkodie & Owusu, 2020). The increase in medical equipment was also observed outside hospitals and medical centers. The World Health Organization (WHO) projected a monthly expenditure of 1.6 million plastic-based protective goggles, 76 million plastic-based examination masks and 89 million plastic-based masks. Also, the daily production

of face masks in China increased by 116 million (a dozen times higher than January, 2020), just in February of 2020 (Andersen, 2020).

Tsukiji et al. (2020) believed that while it was important to anticipate the emergence of new types of waste during this pandemic, scientific insights such as the viability of the virus on different materials (up to 72 hours on plastic, 48 hours on stainless steel, 24 hours on cardboard, and 4 hours on copper) should be paid attention to, just for the adjustment of existing waste management, thus proper handling of waste can be performed.

In some countries, instead of an increase in waste, there might happen a decrease instead. Sarkodie & Owusu (2020) pointed to a decline in the totals waste production in Milan (Italy), due to the institution of strict lockdown, by 27,5% which includes 24,4% decline in residual waste, 20% reduction in paper and cardboard waste and 16,3% decrease in plastic and metal waste. A similar waste reduction was verified in Catalonia (Spain), where the month of confinement saw a 16,65% drop in municipal waste, thus from 282,3 thousand tones to 242 thousand tones, due to mobility restrictions on tourism and reduction of commercial activities (Sarkodie & Owusu, 2020).

## **1.2. Management**

Although the percentages might vary from country to country, the increase in healthcare solid waste is seen globally. Facing this reality, Das et al. (2021) recognized that, since the ability to sustainably process and recycle healthcare solid waste depends on its composition, which is already familiar therefore does not pose a big threat, one of the main challenges lies in managing these greater quantities.

During the COVID-19 outbreak, many types of additional medical and hazardous waste are generated, including infected masks, gloves and other protective equipment. The safe handling, and final disposal of this waste is, therefore, a vital element for an effective emergency response. Prior to this pandemic the control required for this type of waste would be mostly applied to hospitals and health centers, however during this new reality every household could be producing highly infectious medical waste, which poses great threat to public health (Fan et al., 2020).

Effective management of biomedical and health-care waste requires appropriate identification, collection, separation, storage, transportation, treatment and disposal, as well as important associated aspects such as disinfection, personnel protection and training (Sharma et al., 2020).

Tsukiji et al. (2020) stated that local governments must apply specific precautionary measures, operations and practices under this pandemic, not disregarding the normal protocols for household and healthcare waste management. In agreement with these statements Fan et al. (2020) pointed to the need to adjust waste collection and allocation to the changes in waste amount and composition, admitting that the existing collection system could be altered by the demand in different places and timing. In Portugal the same possibility was taken into consideration in the beginning of the pandemic, when the proper management plan for the waste collection teams was established (APA, 2020).

Currently the main concern towards the waste management issue is regarding hospitals' and health care centers' waste, since these are the main producers of such, and so for these establishments it has been devised proper procedures and methods for managing COVID-19 waste (Sharma et al., 2020).

Tsukiji et al. (2020) stated that healthcare waste management must be continued for COVID-19 waste, however with specific precautionary measures and adjustments applied to mitigate any potential risks of COVID-19 infection during the process. These same authors find that, ideally, based on the concept of the 3Rs (reduce, reuse and recycle), the better practice of healthcare waste management should aim to avoid or recover as much of the waste as possible, rather than disposing, therefore minimizing the quantities.

Waste segregation at source is also a valid option for a safe management of potential infectious waste. Tsukiji et al. (2020) state that, ideally, all potential infectious waste should be put in a sealed bag and double bagged if possible, and that it needs to be handled as residual waste not meant for material recovery. Through methods of colour coding, it is possible for people to separate waste by types, which would facilitate the disposal and transportation processes and would also help to reduce the potential risk of exposure to the virus (Tsukiji et al., 2020).

Regarding storage and transport for private residences there are also specific methods, as these places must not be forgotten since most of the people that have contracted COVID-19 are at their personal residences. For such cases, Tsukiji et al. (2020) state that onsite transportation should take place during less busy times, whenever possible. Also, mapping out the sources that are potentially generating COVID-19 contaminated waste and healthcare waste is a critical step in controlling the flow of the waste. The handling and transportation staff must be wearing proper personal protective equipment (gloves, masks, closed suits and shoes) and setting routes should be used to prevent staff from being exposed for too long.

In some cases, like in Lisbon (Portugal), the people responsible for managing the household waste chose to follow the example and guidance of some more experienced entities like the national environmental agency and the national health department, and also kept in touch with some other cities like Amsterdam, Paris and Los Angeles (Lisboa, 2020). On the 20<sup>th</sup> of March, 2020, Lisbon's city council ceased some services for waste collection, for a period of time, to control the risk of spreading the virus by handling potentially infected waste. Among such services there were, selective door-to-door waste pick up and glass door-to-door pick up.

Despite many efforts to inform the different parties, some countries could not adapt to these safety measures, such as Bangladesh. Rahman et al. (2020) state that inside Bangladeshi hospitals, there are few measures for proper medical waste collection and separation, the workers do not use adequate personal protective equipment and the waste is disposed of in unauthorized places. Without proper handling of this waste and a lack of sorting standards, waste collectors are at high risk of getting infected by COVID-19, since they work without proper protective equipment.

Healthcare waste handlers are at great risk during the COVID-19 pandemic, therefore, in order to increase awareness regarding such threat and to educate interested parties on how to avoid possible infection while performing an essential duty, most countries have introduced strict guidance on Occupational Safety and Health (OSH) practices, based on national and international standards (Tsukiji et al., 2020). Some of the measures directly influence operational matters, such as providing necessary personal protective equipment, but most of them rely on educating and training the workers on how to use the proper equipment, like masks, gloves, rubber boots, disposable workwear/hazmat suits, goggles and face-shields.

As for Portugal, the national environmental agency also states that the proper cleaning of the waste pick up vehicles and enforcing proper hygiene standards of the personal protective equipment is required to prevent any infection during this service (APA, 2020).

### **1.3. Recycling and separate waste collection**

One of the reasons this pandemic is so life threatening is due to the fact that the virus can be spread through different ways, one being through contact with fomites, which are objects or materials likely to carry infectious particles (Lewis, 2021). Since this fact strikes fear of the unknown, some governments interrupted their recycling programs and separate waste collection, to avoid handling directly with contaminated waste.

In the early stages of the pandemic recycling was not a priority, since there was not sufficient knowledge regarding how the virus could spread through waste.

Klemes et al. (2020) pointed to the fact that in Germany food containers, which would normally be classified as recyclable waste, began to be treated as hazardous waste, because of the risk of contamination with pathogens. Such practices create logistical challenges for waste management systems, and other economic and environmental issues to emerge. In agreement to this, Fan et al. (2020) also point out that the recycling sector in the US faced material volume changes and operational impacts to accommodate safety measures and at times leading to suspension of services. What followed this scenario was the questions of, how long would the interruption of recycling processes take, and whether there is an optimal solution where recycling and separate waste collection could be conducted safely.

In order to properly assess the safest way to proceed with recycling processes, a better understanding of the virus properties was required. Early studies showed that the virus is not detected on glass and banknote from day 4, stainless steel and plastic from day 7 while it is still detectable on a surgical mask on day 7 (Fan et al., 2020).

A later research by Assuta Ashdod University Hospital in Israel showed that there is little probability of getting infected when in contact with fomites, since the viral material found in samples were not able to infect someone, therefore Lewis (2021) states that resuming recycling programs became a priority for local governments.

Supporting these facts and in an attempt to prevent a decline in recycling standards, the EU released its guidance on waste management in the context of the COVID-19 on 14<sup>th</sup> of April (Europe, 2020). In this guidance the European Commission advises its member states to continue their proper municipal waste management services, including separate collection and recycling processes. The Zero Waste Europe recognizes the scientific based decision making, regarding suspending recycling programs, to prevent possible spreading of the virus, however warns the risks of these short-term legislations as they might undermine the European Union's (EU) long-term circular economy objectives (Europe, 2020).

#### **1.4. Treatment and disposal of the waste**

The tremendous increase in waste volume was an upset to the system which is designed for specific predictable amounts. Sarkodie & Owusu (2020), recognize that the rapid expansion of medical waste was accompanied by a change in procedures and therefore waste treatment



facilities, transportation and waste management technologies were required to maximize their operations to accommodate the emergency.

Issues such as mixed waste are now much more common than prior to the pandemic, mainly due to the increase of hazardous waste in households. Developing inventories and estimates on the amounts being generated is a key factor in controlling the pandemic, however Tsai (2021) suggested that there was still an absence of such methods.

When mixing infectious hazardous substances in household waste, it eventually leads to a discomfort amid waste pickers and the staff responsible for managing and disposing it. In Europe, governments have faced challenges in retaining waste management employees as they feared for their safety and it has become more difficult to maintain a safe environment when handling household waste produced by infected people at home (Das et al., 2021).

Regarding possible methods considered for the safest way to eliminate possible contaminated waste, the following mentioned are the most commonly used. Fan et al. (2020) stated that medical incinerators, and industrial furnaces are viable solutions specially when dealing with great amounts of waste. Sarkodie & Owusu (2020) also believe that, ideally, medical waste like disposable masks should be sterilized and incinerated in designated facilities.

Accepting that incineration is one of the most used and preferred methods, it is important to understand that this process has its downsides. According to Stockholm Convention guidance, if healthcare waste is not properly incinerated, with the adequate equipment there is potential for the release of toxic substances, in relatively high concentrations (Tsukiji et al., 2020). This guidance also shows that small-scale health-care incinerators in developing countries have some operational and maintenance issues and as a result of such concerns the WHO recommended interim treatment and disposal systems, as below:

- Small healthcare waste incinerators are designed to meet the need for public health protection where there are no resources to implement and maintain more sophisticated technologies, and so this leads to a situation where the environmental and health negative impacts from controlled combustion comes second to the need for immediate public health protection if the only other alternative is uncontrolled dumping (Agarwal et al., 2014).
- The burning of PVC plastics and other chlorinated waste should be avoided to prevent the generation of dioxins and furans (Agarwal et al., 2014).

- In some exceptional and extreme situations, burning of healthcare waste in a pit might be chosen as an interim solution, but only if no other method is possible and it must be undertaken in a confined area and after the burning the remainder must be covered with a layer of soil (Agarwal et al., 2014).

Autoclaves are another valid solution, as they are suitable for solid waste and protective equipment, there are no specific pollutant emissions limits for autoclaves and other steam treatment systems and waste does not require further processing, however odors can be a problem if there is insufficient ventilation and waste requires further processing for final disposal (Tsukiji et al., 2020). Microwave treatment is somewhat similar to autoclaves, in terms of the outcome of the process, as the processed waste will also require further processing for final disposal but a fully enclosed microwave unit can be installed in an open area, and used with a filter to prevent the release of aerosols during the feed process.

The World Health Organization (WHO) projected an ideal process on different approaches for healthcare waste treatment methods.

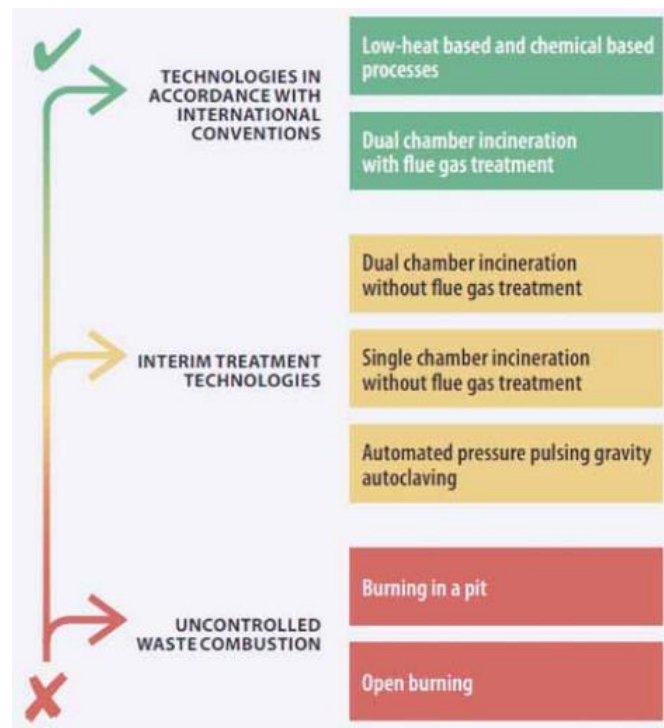


Figure 1.1

*Approaches for Healthcare waste treatment methods.*

Note. World Health Organization's acceptance of multiple types of waste treatment methods.

Source: WHO 2019

As shown in figure 1.1, the World Health Organization dismisses options such as open burning and burning in a pit, as these are methods by which the smoke does not get filtered and therefore are hazardous. This Organization partially recognizes using the methods shown in the Interim Treatment Technologies section of the picture, as these are more technologically advanced and provide a safer and cleaner waste treatment. Finally, two methods stand out as Technologies in Accordance with International Conventions: Low heat based and chemical processes and also dual chamber incineration with fuel gas treatment. These two methods are recognized and accepted as they completely transform the waste into a harmless residue and the method itself is devised in order to prevent most environmental risks.

### **1.5. International organizations and governments contribution**

Governments from all over the world have the tremendous responsibility of securing the well-being of their citizens and managing this pandemic has been a constant adaptation in terms of new elements and difficulties brought by the virus.

Although the priority is given to the healthcare issues, the government has the responsibility of taking into consideration all aspects brought by this pandemic such as waste management. Managing COVID-19 is very much unlike any other situation to the date, since it is a pandemic which is affecting the whole world, and because of this, new procedures needed to be established to prevent an ecological and healthcare disaster. International organizations and agents were called to step up and create new standards that could fit any possible situation and to which governments could adapt to their own countries.

Tsukiji et al. (2020) pointed to the fact that only just over half of the countries in the world have any form of legislation in place regarding healthcare waste management, and only about a quarter have dedicated laws.

Alanezi et al. (2020) stated that reliable sources such as the UN and WHO, along with governments of various countries provide regular updates and necessary information to prevent the spreading of COVID-19. As a non-governmental organization, the UN plays a key role in managing this crisis, since it serves as a link among almost every country in the world. The UN also benefits from being an organization with several departments specializing in a variety of fields of study, which translates in a broader reach in terms of knowledge and reliability. All these details are what makes the UN the entity responsible for handling threatening issues such as the COVID-19 pandemic.

As the UN started to collect data on the COVID-19 and realized its potential risk of spreading uncontrollably, it began to devise plans of contingency, such as new waste management plans, so every country could be prepared for a diversity of scenarios. By devising these plans, countries are not obliged to follow every procedure as stated by the UN, but as they look for guidance from a more experienced and knowledgeable party, almost every country tends to follow their steps. Besides, because the UN planned contingency measures with the few information available in the beginning of the pandemic, some countries that followed did not adapt their approach to the constant change of scenario involving this crisis. Some international organizations publish guidelines to help inform every country that wishes or needs them, however in some matters such as waste management during the COVID-19 pandemic, some countries choose to create their own rules and guidelines as they are more familiar with their capabilities and constraints (Sharma et al., 2020).

In this same report, Sharma et al. (2020) stated that most governments started to follow existing legislation and regulations put in place by their respective countries for the management of infectious waste from hospitals and households. Some governments continue to introduce new policies and guidance to follow in regards of handling waste under the COVID-19 pandemic, considering additional capacity and resources are required to maintain compliance for proper waste management.

In order to properly manage the outcomes of this pandemic, good governance and policymaking play an important role throughout the emergency cycle – from preparedness and readiness, to respond to eventual evidence-based recovery from COVID-19.

According to the information processed by Tsukiji et al. (2020), the issue with many developing countries is in enforcing the policies, therefore a national healthcare waste management policy is required to push political decision making and mobilize government efforts and resources for successful implementation of the plans. Due to the lack of infrastructure, countries like Indonesia are troubling in reaching waste collection procedures in rural areas, translating in waste collection rates roughly half of that in urban areas.

There is a number of key elements to be considered for inclusion in healthcare waste management, such as, existing regulation for standard waste management, identification of the needs and gaps in the country, practical and technical guidelines and specially a contingency plan. This last shall be applied in emergency situations such as the one we are living in (pandemic), so the continuity of healthcare waste management can be ensured.

The disruption of such services, due to the COVID-19 pandemic, causes additional social and health issues and so it must be avoided by implementing existing policies, strategies, plans and regulations (Tsukiji et al., 2020).

A system had already been devised that would guide different countries through exceptional situations such as this one, as shown below in figure 1.2.



Figure 1.2

*Hierarchy of regulatory and institutional framework for healthcare waste management.*

Source: WHO (2014).

Another surprising outcome is that Europe, which is a region with high levels of legislation has, a rather low coverage of laws dedicated to healthcare waste management. Even though many countries, including the majority of Europe, may be lacking legislation on healthcare waste, this does not mean that the waste stream is untreated. Healthcare waste treatment might be addressed through guidelines or policies which were not issued by the EU or another international organization but by national or regional initiative, such as the cases of Germany, Spain and Belgium (Tsukiji et al., 2020).

Through the Zero Waste Europe guidance, the European commission has issued a zero-waste approach that requires members of the EU to recycle waste between 70-80% while

declining Greenhouse Gas (GHG) emissions attributed to toxic waste disposal and incineration techniques (Europe, 2020). The Zero Waste approach aims to preserve the environment and human lives by re-thinking the method used to discharge and dispose waste and avoid procedures such as incineration and discharges to land and water. Despite the current pandemic situation demands a more aggressive yet safe approach regarding waste disposal, the EU still consider it a priority to strive for sustainability and so, “The post-crisis offers lessons that waste management before this pandemic cannot be continued as business as usual but requires structural adjustments, hence accentuating the importance of transitioning from linear to a circular economy.” (Sarkodie & Owusu, 2020, p.8).

The government has the responsibility of establishing rules, guidelines and guidance for proper waste management, however, citizens cannot possibly act accordingly without being properly informed. Because of this, raising awareness and spreading adequate information is very important to ensure positive results.

## **1.6. Awareness**

The public adherence regarding diverse measures about the COVID-19 differs from country to country, and while the nature of the pandemic changes, it is important that the information and advice remains constant. Mostly noted in the early stages of the pandemic, and in some cases even in countries that were being hit hard by it, it was possible to notice some people roaming freely without following precautionary measures such as social distancing, and wearing masks (Alanezi et al., 2020).

Margraf et al. (2020) proceeded with a social analysis which showed that COVID-19 safety measures acceptability depends in a big way on how each country faces this threat. In this same study the authors give the example of countries like Germany and France, which from the beginning established mandatory lockdowns and frequently tried to educate their population on how to behave. In these two countries, 77,4% of the participants rated the high level governmental measures as useful and 91,7% reported adherence to them, where in countries that showed ambivalent attitudes towards the measures and where people felt particularly left alone and not well supported, like in Russia and Poland, adherence was lowest (Margraf et al., 2020).

Margraf et al. (2020) assume that the perception of constructive public communication by governments and authorities predicts a higher usefulness evaluation of the measures and greater adherence. They also find it important that the introduced measures should not be perceived as

an annoying obligation enforced by the authorities, without any or few concerns towards the population and their needs and rights. Economic factors are also taken into consideration in this study, as many individuals were economically affected by the lockdowns and these might disagree with the measures and might question them as they are being negatively affected, therefore show less adherence.

Another factor that Margraf et al. (2020) considered to be important regarding the acceptance of imposed or suggested measures is the mortality ratio in countries and individual medical history. They concluded that individuals who are predisposed to health problems show better adherence to preventive measures and countries with higher mortality ratio also show higher acceptance since there is a clear understanding that their vulnerability is higher.

Tsukiji et al. (2020) have defined some training and capacity building actions to be helpful towards increasing COVID-19 awareness in society. Such actions are based on principles like enforcing education and training programs for healthcare professionals, regarding safe waste handling procedures and raising awareness on developing a healthy working environment for healthcare waste workers, for example: all workers must be trained on risks of exposure to the virus; strategies to reduce human interaction and ensure distance between workers at work; implementing precautionary measures such as demanding that sick employees stay at home (prior to receiving a positive or negative COVID-19 test) and employees notifying their company if a family member is sick.

Awareness raising for the public is also very important and could show positive results in terms of lowering the infection ratio. Tsukiji et al. (2020) consider the following measures to be required:

- Development of guidelines on handling, treatment and disposal of waste generated during the quarantine of a COVID-19 patient.
- Development of media for hygiene practice and safe handling of waste management.
- Disposal must be in designated places only, to avoid formation of uncontrolled dumpsites.

Assuring a flow of proper communication, regarding ways to deal with the virus will also help to reduce the infection ratio. This concern is shown by Margraf et al. (2020), stating that effective communication by national governments and authorities, provide proper and credible information on the seriousness of the virus.

Although it is important to ensure a flow of information regarding the developments of the virus and the pandemic, it is also important to mind the credibility of the information, to avoid any possible negative impacts. Alanezi et al. (2020) believed that it is very important that accurate and reliable information is disseminated to the public through verified sources and the spread of any misinformation must be effectively contained to prevent any loss.

Alanezi et al. (2020) also found that creating public awareness regarding diseases such as COVID-19 is one of the effective approaches for controlling the spread of this virus. They also stated that because the information about this virus the precautionary methods and treatment may vary, therefore it is important to have timely updates about the pandemic and the preventive care to be disseminated among the public in order to contain the transmission of infection.

Acquiring some simple knowledge about the virus will also help to further process more complicated information. For example, in a study in Saudi Arabia, 86.31% of the participants identified the incubation period to be ranging from 5 to 14 days, while 12.68% stated they did not know, and 6% stated to be 21 days, and finally, 18% of the participants believed that there are certain myths circulating online, which are not officially confirmed or declared by the governments or healthcare organizations (Alanezi et al., 2020). These simple to understand facts will only bring more positive results within our society, as information such as this serves its purpose of not letting people take certain risks by being misinformed or uninformed.

Each country is subject to different scenarios facing this pandemic, since the outcome of the spreading depends on multiple factors, such as population density and distribution, geographical display, and economical capacity. While healthcare facility workers are mostly accustomed to handle hospital and healthcare centers waste, additional capacity building and awareness raising is urgently needed for households.



## CHAPTER 2

# Context for the present research

In order to understand to a greater depth, the impact that the pandemic has been having on waste management and the multiple factors to be considered in terms of both government and society's intervention, it was important to proceed with a more focused research of specific countries, this way obtaining information that is not available to the public. To achieve this, Portugal and Brazil were chosen for this research.

To have the information from two different countries was useful, since it was possible to compare the data from both and see what aspects are similar, which can help to prove some ideas from the existing literature, and also to see what aspects are different, which can help to identify differences in management methods. For this, geographical and social aspects had to be considered.

These two countries share the same language and also other aspects, which is helpful for this research for comparison purposes, and it also makes the information gathered more accessible.

As Portuguese myself, I felt very concerned during the pandemic with the way that Portugal was dealing with waste management during this period of time and I wanted to know the impacts that the pandemic has been having on my country and what has been done to contain this threat. I also knew that other countries were also suffering from the same problem, and so I felt it was important to understand how differently this problem (the pandemic) has been affecting different countries.

Almost every day on the TV I would see how Brazil was one of the countries in the world that has suffered most with the pandemic, and so I felt curious to understand the differences of these two countries in terms of waste management during the pandemic. As Portuguese we share a connection with Brazil, since we share the same language. Since these countries are very different in terms of size and population, I felt it would be very interesting to study both of them.

### **2.1. Waste management in Portugal before and during the pandemic.**

Portugal is a relatively small country, with a resident population of approximately 10 million people, with a population density of 111,7 person per square Kilometer, 44% living in cities and the majority in littoral areas (INE, 2021a).

As per the latest updates on the webpage of the Portuguese National Institute of Statistics (INE), by November 2020 Continental Portugal was producing 4 754 820 metric tons of urban waste, of which 2 436 710 metric tons was being disposed to landfills and 512 kilograms was being collected per year, per inhabitant (INE, 2021b). Portugal benefits from a good system of municipal waste collection, from the disposal sites to the collection teams and interaction with the recycling companies. Despite this there are still some low percentages in terms of waste recycling and collective collection. By November 2020, 21 percent of urban waste was being selectively collected and 42% was being prepared for reuse and recycling, per year (INE, 2021b).

As in most of the other countries in the world, urban waste is managed by local and/or municipal governments, however there is a National organization responsible for projecting and overseeing the implementation of waste management plans and laws, (APA, Agência Portuguesa do Ambiente).

As per APA (2021) it is up to each citizen to responsibly dispose of their waste in the sites available to them by the local governments or private associations. Regarding the selective collection of waste, amongst which are paper and carton packages, metal, plastic and glass recipients and culinary oil, it is the municipalities responsibility to provide such services. The selective collection of waste is a service that has to be requested by the citizens, however it is not free of charges, since there is a tariff charged for these services as a way to cover the expenses, including the proper treatment of the waste.

Pre-Pandemic waste treatment systems that were designed for moderate flows, are now operating at an abnormal rate, due to rapid increase in the quantity and quality of the waste.

Recognizing the importance of adequate waste management during the COVID-19 pandemic has been one of Portugal's key elements in responding to such a crisis. On the 23<sup>rd</sup> of March 2020, the Portuguese Minister for the Environment and Climate Action, João Pedro Matos Fernandes, signed three orders, covering municipal waste management and other essential areas. These orders aimed to guarantee essential services to the community whilst dealing with the risk of infection (ACR+, 2020).

It has been a top concern to ensure that all workers dealing with waste, during the pandemic, have and wear the proper personal protective equipment during such activities. The Portuguese government aims to prevent the spreading of the virus and believes that public

workers responsible for municipal waste transportation and processing are at risk and therefore must have protective equipment and a set of safety guidelines (ERSAR, 2020).

The Portuguese government has established a set of guidelines that aimed to ensure the continuity of municipal waste collection. Some of the rules were more accessible and easier to apply than others. The more basic, yet important ones, were regarding the personal protective equipment and how it should be used and handled. The usage of disposable rubber gloves is ideal, however the standard ones used prior to the pandemic are acceptable since they are regularly cleaned and striped of properly, without touching human skin and compromising the safety of oneself and the others. Surgery masks are not to be used since they are not designed to last long periods of time and offer less protection, therefore FFP2 and FFP3 are the ones to be used since they can last for a full shift and, depending on the duration, maybe a full day (APA, 2020). The biggest impact that the guidelines caused was on an operational level. First of all, between each shift the trucks and common objects, such as keys and controls, had to be disinfected, which delayed the pick-up process, then, to reduce the probability of contact with infectious waste the workers were advised to avoid carrying large bags or quantities at once at each pick up. Also, the routes scheduled were constantly changing to avoid unnecessary contact amongst workers from different groups. These measures, however helpful in containing the spread, affected in a negative way the flow of waste, resulting in bigger and possibly uncontrollable quantities piling up by the time of disposal.

These guidelines were projected in the beginning of the pandemic and since then the scientific understanding of the properties of the virus has led to a development in society's behavior towards this threat. The recommendations ERSAR (2020) published in the beginning of the pandemic were conceived based on a more pessimistic point of view, one of the reasons for this was that the scientific understanding of the virus was, by then, much lesser than it is over one year later. These recommendations had the purpose of ensuring maximum safety amongst workers by preventing possible spreading scenarios, however less efficient and consequently ecological.

Until more experiments and studies explained the particularities of the virus, scientists had to use some knowledge about other infectious diseases to devise an emergency plan to ensure maximum safety (Lewis, 2021). In some cities such as in Lisbon (Portugal) all municipal waste was treated as non-recyclable and disposed improperly, from March until mid-June, 2020 (Lisboa, 2020).

Although the probability of getting infected by picking waste is low, it is not zero, therefore higher safety measures had to be introduced. Ultimately, currently there are no significant

limitations involved in recycling. Taking as example the city of Lisbon – The safety standards are higher and logistical changes were made in order to reduce physical contact amongst workers, but despite these, the operational process did not change. As stated, Lisbon reaffirms its commitment towards the environment and ceasing the recycling programs and separate waste collection services was a measure thoughtfully implemented after the publication of the guidelines from APA, the national health administration and also following the example of other cities, as Los Angeles, Paris and Amsterdam (Lisboa, 2020).

## **2.2. Waste management in Brazil before and during the pandemic**

Brazil is an upper middle income country with a population of 207 million people and it is one of the worlds' most urbanized countries, with over 85% of its population living in cities (IEG, 2018).

As per the 2018 Integrate Solid Waste Management and Carbon Finance Project (2018), many cities in Brazil lack basic urban needs, such as solid waste management. In this same report it is stated that by 2018 Brazil was producing 78 million metric tons of municipal solid waste per year, of which 90% is collected.

The policy for Solid Waste Management (SWM) is guided by the National Solid Waste Policy (NSWP) which was first applied in 2010 and it stands for the reduction, reusing, recycling, treatment and recovery of the waste, before considering it for disposal at sanitary landfills IEG (2018). This policy also has plans for the municipalities to receive federal funds for financing waste management projects.

In Brazil, at a federal level, the Ministry of Environment oversees the implementation of NSWP, and like in many other countries, the municipalities and local governments are responsible for the SWM, however the country faces public sector weaknesses and institutional arrangements that complicate the control. To secure proper management, the Ministry of Cities is responsible for promoting infrastructures in municipalities with more than 50,000 inhabitants and the National Health Foundation (FUNASA) covers those with less than 50,000 inhabitants.

Municipalities in Brazil have the primary responsibility for the SWM, however many lack proper planning, infrastructures and services. Waste services are not usually charged and when they are, the profits are not enough to support acceptable services. This absence of proper management plans and profits from the public sector has resulted in several municipalities finding the assistance of private consultants to assist in preparing solid waste management plans. While this initiative is good, S. Pereira & Fernandino (2019) point to some cases where

the measures are simply copied from other municipalities while they should be adapted to specific cases, due to the differences in infrastructures, number of citizens and resources.

The private sector could play a big role in surpassing these challenges, by bringing the needed experience, some financial resources and infrastructures. However, this requires political will to improve the cost recovery from waste charges and subsidies from public budgets by cross-subsidizing from other financial sources, such as waste to energy revenues. Although there is opportunity for growth when considering the aid of the private sector, the previous records show that there are some implementation difficulties, for instance finding land and obtaining licenses and permits for construction.

Following this constraint, Penteadó & Castro (2021) point to a factor that must be accounted for when devising Municipal Solid Waste Management practices, which is the geographical dimensions of Brazil and social and economic differences among the different states and cities. Due to these factors, there is no single plan that can be applied to the whole country. All the several states and cities benefit from different resources, have different relationships with the higher government, have completely different numbers of citizens, have access to basic waste management resources and some cities are simply much more developed than others. These factors are weighted in and the conclusion is that the better way to implement a proper system that can ensure a good waste management plan and the safety of the waste pickers is by having an evaluation on a case-by-case basis.

Penteadó & Castro (2021) have also accessed other problems and limitations behind the weak internalization of the published measures and requirements for sustainable Municipal Solid Waste Management. The authors believe that there is a lack of effective education campaigns on sustainable and eco-friendly behaviors and weak commitment in implementing the devised measures for solid waste management.

In terms of waste management during the pandemic, in Brazil there has been some disagreements within the federal government, which can cause some difficulties when managing it.

Penteadó & Castro (2021) show concern that on large and diverse country like Brazil, decision makers might not be capable of elaborating and implementing proper awareness and educational campaigns about the risks related to the transmission of Covid-19 by improper solid waste management, that can reach all the citizens. They also show concern that, due to the inequality seen among different states and cities, not all waste workers are provided with proper PPE and are not advised on how to proceed to work as safely as possible.

This concern is based on the fact that a lot of municipalities have records of disposing of their waste without concern to public health or environmental impact, therefore changing these behaviors and habits might not be entirely possible.

Despite such difficulties, there has been significant efforts from universities, research institutes and private parties on providing the population the needed personal protective equipment and also on raising awareness on how to deal with the pandemic and what comes with it. For example, national organizations involved in environmental activities and waste management have issued reports and recommendations for safer waste handling (Penteado & Castro, 2021).

Similarly to other parts of the world, in Brazil, in some cities like in São Paulo, the selective collection was interrupted in all cooperatives associated with municipal government (CEMPRE, 2020). The workers, however, received funding from the government during that time. This decision was not easy for a few reasons: one being the fact that in big states and cities like São Paulo, each capital and metropolitan region has their own collective model, making it extremely difficult to implement general plans; the second is that returning to the selective collection process would be as difficult, since the population would have become accustomed to mixing all their waste; finally one big concern is that the that governments would have to provide income to the waste pickers, during this time. If there were only contract workers, it would not be such a problem, however Brazil has a large number of informal waste pickers (approximately 20,000 in the city of São Paulo) (MNCR, 2020).

Informal waste pickers are a concern during the pandemic for a few reasons as well. These people generally collect waste from dump sites or containers and deliver it to cooperatives or directly to transformation sites, and suspending the selective collection affects their living (Penteado & Castro, 2021).

## CHAPTER 3

# **Waste management in Portugal and in Brazil**

In order to understand the subject of this dissertation, which is the impact that the Covid-19 pandemic has been having on waste management, different perspectives had to be considered and multiple factors had also to be taken into consideration, since such issue is fairly recent and unprecedented, and also the variables of the problem depend on different groups of people and their roles cannot be compared equally as individuals. Upon facing these issues it was possible to establish a connection with what was stated by Creswell (2009), which was that all methods have bias and weaknesses, and the collection of both quantitative and qualitative data would neutralized the weaknesses of each separately. Also, it would complement what could be lacking from each method, therefore the option for this study was opting for a mixed methodology.

The research methodology aimed to explain and demonstrate the whole process involved in the investigation, such as the reason why the method itself was chosen, which strategies were considered and why, possible setbacks or complications that could have led to different approaches and also the display of information and sequence of topics.

A qualitative methodology represents an interactive method of analyzing and collecting data. This methodology benefits from a distinctive trait, which is the understanding of the phenomena by having a more personal contact with the subjects through methods such as interviews, to understand possible ideas and results, rather than simply interpret analytical data (Silva, 2013). It aims to understand human behavior and its complexities, what it leads to and what has led to such behaviors or actions.

A Quantitative methodology represents a more objective research, focusing on numeric and unchanging data. It emphasizes the statistics, mathematical, or numerical analysis of the data collected through a set of defined questionnaires, surveys and polls, or by analyzing pre-existing data (LeTourneau, 2020).

Some studies are more complex, due to the subject itself or limitations of the information, therefore require a different method, or even more than one. Qualitative data tends to be more open to interpretation, where quantitative data finds specific data by the interpretation of close-ended responses.

Having followed the developments of the Covid-19 pandemic, one was mostly presented with the image of several facemasks improperly disposed, laying on the streets and floating on the seas and oceans, especially during the first months of the lockdowns. This reality led to what, eventually would be the investigation question of this dissertation.

Although the subject of waste management during the Covid-19 pandemic has already been studied and presented internationally, in some academic, governmental and non-governmental reports, these were mostly developed to report ongoing developments on the pandemic and also to educate and inform people on how to manage their waste. There are also studies showing the possible consequences of incorrectly handling waste, the consequences of handling waste as per the early advised measures, and some hypothesizing about different methods of handling the waste at a large scale, such as in a city, and in a small scale, as a condo. The investigation question of this dissertation is exploratory, because it aims to understand something beyond what has been published in these reports. Its purpose is to understand how society, both common citizens and governments, has been managing this issue in terms of what might be influencing these parties to behave like they do and what might be behind their decisions. Deciding what measures must be applied and why, when talking about governments, and why and how have normal citizens been managing their waste, is the reason for the need to use both a quantitative and qualitative analysis.

In order to understand the investigation's purpose and to answer its question, two different approaches were considered, resulting in two studies:

- To understand how the Portuguese and Brazilian have been managing their waste on a regional level (municipal), during the Covid-19 pandemic.
- To understand how citizens from both Portugal and Brazil can affect the municipal waste management during the Covid-19 pandemic.

### **3.1. Study 1**

#### **3.1.1. Method**

The first study consisted of the elaboration of two semi structured qualitative interviews. Interview 1 for the Portuguese case and Interview 2 for the Brazilian Case. Weiss (1994) stated that this type of interview is aimed for when the interviewee provides a great deal of deeper



information and when the script is tailored for a specific respondent. This allows for a deeper analysis with fuller understanding of the experiences of the interviewee.

The process of choosing the interviewees was defined to retrieve credible information from someone who had an active part in managing municipal waste during the Covid-19 pandemic. This person had to have a high hierarchical level in the regional organization, since this was a safe way to obtain credible answers and that they were dully corresponded.

Both the interviewees were given the option of remaining anonymous, which both accepted, therefore the person interviewed for Portugal shall be referred to as Interviewee P and the person interviewed for Brazil shall be Interviewee B. Both were given this option for their benefit and also because it is their right of privacy. Also, this anonymity might help in terms of having more honest answers.

Interviewee P is a person who has an active part in managing municipal waste in Lisbon's Municipal chamber. Interviewee P's duties and responsibilities are to manage the waste collection processes, from assisting to manage the waste collection teams to organizing and establishing collection routes, also to care for the separate waste collection and to devise and promote awareness campaigns for proper municipal waste management. Interviewee P takes a very important part in waste management during the Covid-19 pandemic.

Interviewee B is a coordinator of environmental management and education in the municipal region of Salto in the State of São Paulo, Brazil. Interviewee B's duties and responsibilities are to provide environmental education, raise environmental awareness and also to help to coordinate the frontline in managing waste management.

Interviewee B Provides a public service and works in a partnership with the Brazilian government, however as stated by itself, the continental dimensions of Brazil result in this type of regional management, where inside of the same state and city there are more than one entity acting for the same cause, like waste management, this way ensuring a broader reach and better control.

With these interviews the aim was to understand some aspects not available to the public, to understand the reasons behind some decisions that were made and to confirm some aspects that might have not been very clear when published or announced.

First it is important to understand that the purpose of these interviews was to understand on a more personal level how the managing process is being done by these two municipalities. The analysis was done on a smaller (municipal) level because the regulatory and managerial process is done in this level rather than nationally, as demonstrated in the literature review.

The scripts for each interview were very similar, however not the same. This is due to the fact that the circumstances of the areas in which the interviewees act are different from one another, and also because of the interviewees themselves. Although these interviews are guided by a script, the purpose was to let the interviewees feel free to openly communicate and to talk about the matters that felt important, therefore during the course of the conversation the same topics might be talked about in different moments.

A key element for analyzing the interviews is to familiarize with the data, by going through the transcription and original recording more than once. This will allow for the feelings and emotions felt at the time of the interview to be fully captured which will provide accuracy and even show hidden meanings to some statements (Braun & Clarke, 2006).

In order to have the information gathered from the interviews displayed, so it could be duly interpreted and analyzed, it was opted to separate the information by common topics and citations. This process was projected to have the different topics of the interviews organized and then the main ideas explained and supported by the citations from the interviewee. This method for analyzing the interviews was based on the premise defended by Weiss (1994), who states that the findings of the qualitative study are to be supported more by citations and case descriptions, due to the fact that this method relies more on interpretation.

The process of analyzing and interpreting the interviews was time consuming, however it was very useful for retaining key information, which helped to establish what was to be used for the main analysis.

### **3.1.2. Results and discussion**

The interviews were the key element to understand the full range in authority and functions of the waste management and urban hygiene departments. As demonstrated, both interviewees are responsible for a large number of people, both employees and common citizens. Having to deal with all the complications brought by the pandemic while managing to continue the very important necessity of urban waste management shows the impressive adaptability of these people.

The interviews showed that both interviewees have similar concerns in regard to how to manage this pandemic, and both also share very similar opinions in terms of the difficulties felt. The differences in opinions were mostly due to the different characteristics of the country. Brazil being a much bigger country than Portugal with a lot more citizens means that in Brazil there is a more distant link between the national government and agencies and the

local/municipal governments. This could also mean that, although Salto has less citizens than Lisbon, there is still a lot of social diversity, which complicates the task of managing people.

Another key factor is that of the benefits of having an environmental education system implemented for citizens. Even if not very extensive, to invest in such programs and initiatives should be a priority for any country and/or region, as shown with the case of Salto.

The findings of this study will be presented in six main topics. These topics were established by the objectives set by the questions from the interviews. These topics are:

- The contribution of international organizations.
- Challenges for the implementation of waste management during the pandemic.
- Managing workforce.
- Waste separation and recycling.
- Building awareness for adequate waste management.
- Perspective for the future.

### **3.1.3. The contribution of international organizations**

The first topic to be demonstrated is regarding the contribution of international organizations to the municipal management. This topic is key because the pandemic is so recent and still happening and these international parties were the first to take action in preventing a potential waste management crisis, through reports and guidance. The aim was then to understand if these organizations had in fact any contribution to the cities studied and to the interviewee's work and responsibilities.

For this topic, it was possible to see both differences and similarities in the opinions shared by both interviewees.

Interviewee P claimed to have used this information to adapt the measures on a municipal scale and also to acquire information that was unknown or new due to the lack of priors or similar cases. "There were, at some point, questions regarding the matter of managing one's own waste (...) We were not ready for a pandemic and what would be their consequences in terms of waste management." (Interviewee P).

In this matter, Interviewee P still recognized that the international orientations allowed for Lisbon to act accordingly as it is supposed to, serving as a guide and helping to develop new measures and ways to manage this waste. "It has served as a guidance for us, as a municipia, to follow, therefore it was crucial." (Interviewee P).

On this same matter it was possible to understand that although Interviewee B was aware of the guidelines and orientations provided by the international organizations, this was not decisive for Salto's adaptation to the pandemic. Interviewee B then explains that in Brazil the legislation is enforced on a regional level, claiming that there is a national legislation being followed, however, due to the big diversity and size of the country there is a bigger regional control. "In regards of waste management there was no change in legislation. (...) Logically, there is legislation to be followed, however Brazil is a very diverse country." (Interviewee B), and also the involvement of the national Government, which is the organization that could transmit as a rule or guideline the information provided by international organizations, is less active than it could be.

Although both interviewees confirmed to have knowledge about the measures, guidelines, and participation of international organizations in regard to waste management during the Covid-19 pandemic, Interviewee P appears to have given more use to the intervention of such organizations "All guidance and publications were extremely useful." (Interviewee P) than Interviewee B, who claimed that there was no change in legislation, regarding waste management.

Although there is a difference in population size for both the regions studied (Salto having less citizens than Lisbon), the fact is that, as stated by interviewee B, previous to the pandemic, Salto had already some programs for adequate waste management, including for medical waste, which means that there was already a prior that helped during the pandemic, as the community had already some useful understanding of waste management.

This previous waste program resulted due to the fact that some people were treating all waste produced in medical facilities as recyclable, however that is not the case, hence the need for this program.

"(...) so, we already had a strong program for recyclable segregation, because sometimes people would think that because you are inside a medical facility, all of the waste produced must be sent to treatment, yet that is not the case. So, we already had a strong basis set, prior to the pandemic." (Interviewee B).

This however, does not mean that the international orientations should be disregarded entirely, just that there was not such a focus on the international involvement.

Interviewee P justified using the information provided internationally to compensate for the fact that the risk was unknown and there was not any experience in managing a pandemic.

There is also the influence of the Portuguese national environmental agency (APA), which has a more active influence in national city councils, who itself recognize the measures and guidelines issued by these international organizations to be used in Portugal and posted them in their internet platform.

#### **3.1.4. Challenges for the implementation of waste management**

The second topic is regarding the challenges that appeared during the adaptation of the waste management during the pandemic and also the difficulties felt in this adaptation. The purpose of this topic is to have the inside opinion on what was most difficult for the governmental organizations. The information available to the public during the pandemic is arranged to present facts, guidelines, options and rules, however the process that comes before this and the reason that led to some decisions is not public. Becoming aware of the challenges is important in order to understand the reasons behind some decisions that might be considered inappropriate or inadequate to the public.

For this subject both the interviewees had similar statements, which was that the biggest challenge felt was sudden increase in medical waste.

Interviewee P considered that the increase in medical waste in urban context has brought challenges since it resulted in an increase in undifferentiated waste and also because this type of waste needs to be handled and treated by specially qualified personnel: “(...) We began to collect more undifferentiated waste. (...) There was a sudden increase in the production of other types of waste that were not urban residues, but now considered medical waste.” (Interviewee P).

In the case of Portugal, Interviewee P claimed to “(...) have needed to use additional outsourced services, to respond to the challenges and needs that were surging.” (Interviewee P).

Interviewee B was mostly concerned with the increase in waste during the outbursts of positive Covid-19 cases “With every outburst in cases, there is a sudden increase in waste generation and health care services.” (Interviewee B). When these outbursts happen, they need to adapt their routines in order to prevent an overload of waste leading to mismanagement and they also have to increase the control on the waste containers, since the increase in waste could result in dangerous accumulation and possible overflow. Normally there were 3 collections per week and during these outbursts there were needed 4.

“We used to collect three times a week and now we do it four times a week, while trying to manage each collection closely, since we use containers, and at the timer of each outburst we have to make sure that there is not any overflow of waste.” (Interviewee B).

This type of waste requires experience to handle, and it has to be carefully transported and processed, so having this type of waste being produced in a much bigger scale and in an urban environment with little care, or none, is dangerous. This led to the suspension of separate waste collection which resulted in the next challenge, which is the increase in the amounts of undifferentiated waste. “(...) there was an increase in the amount of undifferentiated waste, (...)” (Interviewee P).

Facing this suspension, Interviewee P still had the additional concern of the delay in implementing pro-environment programs, such as the municipal regulation that prohibited the use of single use plastics. “(...) there was a delay in the implementation of that measure, where people began using more single use and disposable products.” (Interviewee P).

These statements, although similar, show that interviewee P considered the type of waste to be more challenging while interviewee B considers it to be the quantity instead. This could be related to the infrastructures available in both locations. Lisbon, being bigger and having more citizens means that there is also a need for more waste collections and also facilities that can support larger quantities of waste. In the case of Salto there was not the need for such resources, so when the pandemic struck, this issue arised and became a serious challenge.

Lastly, there is also the fact that, as explained by Interviewee B, waste management in most cities and regions of Brazil is handled by private parties, which means that it might be more difficult to acquire the much-needed resources to properly handle a situation like this. “Here it depends on the contract. (...) It is a public/private partnership, with a concession. (...) however, not every city benefits from this, this is not a Nationwide scenario, but a specific contract to where I work.” (Interviewee B).

### **3.1.5. Managing workforce**

The third topic is regarding the issue of managing labor during the pandemic. This topic is of great importance since these are the people that are directly handling possible contaminated waste, therefore is important to understand the process of managing these teams. Analyzing this will help to comprehend if the pandemic has in fact affected waste management, as studies show.

On this matter Interviewee P stated that one of the main concerns during the pandemic was to protect the workers, “(...) what we wanted was to reduce the propagation of the virus within our staff.” (Interviewee P). Similar to this statement is that of interviewee B, who expressed great concern, claiming that managing this type of labor in Brazil is very difficult and having the waste collectors following the safety measures is a big challenge, “(...) our labor is very complicated. (...) a lot of them lack the simple habit of washing their hands.” Also, since these people work mostly accompanied by their colleagues and not supervisors it becomes very difficult to ensure they follow the safety rules, “I am walking on the street and I notice that my teams are not wearing the adequate facemask for infectious waste.” (Interviewee B).

Interviewee P stated that some workers were not understanding the risks involved, for them, their coworkers and even their families, so they had to create presentations to raise awareness which was very important so they could work as safely as possible. “We had to do a lot of presentations for raising awareness so they could understand that there was in fact a risk of contamination and that all workers had to follow the rules.” (Interviewee P). Similar to this, Interviewee B also had to have a closer approach, claiming that “(...) it is all the time, that we have to guide them, delivery hand sanitizer, asking them to use the specific facemasks – not the regular ones, but a specific one with special filters - for waste collectors, besides the adequate PPEs for the collection process.” (Interviewee B).

For Interviewee P, the need to adapt the methods and routines, to prevent the spreading of the virus, resulted in changes that went from “(...) creating specific areas of circulation to avoid unnecessary agglomeration of people, and differentiate exits from entries.” (Interviewee P), reducing the number of people in collection teams and have them changing among each other to avoid prolonged contact, “(...) displaying numerous signs to guide people through the workplace.” (Interviewee P), and also to raise safety awareness and having presentations to educate and inform the workers on the dangers related to their work, “We had to adapt to a new work model, which meant we had to create internal measures that would allow us to keep working” (Interviewee P).

On a different note, even with these challenges, Interviewee B claimed to proceed with their waste collection without adding more workers and maintaining the pre-existing structure. This was possible by rearranging the teams and schedules, “We managed to organize all of this with the existing work shifts, with the existing workers. (...) we keep changing the teams and their display.” (Interviewee B).

Regarding this topic of managing workforce, the opinions from both interviewees are similar. Both interviewees showed a strong concern towards the health of the workers, therefore

throughout the pandemic one of the priorities for both was to manage their teams in a way that the risk of them becoming infected was minimum.

### **3.1.6. Waste separation and recycling**

The fourth topic is regarding the issue of waste separation and recycling. As demonstrated by available literature and organizational platforms such as the case for Lisbon (Lisboa, 2020) and Salto (Penteado & Castro, 2021), already presented in this study, waste separation and recycling had to be temporarily reconsidered in some countries, during the pandemic, therefore it was important to understand the opinion of the rule makers on this matter. The analysis of this topic will also help to understand if in fact the suspension of such services and processes was necessary.

In the case of Lisbon, it was possible to see that this issue is important, since Interviewee P mentioned it during its presentation and prior to scripted question. Interviewee P states that the reason for suspending waste separation and recycling is because of the lack of information on the virus properties and how easily it could be spread. “We did not know how the pandemic was going to evolve. It was all new to us and what we aimed for was to reduce the spreading of the virus.” (Interviewee P). Early in the pandemic, the focus was mainly in containing the spreading of the virus and because there was a possible risk of contamination through fomites, it had to be eliminated.

Interviewee B claimed that for the case of Salto, this process was interrupted in order to prevent the contact with possible contaminated waste. The justification was that to separate and recycle requires contact with the waste whereas to dispose it as common does not require practically any further contact. “This guidance comes from the fact that you do not separate your recyclables, so everything goes to nondifferentiated waste, because, theoretically, there is no contact, while, when separating there is.” (Interviewee B).

Both Interviewees informed that in both countries it was decided to suspend the separation and recycling of the waste from approximately March to June 2020.

“(…) At that time, we decided that there would be no separate waste collection during that period. We collected undifferentiated and kept it like that until June.” (Interviewee P).

“In the beginning of the pandemic, from March up until, approximately May, (…) the recycling and sorting routines were suspended, as per recommendation of Brazilian associations (…)” (Interviewee B).



By late June, studies showed that the possibility of becoming infected through contact with these types of substances was low, but not zero, (Lewis, 2021) therefore it was decided that it was best to resume the waste separation and recycling, although with some logistical changes: “(...) we distributed the workers in several work shifts, so there is the morning shift with two different work hours, the afternoon shift with another two different work hours, and the night shift, with three different works hours.” (Interviewee P).

On the matter of the interruption of recycling and separate waste collection it appears there were two factors for making such decision. The first factor is that due to the lack of information regarding the virus and how it could be spread, most countries, including Portugal and Brazil, decided to suspend these processes to avoid any possible risk for both the workers collecting and handling the waste. The second factor is that this decision was being adopted firstly by most of the countries in the world that were being heavily affected by the pandemic, (ACR+, 2020) which would influence the decision of other countries, leading them to follow the example.

The fact that in Lisbon these services were resumed later than in Salto might be connected with the management chain of both countries. As stated by Interviewee B, in Brazil they are regionally managed with little influence from the national government, so it would be easier and quicker to resume. In Portugal, although the management of the cities is also at a municipal level, there is a bigger influence from the National government, and in this case the Portuguese Environmental Agency which is the organization that guide most the country in such matters, as stated by Interviewee P.

### **3.1.7. Building awareness for adequate waste management.**

The fifth topic is regarding the process of building awareness, and it is divided in two sub-topics, the first one being the methods used for such and the second one the effectiveness of such methods.

In the first sub-topic it is possible to understand the efforts made by the government in raising awareness for proper waste management during the pandemic. In addition to understand the efforts made it is also intended to see if raising awareness was in fact a priority and if the methods used for such demonstrate that. Given the urgency of preventing the pandemic to go out of control by enforcing measures and limitations of social distancing, the matter of waste management seemed not as important, therefore this topic is very important for this study.

The second sub-topic had the purpose of understanding how well the awareness measures and the guidance were accepted by the citizens. This would help to understand if the measures were adequate, well planned and well implemented.

Regarding the first sub-topic, of the methods used for raising awareness, Interviewee P was asked about the importance of raising awareness regarding the matter of adequate waste management, to which responded that it was important to reach the maximum number of people possible, however stating that despite keeping a close contact with the citizens, there were a few difficulties in reaching everyone: “We tried to keep a close contact with all the citizens. (...) Obviously that it is possible that we could not reach everyone, but we tried to cover the biggest area possible.” (Interviewee P).

Similar to the waste management programs, prior to the pandemic, Salto had also awareness plans being implemented. Interviewee B conducts an environmental education program which provides the local community with adequate knowledge regarding matters like how to properly dispose of a used syringe and needle. This program also prepares the community to deal and dispose of medical waste being used at home, so by the time the pandemic hit, they already had a network assembled and also a background of useful awareness programs.

“(...) I coordinate a program for environmental education, (...) For example, we had videos made on how to properly dispose of syringes and needles. (...) In this specific case of the pandemic, we showed how to dispose of your waste and also helped when some questions might appear.” (Interviewee B).

Interviewee B alerted to the fact that this type of care and service is not common to all of Brazil. “This is not applied in every city across Brazil, this is something applied in Salto since it is part of contract served and it varies from city to city.” (Interviewee B). The interviewee later gave the example that “(...) a nearby town had a different approach, which was to display big outdoor signs explaining how to manage your waste.” (Interviewee B), which was very useful and effective.

For Lisbon, Interviewee P described most of the methods used for raising awareness, both for regular citizens and also for the waste collectors and handlers. For the waste workers the methods used were mainly a sort of informational workshops where they could understand the risks involved and also the methods for safely proceed to work, “We had to do a lot of

educational workshops, not just for waste collector but also for back office (...) and also display signs and stickers in the workplace.” (Interviewee P).

As for the regular citizens, Interviewee P stated that there was a big focus on using online platforms, such as social media and the creation of websites, also publishing online news and sending emails was a big part of this process. Interviewee P explained that because a lot of people request various services from the city council via e-mail, they used this data base to help to spread awareness, providing a more personal approach. “(...) Social media was the method we opted to use, and we also created web pages for urban hygiene.” (Interviewee P).

One of the concerns for this matter was that some people do not have access to, or do not know how to use social media or even the internet, such as the elderly, therefore they relied on the connections with the regional offices to provide assistance for these people and keeping them informed on matters of raising awareness. “(...) Through regional offices, we were able to reach the people we do not use or have social media, such as the elderly.” (Interviewee P).

For the matter of the methods used for raising awareness the opinions from both interviewees are different from one another. For Salto, Interviewee B claimed to be depending on the adaptation of an already existing strategy, while for Lisbon Interviewee P claimed to have created new methods based on building awareness and connecting with the citizens.

Although, according to Interviewee P, Lisbon has been tacking actions regarding pro-environment measures and regulations, Salto has a record of taking an active part in environmental education, which is translated by the fact that they already had waste management programs for their citizens. In Lisbon’s case it is more difficult to have such programs, without the need for it, since it is a much bigger city and has more citizens than Salto.

Regarding the second sub-topic, of the effectiveness of the awareness methods, when asked about the feedback of the awareness measures, Interviewee P recognized that it is extremely difficult to reach everyone. “Obviously that it is possible that we could not reach everyone, but we tried to cover the biggest area possible.” (Interviewee P).

Trying to reach a large number of people living in a city like Lisbon, where some streets are more visited than others, some apartments, residencies and buildings have better sense of community than others must be very difficult, also people do not follow the same patterns and routines of each other therefore it is difficult to establish one method of awareness that is effective for everyone.

Interviewee P stated that when one method used for raising awareness is not effective, they adapt and try others. For example, after noticing that they were not reaching a large number of people, they started placing stickers on garbage containers for everyone to see. “If it is not

working by using social media, then we will have to introduce some changes (...) and we designed specific stickers which we placed in street garbage containers.” (Interviewee P).

In Interview 2, the subject of the acceptance of the awareness measures from the population was not as developed as hoped for, but it may be justified because of the diversity seen in Brazil. “(...) Brazil is a very diverse country.” (Interviewee B). Due to the continental dimensions of this country, “(...) Brazil has a continental size (...)” (Interviewee B), even in towns and cities the population is vast and diverse which makes more difficult to have this type of feedback from the citizens.

Still on this matter, Interviewee B commented on some feedback received, not regarding the awareness but regarding some regulations implemented. This was the case about the decision of suspending separate waste collection, when people criticized this measure showing concerns towards not collecting waste as infectious. The justification provided by Interviewee B was once again that the big dimensions of the country did not make this possible to happen, and also complementing with the fact that to have waste being properly collected as infectious would be extremely expensive: “That was heavily criticized in Brazil, as in ‘Are you not collecting as infectious?’, but Brazil has a continental size, so that would be very expensive.” (Interviewee B).

While Interviewee P recognized that it is difficult to reach everyone, meaning it is difficult to measure the acceptability, Interviewee B claims that the measures were well distributed, however not well received.

Interviewee P focuses on explaining the difficulties involved in reaching everyone and stated that there is a constant effort in reaching everyone, which might be seen in their social media post for the last year. Interviewee B focuses on providing the feedback from the citizens, which relies on a critic of the measures.

Regardless of the statements, the fact is that reaching everyone, or at least most of the people, is extremely difficult because each person is different and has different habits and routines than the next one. To have an effective awareness program does not depend entirely on the government but mostly the mass media. People are more connected by the media than by governmental guidance and orientations.

### **3.1.8. Perspective for the future**

The sixth and last topic is about the perspectives for the future, in regard to the impacts the pandemic has been having on waste management. It was introduced with the purpose of

obtaining a more personal opinion and with this, trying to understand if the Interviewees are familiar with the developments of the topic of waste management around the world. The reality is that each country, city and or region has a different approach towards this issue and having a broader knowledge on this matter will only be beneficial for internal management issues.

On this matter Interviewee P stated that the significant increase in hazardous waste, in urban environment affected the municipal waste management and will also have negative impacts on the future waste management. Interviewee P once more stated that this pandemic had direct influence in the implementation of pro-environment initiatives which will inevitably be a step back for the environment: “We always kept adapting (...) there were difficult situations which I believe we can get over, however the pandemic has been creating these challenges in the processes of separate waste collection.” (Interviewee P)

Regarding perspectives about the future, Interviewee B had a strong opinion regarding what society believes is the main problem that the pandemic has brought to waste management. Because of the lack of attention given by the media on the subject of the consequences that the Covid-19 pandemic has been having on waste management, Interviewee B believes that society has the misconception that the pandemic resulted in much more people generating larger quantities of waste in their homes, which is true, however the interviewee adds that the fewer waste being generated at workplaces will compensate for that: “Here, when you talk about waste during the pandemic, everyone is talking how people are in their households producing much more waste, but I do not think that it is as simple as that.” (Interviewee B).

Finally, interviewee B recognized that the problem of the increase in household waste is not as simple, since the waste being generated during the pandemic that led to people confining in their homes has changed, for example the increase in plastic packages from online shopping and food delivery, which might result in further complications in waste management.

“So, there is the subject of the increase in household waste, but on another perspective, in companies and offices there was a reduction, so maybe, is there an imbalance due to the increase in packaging from people ordering more take away food? Yes.” (Interviewee B).

For this subject both interviewees recognized that the pandemic will have negative impacts on waste management and is also a threat to the environment, however they approached different topics. Interviewee P shows a great deal of concern on the matter of the negative impacts that the pandemic is having on separate waste collection and the negative influence that

the pandemic is having and will have on pro-environmental programs, rules and regulations, that had to be suspended.

Interviewee B on a different note was more concerned regarding the misconception that people might have on the subject of waste management during the pandemic.

## **3.2. Study 2**

### **3.2.1. Method**

The second study consisted of the elaboration of two questionnaires, one for residents in Brazil and the other one for residents in Portugal. These two questionnaires are identical, however slightly adapted to the different traits of each country, for example the differences of the national health organization of each country.

These questionnaires were developed to acquire some knowledge regarding the perspective of common citizens during the COVID-19 pandemic, and how impactful have we, as a society, been to the process of waste management during such time period.

The purpose for this study was to establish what factors in society and in citizens might have an impact on the process of waste management however, not to have a deep understanding of human behavior since each person is different from the next one and countless factors might be impacting every individual. This study was aimed to obtain a sample of society's point of view during the pandemic and also on some environmental behaviors.

The first questionnaire to be elaborated and applied was the Portuguese one, and because of geographical factors it was considerably easier to have more people taking it. The Brazilian one was elaborated and applied later on, and because it had to be taken only by people residing in Brazil it was much more difficult to have more results. The number of answers however would not be an impediment to this study, since the purpose is to complement the results obtained by study 1 and not to have an extensive separate analysis.

The number of people who answered these differ from each other, where the Brazilian one defined the limit for both, being 36 people to have their answers considered, for each country. Each questionnaire consisted in 17 questions, although some of them were merely to provide some individual background. From these 17 questions, there are 7 main ones, with follow up questions, that shall be explained below.

The first question "How do you classify your concern towards the environment, prior to the COVID-19 pandemic?" was placed to understand the concern towards the environment of

the subjects taking the questionnaire. This helped to establish a baseline used to evaluate their interpretation of the importance of waste during the pandemic.

For this question, it was asked to classify in a scale of 1-5, where the numbers represent their concern towards the environment, prior to the pandemic.

The second question was to comment the statement “Is it difficult for someone like me to make an impact on the environment?” and it helped to complement the previous question on the matter of obtaining a personal perspective towards the concern for the environment. This question helped to define whether there is a common belief that individual action is a key element for a positive impact on the environment, rather than believing that this subject is something that individuals have no control of and that it depends on governments, private companies and institutions.

The third question “Did you know of the guidance provided from the ministry of health on how to manage your waste during the pandemic?” was placed to understand if the methods applied from the national governments to inform and educate the population on how to properly manage their waste during the pandemic were effective. This question had a follow up for the people who chose the option “Yes”, which is specified in 3.4. The follow up question (the fourth question), for those who chose “Yes” on the previous one, is “How did you know of the guidance?” and was placed to see what methods were mostly used for raising awareness on this subject.

The fifth question “Did you know of the guidance in your city or state on how to manage your waste during the COVID-19 Pandemic?”, specified in 3.5 is very similar to the third question, however only applied to the Brazilian questionnaire due to this type of legislation being more on a regional level. This question also had a follow up question (the sixth question) of “How did you know of the guidance?”

The seventh question “How did you manage your waste during that time?” was addressed to people who had positive COVID-19 cases at their households, which was previously asked in the questionnaire, but the results are irrelevant for this study. The purpose was to see if people were aware of the correct methods to treat your waste if you have a positive COVID-19 case in your household. This will not be entirely related to the previous question regarding the effectiveness of the awareness measures from the government, since people might be learning the proper methods from other sources apart from their governments and even after they learn the proper way they might willingly or unconsciously not follow the guidance.

Finally, a few demographic questions were made to provide some context to the analysis. For this study, 46% of the Brazilians are Male and 54% Female; 51% of the Portuguese are

Male and 49% Female; 96% of the Brazilian live in an urban environment and 4% in a rural environment; 80% of the Portuguese live in an urban environment and 20% in a rural environment; 85% of the Brazilian and 70% of the Portuguese have college degrees and academic education.

**3.2.2. Results and discussion**

The questionnaires helped to understand that although these countries are very different from one another, there seems to be a similarity in the way that the citizens feel impacted by the pandemic. It also showed that in big countries, like Brazil, it is more difficult to communicate and apply measures such as the ones for proper waste management during the pandemic.

For this study the results will be presented by analyzing the percentages obtained in each question of the questionnaires, taken in each country, while considering the information and facts obtained by the literature review and the interviews.

For the first question, the citizens from both countries share a common concern towards the environment however, there is a difference in how they classify their concern, as shown in table 3.1.

**Table 3.1**  
*How do you classify your concern towards the environment, prior to the COVID-19 pandemic?*

|      | Not concerned | 2   | Neutral | 4    | Very concerned | Total |
|------|---------------|-----|---------|------|----------------|-------|
| BR % | 0             | 3.5 | 37.9    | 17.2 | 41.4           | 100   |
| PT % | 0.4           | 1.5 | 16.5    | 50.5 | 31.1           | 100   |

The Brazilian sample had a higher percentage of people claiming to be very concerned, but also a similarly high percentage of people who are seemingly neutral regarding this subject, meaning that, although among the people taking this questionnaire, there is a good percentage claiming to be concerned, it is still not as ideal as it could be.

The results for the Portuguese sample showed a high percentage of people fairly concerned towards the environment and show less people neutrally concerned, which is a good indicator for this study, however, also has less people greatly concerned, which can mean that people share an ordinary or basic concern but not the higher level.



The second question aims for people to describe the impact they can make on the environment. For this the results were more disperse, but it was still possible to understand a tendency, as per table 3.2

**Table 3.2**

*Is it difficult for someone like me to make an impact on the environment?*

|    | Completely disagree | Disagree | Tend to disagree | Neutral | Tend to agree | Agree | Completely agree | Total |
|----|---------------------|----------|------------------|---------|---------------|-------|------------------|-------|
| BR |                     |          |                  |         |               |       |                  |       |
| %  | 20.7                | 31.2     | 6.9              | 6.9     | 17.2          | 17.2  | 0                | 100   |
| PT |                     |          |                  |         |               |       |                  |       |
| %  | 17.2                | 18       | 23.4             | 13.6    | 17.6          | 8.4   | 1.8              | 100   |

In the case of the Brazilian sample, the results show a positive tendency of people disagreeing with this statement which shows that people are aware of how impactful individual actions may be. For the Portuguese sample there was also a similar tendency, however less assertive, where more people tend to disagree instead of completely disagreeing.

Overall, although there is a tendency for people agreeing that they can make an impact on the environment, there is also people who disagree with this, therefore there is no unanimous opinion on this subject.

With the third question, in table 3.3, it was aimed to understand if the measures applied from the Ministries of health for raising awareness were effective or not, therefore asking if they knew of the guidance provided on how to manage the waste during the pandemic. For the people who chose “Yes” there was a follow up question to indicate how they knew of the guidance, as per table 3.4.

**Table 3.3**

*Did you know of the guidance provided from the ministry of health on how to manage your waste during the pandemic?*

|      | Yes | No | Total |
|------|-----|----|-------|
| BR % | 28  | 72 | 100   |
| PT % | 44  | 56 | 100   |

The Portuguese sample showed a leveled percentage, meaning the methods could have been better applied. The Brazilian sample showed a poor percentage of people who had knowledge of such guidance, which might mean that the methods could have been overall poorly applied, however it must be noted that in Brazil this type of management is made on a regional level instead of National. Taking this into consideration, in Brazil's questionnaire there was an additional question "Did you know of the guidance in your city or state on how to manage your waste during the COVID-19 Pandemic?", where the results are shown in table 3.5 and a follow up question "How?" as per table 3.6.

**Table 3.4**

*How did you know of the guidance?*

|      | TV | Newspaper | Internet | Friends/Family | Others | Total |
|------|----|-----------|----------|----------------|--------|-------|
| BR % | 50 | 25        | 12.5     | 12.5           | 0      | 100   |
| PT % | 50 | 0.8       | 45.1     | 2.5            | 1.6    | 100   |

For both countries, the method that is most effective is the TV, which is understandable, since it is the way that government representatives communicate live to all the population. Also, during the early stages of the pandemic, updates were provided on a daily basis and it is easier to do reach more people via open television channels.

For the Brazilian sample, second to TV, newspapers were the most used at 25% and Internet and Friends/Family after, with 12,5% each, whereas for the Portuguese sample only 0,8% knew of the guidance from newspapers and 45,1% from the internet. This could be justified due to the fact that the Portuguese government had implemented a mandatory lockdown early in the year of 2020 with the outburst of the COVID-19 pandemic, where only essential services such as food and medical where working, meaning people would not have the regular access to newspapers and would mostly rely on internet access in their homes. Brazil however had a significant decrease in the COVID-19 restrictions, and people were living their lives without great concern for the virus, (Burki, 2021) .

**Table 3.5**

*Did you know of the guidance in your city or state on how to manage your waste during the COVID-19 Pandemic?*

| BR | Yes | No | Total |
|----|-----|----|-------|
| %  | 52  | 48 | 100   |

**Table 3.6**

*How?*

| BR | TV   | Newspaper | Internet | Friends/Family | Others | Total |
|----|------|-----------|----------|----------------|--------|-------|
| %  | 26.7 | 13.3      | 40       | 13.3           | 6.7    | 100   |

For the question shown in Table 3.5, it was possible to see that although not ideal, there is a significant increase in the percentage of people who did know of such regional guidance. When asked “how?” most answered that it was via internet, which is the platform mostly used throughout the world, and where most information is available.

In the final question people could choose from three of the suggested measures on how to manage your household waste from the UN (Tsukiji et al., 2020); no precautionary measures and other measures, as demonstrated in Table 3.7.

**Table 3.7**

*How did you manage your waste during that time?*

|      | Kept sorting the recyclables separate collection | Close for 2/3 of capacity | the bag at its double bags | Used double bags | No additional precautionary measue | Others | Total |
|------|--|---------------------------|----------------------------|------------------|------------------------------------|--------|-------|
| BR % | 50   | 11.1                      | 19.5                       | 13.9             | 5.5                                | 100    |       |
| PT % | 39   | 19                        | 22.1                       | 15.8             | 4.1                                | 100    |       |

As shown, in Brazil, 50% of the people who participated in this study kept sorting the recyclables for separate waste collection and in Portugal it was 39%. Combining with 13,9% and the 15,8% of people who had no additional precautionary measure, means that 63,9% of Brazilians and 54,8% of Portuguese did not follow the guidance applied for households with positive COVID-19 cases. In the Brazilian sample, a combined percentage of 30,6% (11,1% +

19,5%) followed the basic procedures to be applied, and in the Portuguese sample, 41,1% (19% + 22,1%).

Overall, the majority of people did not follow the guidance, which can be translated into problems for the waste collection and sorting services as well as a possible threat to workers handling waste.

## **Discussion, limitations and conclusion**

### **4.1. Overall discussion**

After analyzing the information gathered with these two studies and the literature review, it was possible to see how complex the subject of this thesis is, and it was also possible to understand how multiple factors have impacted and are still impacting the process of waste management during the COVID-19 pandemic.

The literature review had the main purpose of providing a basis to the two studies and to establish a background to the problem, however, because this is a recurrent issue and a considerable part of the literature consisted of guidelines and suggestions, it ended up creating the standards on how to properly implement an adequate waste management program during the pandemic. The interviews, however, showed that there are some difficulties in the process.

Authors and institutions have been publishing the ideal scenarios for countries to follow the guidelines and adapt, like Tsukiji et al. (2020) guideline where it is stated that households with positive COVID-19 cases should dispose of their waste as residual waste, not for recycling, and Fan et al. (2020) urge to adapt the waste collection programs to the growing quantities of waste and its hazardous nature. These researches mentioned in the literature review were very important for this dissertation, since they would help to understand what is the best way to manage this pandemic, from a waste management perspective and what might be the difficulties during such process, which is what was aimed with the two studies of this dissertation.

Early studies indicated that coronavirus could persist on substances like plastic and steel for days, which triggered a wave of over cautious behavior throughout the world (Lewis, 2021). Lewis (2021) stated that these early studies did not test conditions that exist outside the lab, instead the experiments started out with tremendous amounts of virus (not like in the real world) and the environment was controlled in conditions such as humidity and temperature. Lewis found that the principle that has led to the interruption of separate waste collection and recycling cycles is that the virus passes from one person to another through contaminated surfaces, known as fomites, and although possible, there is little evidence to support the idea that this way presents a significant risk.

Considering these facts, it is possible to understand the reason behind the initial decision of suspending recycling programs and separate waste collection services, and both interviewees

P and B agreed with this. Local governments had and still have to consider securing people's safety as their main priority, therefore, taking into consideration the initial data, where the possibility of infection by physical contact with fomites was a top concern, reducing contact with possible infectious materials and substances was a valid option for the first months.

With the elaboration of the interviews for the first study, it was intended to understand if the efforts being done by local governments were adequate and if there is enough concern towards the issue of proper waste management during the COVID-19 pandemic, by the same governments. The fact that each interview represents different governments, ideas and countries has helped to provide a stronger conclusive analysis for the investigative question.

The answers showed that both municipalities have adapted well to the pandemic and are active as to ensure that proper waste management is being implemented. Contrary to what one might assume after reading the international reports such as Tsukiji et al. (2020), waste management during the pandemic has limitations that are not accounted for in these idealistic guidelines. The interviews also showed that the basic concepts demonstrated in the literature review were considered, such as adapting the waste collection circuits, raising awareness and informing people on how to manage their household waste, however there are factors that make it difficult to have a better performance.

Two key factors were common in both interviews. The first one was that of the management of workforce for waste collection. As stated in both interviews, waste collectors are an essential element since they are the ones who are in direct contact with possibly contaminated waste. They were described as sometimes showing a careless attitude towards the personal protective measures and equipment. Considering the need for having more waste collections and teams with less workers and constantly shifting amongst each other, to have this lack of safety standards amongst workers and compromise the chain might translate in the interruption or malfunction of this essential public service

The second factor was that of the difficulties felt in raising awareness for adequate municipal waste management. Both interviewees stated that they tried to reach the largest number of people possible and despite believing to have been effective, both admit that it was not possible to reach everyone. That could be seen in the questionnaires, where it showed that not a lot of people, in both countries, had knowledge of the guidance provided from the National Ministry of Health and in the case of Brazil, from regional entities.

Both tried different approaches, for example, the case of Lisbon where they relied more on digital methods like developing a web site, using social media and accessing an email database for their residents, and the case of Salto where they already benefited from environmental

educational programs and simply adapted to the pandemic and also created demonstrative videos showing how to dispose your waste.

The decision makers can only be effective if society is correspondent towards their goals. In this case, for the measures to be well applied and show positive results, the population must be cooperative.

The subject of waste management is directly associated with ecological behavior. After analyzing the answers from the questionnaires, it was possible to see that although there is concern towards the environment, there is still a large percentage of people who do not share these values. From people who are not concerned with the environment, to people who do not believe that individual behavior can have an impact, to people who disregard measures created to both protect human lives and also to help the environment through adequate waste management, the population considered for this study, that can be considered a representation of society as a whole, does not seem to share the environmental concern that would make a difference in properly managing waste during the COVID-19 pandemic.

Overall, it is possible to say that both local governments studied showed a positive performance considering the direct impact that the population has had and also in the context of their national governments.

## **4.2. Limitations**

There were a few difficulties in the process of elaborating this thesis.

In regard to the literature review, since this is a recurrent and still very recent issue, new developments have been published regularly since the beginning of the pandemic. This happened to be something very difficult to manage, since the information was changing while the research was happening. Another issue was that of the few significant literature available, especially governmental reports on the subject of waste management during the pandemic. There was also little literature on this subject for Portugal and also little international guidance for waste management during the Pandemic.

The fact is that this pandemic naturally brings governments to show more concern for protecting human lives, therefore they focused their efforts to inform people about specifications of the virus and restrictions to keep people safe, and not the adjacent problems that also have direct impacts on human health, like waste management.

Regarding the present research, there were also a few challenges. The process of choosing the approaches for each of the studies was not simple.

For the first study, although the best option was to proceed with interviews, this happened to be a long process, from choosing the interviewees, to creating a script and to processing the results. Also, the decision of the type of interview and the decision of the type of interviewees could not be done earlier, since there had to be an extensive process of gathering and understanding information.

At first it was hoped to have more than one interviewee for each country, however there were some factors that did not facilitated it. The initial idea was to have, at least, an interview with a government representative in order to understand the government's perspective on legislation during the pandemic, and another interview with a worker from a waste collection and disposal center, in order to understand and probably see how the process was done. Eventually it happened that the two people interviewed had in fact an active part in managing the municipal waste collection and disposal.

There were several attempts to schedule interviews, but only two responses (the ones from both interviewees of this study). This is understandable since the people who were to be selected for the interviews are extremely busy with their work, especially during the pandemic, when they have more responsibilities than usual. Also, this was at a very early time in 2021, when mass vaccination was still at an early stage, and it was more difficult to have a personal interaction and approach with potential interviewees.

For the second study the process of choosing the questions was not very difficult, since this was at a later time in the dissertation timeline, however it was very difficult to obtain a solid and compatible number of answers from the two countries. The Portuguese questionnaire was done earlier, since it was a part of a separate research, which would also help to obtain more answers, while the Brazilian questionnaire was done later. Also, the physical distance from the possible subjects taking it was not helpful. To reach a larger number of answers it is important to have a lot of links with people, which was difficult since the questionnaire was being done from a different country, far away from Brazil.

Overall, apart from these difficulties it was possible to obtain good material, which provided some solid results.

### **4.3. Conclusion**

In conclusion, with the elaboration of this dissertation it was possible to understand that waste management during the COVID-19 pandemic is a complex issue and that for the two cities



studied, the proper implementation of the ideal plan and guidance does not depend entirely on the governments and decision makers.

This thesis showed that both cities studied, and their governments, have had a set of adequate approaches towards the issue of waste management, however some factors are limiting their results from being more positive. The first factor is the fact that this issue has not been given as much media coverage and importance as it deserves, worldwide, and in the case of the countries studied, nationally. This resulted in a major obstacle for the local governments to try and raise awareness for this serious problem, which consequently affects the way municipal waste is being managed. Another factor is that, even if there was more coverage, it would still be difficult to reach everyone, because of the diversity seen in every country's population and the large territories that have to be managed by waste management teams and local governments. The last factor is that the subject of waste management is directly linked to the matter of ecological behavior and mindset. To have a successful waste management, both during the pandemic and after, when there is less concern, it is important to build a strong environmental education nationwide, this way people would be naturally concerned towards the way they manage their waste and the implications of doing it wrongly and would try to be more careful and even look for guidance, instead of waiting for it to be easily available to them.



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## **Annex**

### **Annex A**

#### **Script for the interviews**

- Pode descrever o seu papel/função nesta organização?
- Considera que o setor da gestão de resíduos sofreu alterações com a pandemia? De que modo?
- Diria que o impacto verificado na gestão de resíduos é um que merece atenção e pode representar um risco para o futuro?
- Qual é a sua opinião sobre o papel de organizações internacionais como as Nações Unidas e a Organização Mundial de Saúde para a gestão de resíduos durante a pandemia?
- Quais os principais desafios verificados no planeamento de recolha de resíduos municipais? Quais os métodos utilizados para assegurar a segurança dos profissionais?
- Alguns países decidiram suspender os processos de reciclagem no início da pandemia. Esta opção chegou a ser ponderada? Porquê?
- Como tem sido feita a comunicação das medidas e precauções a tomar com o público? Por exemplo, como são informados os cidadãos?
- Tem sido monitorizado o cumprimento das orientações publicadas relativamente à gestão de resíduos domiciliares? Se sim, que métodos têm sido utilizados?
- Na sua opinião, de que forma a pandemia irá (ou está a ter) impactos no meio ambiente?

## Annex B

### Questionnaire

|   | Discordo totalmente   | Discordo              | Tendo a discordar     | Não concordo nem discordo | Tendo a concordar     | Concordo              | Concordo totalmente   |
|---|-----------------------|-----------------------|-----------------------|---------------------------|-----------------------|-----------------------|-----------------------|
| A ciência moderna resolverá os problemas ambientais alterando pouco o nosso estilo de vida. | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| As pessoas preocupam-se muito com os efeitos negativos do progresso sobre o ambiente.       | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| É difícil para uma pessoa como eu fazer muito pelo ambiente.                                | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Para proteger o ambiente, o Brasil precisa de crescimento econômico.                        | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/>     | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Antes da COVID-19, como considera que era a sua preocupação em relação ao ambiente?

Nada preocupado(a)      
      
 Neutro(a)      
      
 Muito preocupado(a)

Em que medida essas posições se modificaram na sequência da COVID-19? Por favor, mova o cursor abaixo para a esquerda ou direita, para indicar a sua opinião, de 0 = mudou para muito longe da minha posição anterior a 10= mudou para muito mais perto da minha posição anterior (5= a minha posição não mudou)

|  | 0   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|--|---|---|---|---|---|---|---|---|---|---|----|
| Em que medida as suas posições em relação à preocupação ambiental se modificaram na sequência da COVID-19? | <div style="display: flex; justify-content: space-between;"> <span>Mudou para muito longe da minha posição anterior</span> <span>A minha opinião não mudou</span> <span>mudou para muito mais perto da minha posição anterior</span> </div> |   |   |   |   |   |   |   |   |   |    |
|  |   |   |   |   |   |   |   |   |   |   |    |



Teve conhecimento das orientações da sua cidade ou estado sobre a forma como tratar o seu lixo durante a pandemia?

- Sim
- Não

Por que meio

- TV
- Jornais
- Internet
- Amigos/Familiares
- Outro meio. Por favor, indique qual:

Teve conhecimento das orientações do Ministério da Saúde sobre a forma como tratar o seu lixo durante a pandemia?

- Sim
- Não

Por que meio?

- TV
- Jornais
- Internet
- Amigos/Familiares
- Outro meio. Por favor indique qual:

Houve algum caso positivo de COVID-19 no seu agregado familiar?

- Sim
- Não

Como trataram o lixo durante esse período? (Uma ou mais respostas)

- |   |   |
|---|---|
| <input type="checkbox"/> Continuamos a separar os materiais recicláveis para a coleta seletiva. | <input type="checkbox"/> Não tomamos nenhuma medida adicional   |
| <input type="checkbox"/> Fechamos o saco do lixo quando este atingiu 2/3 da sua capacidade      | <input type="checkbox"/> Outra medida. Por favor, indique qual: |
| <input type="checkbox"/> Colocamos o saco do lixo cheio dentro de um segundo saco do lixo       | <input type="text"/>  |

Para terminar, vamos colocar algumas questões socio-demográficas para caracterizar a nossa amostra

Por favor indique o seu estado e cidade de residência.

Qual o ano do seu nascimento? (Por favor, use o formato AAAA, por exemplo 1995)

### Sexo

- Male
- Female
- Non-binary / third gender
- Prefer not to say

### Escolaridade

- Sem escolaridade
- Ensino Fundamental I (do 1º ao 5º ano)
- Ensino Fundamental II (do 6º ao 9º ano)
- Ensino Médio (equivale ao Secundário)
- Ensino superior

Como caracteriza a sua localidade de residência?

- Urbano
- Rural