

Transition of Medical Waste Management (MWM) from Romania to the Circular Economy Paradigm: Expectations and Objective Limits

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Abstract

The circular economy and medical waste management (MWM) are important for protecting the environment and human health. In the healthcare sector, the circular economy can be applied by reusing medical equipment, recycling materials from medical waste and adopting more sustainable practices such as reducing energy consumption and using more environmentally friendly materials. Clearly, reusing medical equipment reduces the amount of medical waste and can reduce costs. The authors intend through this paper to address MWM in Romania within a more sustainable circular system, attempting to identify the pros and cons, as well as the limitations, of a massive shift of MWM to circular economy principles. The structure of this paper includes, following this introductory part (1): Theoretical background (2), Research methodology (3), Circular economy and the healthcare waste management system (4), Approaching healthcare waste management within a more sustainable circular system (5), Limits of the massive shift of MWM to circular economy principles (6) and Conclusions (7).

Key words: medical waste management (MWM), circular economy, purpose, environmental protection, public health, support strategies/plans

J.E.L. classification: I18, I28, Q57

1. Introduction

The circular economy aims to transform the current „take, produce and throw away” economy into a sustainable economy based on the principles of „reduce, reuse and recycle”. In this way, the circular economy aims to create a more sustainable and greener world that can support society's current and future needs. Circular economy and Medical Waste Management (MWM) are closely related due to the potentially hazardous nature of these wastes to human health and the environment. The implementation of circular economy principles is essential to manage these substances responsibly. In the healthcare sector, the reuse of medical equipment and the recycling of materials from medical waste are practiced, aiming for a sustainable approach. However, it should be emphasized that such activities require special measures to protect the safety of medical personnel and the surrounding environment.

Therefore, our paper aims to highlight that by implementing sustainable practices and appropriate medical waste treatment processes, the medical sector can contribute to a more sustainable circular system.

2. Theoretical background

In recent years there has been extensive research into MWM, with the results resulting in: (i) New technologies for treating medical waste, including sterilisation technologies, low carbon incineration technologies and other advanced technologies that can reduce environmental impact; (ii) Recycling of medical waste, to the extent that plastics in medical packaging can be recycled for re-use; (iii) Development of new standards and regulations, with such rules for MWM being introduced in many countries. These regulations include stricter medical waste handling procedures and environmental protection measures.

The concerns of the scientific community in Romania in developing solutions for MWM are numerous, we focus only on a few that have relevance for the development of sustainable and efficient solutions for MWM (Mihai, 2020; Platon et al., 2020; Bungau et al., 2016, 2020; Fodor et al., 2018; Roman & Bostan, 2020; Besciu & Androniceanu, 2015; Stan, 2022; Hurjui, 2016). Overall, research of this kind is a valuable resource for healthcare and MWM professionals, leading to significant improvements in how this waste is managed and treated.

However, it is important to continue the search for new and more effective ways to protect the environment and human health through MWM.

3. Research methodology

Our paper, beyond investigating several scholarly works focused on similar themes to the one we are addressing („Transition of Medical Waste Management (MWM) from Romania to the Circular Economy Paradigm: Expectations and Objective Limits”), also involves the study of several recent reports produced by Romanian authorities and non-governmental organisations addressing issues related to MWM in Romania. These include the European Commission's MWM Country Report 2020 (EC, 2020), including an analysis of the MWM situation in Romania and the progress made. The National Agency for Environmental Protection has also developed the Best Practice Guide for MWM in Romania, which includes recommendations and guidelines on the safe classification, handling, transport and storage of this material.

At the same time, the legislative framework was also investigated: Law no. 211/2011 on the waste regime, Government Decision no. 856/2002 on waste management records and for the approval of the list containing waste, including hazardous waste, Government Decision no.1061/2008 on the transport of hazardous and non-hazardous waste on the territory of Romania, etc.

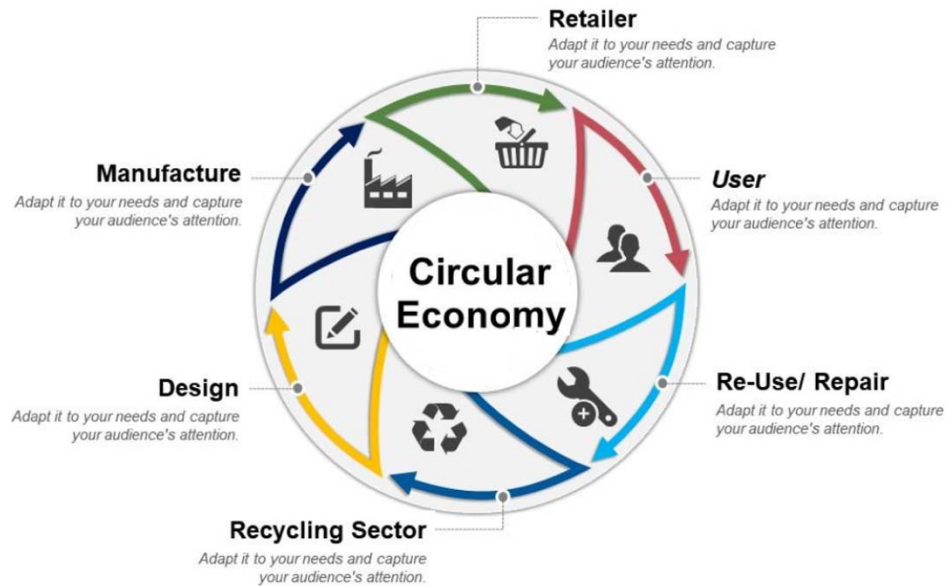
According to these regulations, medical waste must be collected separately from other types of waste and transported and treated appropriately to prevent the risk of environmental and human contamination. In addition, medical institutions and other entities producing medical waste are obliged to keep records of such waste and report regularly to the competent authorities on the quantities generated.

4. Findings

4.1. The circular economy and the healthcare waste management system

As the following shows, the healthcare sector is able to contribute to a certain extent to a more sustainable circular system if the concepts and principles of the circular economy are taken into account. The aim of the circular economy - clearly oriented towards eliminating the idea of „waste” and encouraging the use of resources in a more efficient and sustainable way - is to create a sustainable economic model that minimises environmental impact, reduces resource waste and encourages innovation (Figure no. 1).

Figure no. 1 Circular economy diagram

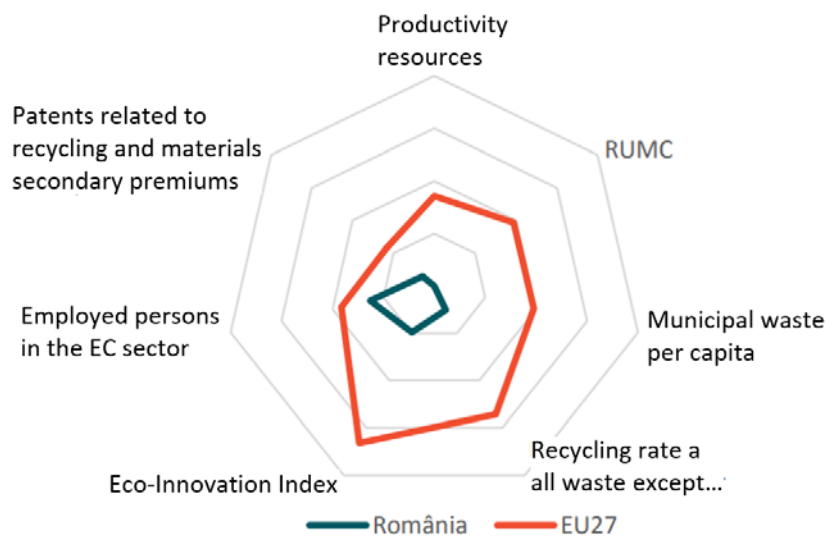


Source: <https://www.slideteam.net/circular-economy-diagram-presentation-outline.html>

In fact, the circular economy focuses on reducing resource waste through a system where materials are used, reused and recycled in a continuous way. In this system, products are designed and manufactured in such a way that their components can be reused or recycled, and materials are collected, treated and returned to the production cycle.

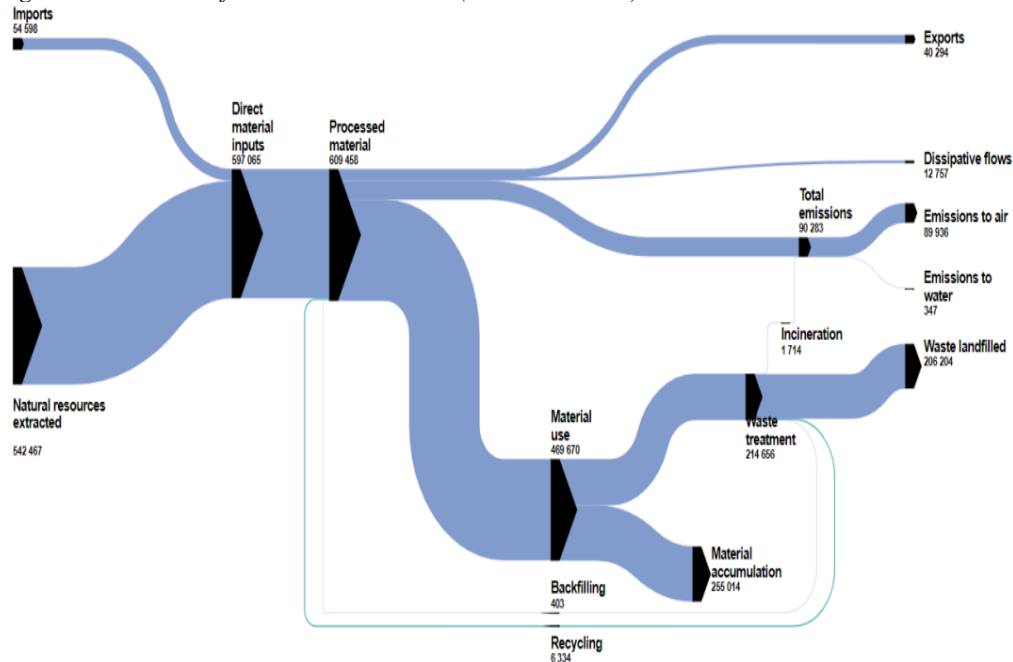
It must be said that Romania's performance in terms of circular economic indicators is modest, being below the average of EU Member States (Figure no. 2), despite the existence of an appreciable flow of materials in Romania, 2020 (Figure no. 3).

Figure no. 2 Assessment of circular economy indicators in Romania



Source: https://sgg.gov.ro/1/wp-content/uploads/2022/08/Strategia-economie-circulara_18.08.2022.pdf

Figure no. 3 Material flow in Romania, 2020 (thousand tonnes)



Source: https://sgg.gov.ro/1/wp-content/uploads/2022/08/Strategia-economie-circulara_18.08.2022.pdf

In 2019, Romania had the lowest resource productivity (ratio of gross domestic product to domestic consumption of materials) among EU Member States (0.7851 EUR/kg); the material utilisation rate (RUMC, which measures the contribution of recycled materials to total material use) was 1.3%, compared to the EU average of 12.8%³⁸ (RG, 2022).

In relation to the healthcare sector, we show that it generates a significant amount of waste, which can be more hazardous to human health and the environment than other categories of waste. These include „pathological waste and anatomical parts, infectious waste, sharps waste, chemical and pharmaceutical waste and radioactive waste. A special type is also amalgam waste used in dental surgeries.” (ECOSYNERGY, 2021). The picture below is illustrative of this (Figure no. 4).

Figure no. 4 Current waste from the hospital sector

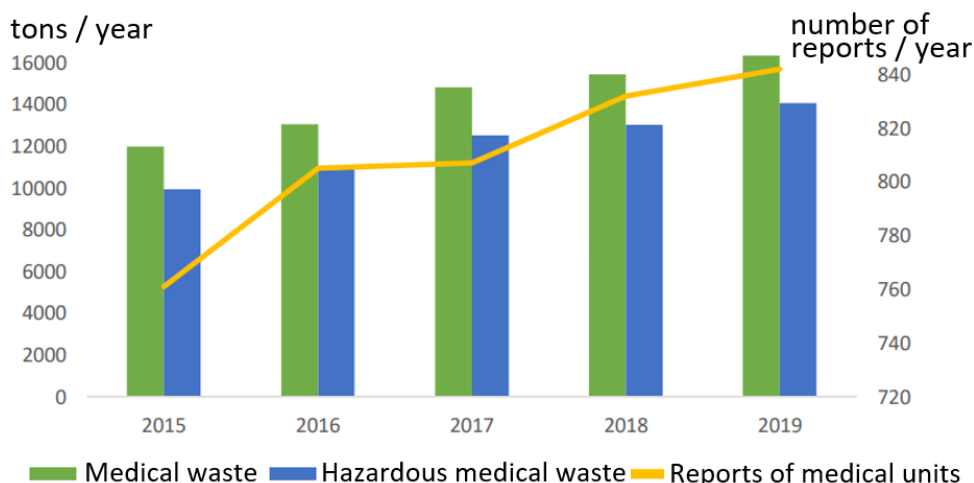


Source: Authors' processing

The processing of medical waste is carried out by specialised operators with incineration and thermal treatment facilities; the breakdown by type of processing of hazardous medical waste shows that in the case of hazardous medical waste, the thermal decontamination method is more widely used (55%), while in the case of non-hazardous medical waste, burning predominates (CC, 2021). It should be noted that in Romania in 2018 there were 11 hazardous waste zonal incinerators, 14 thermal decontamination treatment stations and 23 functional treatment equipment in health care facilities (MIPE/2022).

Focusing on the period 2015-2019, based on the reports of medical units to the National Institute of Public Health, we observed an increase in the total annual amount of medical waste in Romania, including hazardous waste (Table no. 1), which is the majority of the total medical waste (Figure no. 5).

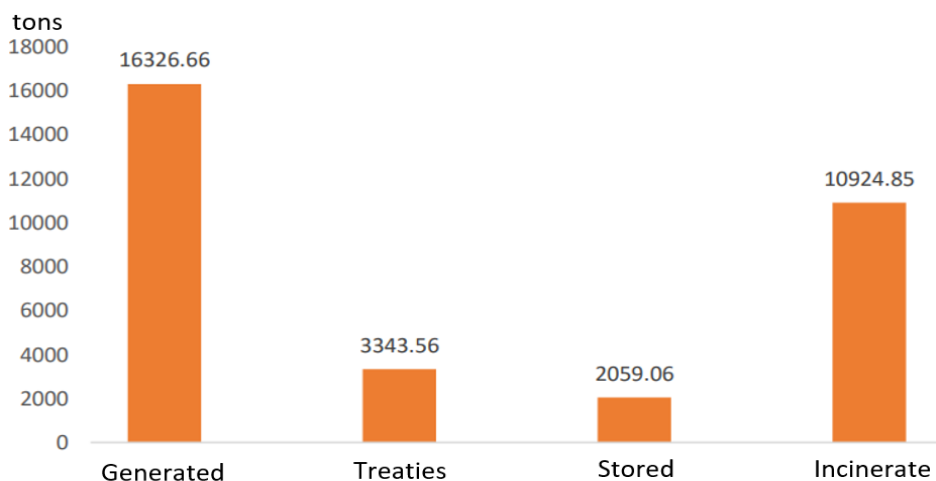
Figure no. 5 Total amount of medical waste and hazardous medical waste (2015-2019)



Source: <https://mfe.gov.ro/wp-content/uploads/2022/07/e1265341ee7e708dbec5838bfa0ef29c.pdf>

The breakdown by type of processing of the resulting medical waste (16.3 ton/2019) shows that burning predominates (Figure no. 6).

Figure no. 6 Quantities of healthcare waste and how it is processed (2019)



Source: <https://mfe.gov.ro/wp-content/uploads/2022/07/e1265341ee7e708dbec5838bfa0ef29c.pdf>

As of 2020, the first in the series of years marked by the Covid-19 pandemic, it is estimated that more than 20,000 tons of medical waste from state and private hospital units have resulted in Romania (ECOBURN, 2020). In that year, „Surgical masks, gloves, personal protective equipment, plastic bags, the Covid-19 crisis stimulated a rapid expansion in the production of plastic products generated by the almost desperate need of governments to secure stocks of these items needed by the medical system and the population. Thousands of tonnes of used products have choked recycling chains and processing facilities overwhelmed by this tsunami of waste. Their disposal is already a serious problem facing the authorities.” (Guță, 2020). As regards the breakdown by type of processing of the resulting medical waste after 2020, the proportions concerned have not changed significantly, even though the volume of such waste is increasing (MIPE/2022).

In the context of the circular economy and the above, it should be noted that the healthcare sector can contribute more to creating a sustainable circular system by adopting more sustainable practices in MWM, helping to protect the environment.

Ways in which the healthcare sector can contribute to creating a more sustainable circular system are: (i) Reducing resource consumption - by using sustainable equipment and products, as well as reducing packaging and waste; (ii) Reusing certain medical equipment through sterilisation, thereby reducing medical waste and costs; (iii) Recycling materials from medical waste, creating new products; (iv) Reducing energy consumption and using more environmentally friendly materials.

4.2. The MWM approach in a more sustainable circular system; existing limits

A circular system for MWM can help minimise waste and maximise resource recovery. This system can be structured in four stages: (1) collection; (2) treatment; (3) recycling; (4) reintroduction of recovered materials into the economy.

1. *Collection* – is the responsibility of specialist MWM operators equipped with appropriate equipment and vehicles, involving the collection, packaging, labelling, transport and safe disposal of waste in accordance with applicable regulations.

2. *Treatment* – aimed at minimizing the impact on the environment and preventing the spread of diseases – through incineration, sterilization, disinfection, etc.

3. *Recycling of medical waste materials* – aims to maximize resource recovery. The activities in question include transforming waste into new products or using it to produce energy. Obviously, not all medical waste can be effectively recycled (there are risks associated with handling sharps, etc.).

4. *Reintroduction of recovered materials into the economy* - involves directing them into new products or using them as energy resources.

In order to implement a circular system for MWM, it is important that medical staff are properly educated and trained on sustainable practices and waste management processes. Equally, local authorities have a key role to play in MWM, as they need to ensure that medical waste is collected, transported and treated in a safe and efficient way.

Limits of MWM's massive shift to circular economy principles

A high degree of transition of MWM to the principles of the circular economy is difficult to achieve. MWM is very strictly regulated in most countries as they can contain hazardous and toxic substances that can affect the environment and human health.

The transition to which we refer may face several barriers and limitations, including:

- *Technical limitations.* There are technologies available to treat medical waste, but these are not always efficient and may require large investments in infrastructure and specialised equipment. In addition, these technologies may require skilled and specialised personnel to manage.

- *High costs.* Disposal of medical waste can be costly and difficult to justify for some companies or medical institutions. In addition, the investment required to implement zero waste practices can be high and significant change to existing work processes may be required.

- *Lack of cooperation.* Moving to the circular economy requires cooperation between multiple stakeholders such as hospitals, waste management companies and local authorities. Without proper cooperation, this process can be slowed down.

- *Incomplete information.* Currently, there is a lack of comprehensive data and information on the quantity and quality of medical waste produced. This can make it difficult to plan and develop appropriate circular economy programmes.

- *Public perception.* There are concerns about the risks associated with recycling or reusing medical waste and this may influence public perception of the circular economy approach in this area.

Overcoming these barriers requires a coordinated and collaborative approach between authorities, industry and the public. It is also important to develop the necessary infrastructure, provide comprehensive and up-to-date information and address public perceptions through education and awareness.

5. Conclusions

Moving to a circular economy for medical waste can be difficult, but it is very necessary to reduce its negative impact on the environment and human health. As presented in the paper, the circular economy brings multiple benefits for humans, the environment and society as a whole. However, for reasons specific to the healthcare sector, it is difficult to achieve a mass scale transition of MWM to circular economy principles. The main limitations identified by us relate to the fact that the field is very strictly regulated in most countries, as medical waste can contain hazardous and toxic substances that affect the environment and human health.

Some barriers are related to the technologies available to treat medical waste, which are not always efficient and require large investments. Beyond the high costs involved, there is a lack of proper cooperation between multiple stakeholders - hospitals, waste management companies and local authorities. In addition, there is a lack of comprehensive data and information on the quantity and quality of medical waste produced, with negative effects on the planning and development of appropriate circular economy programmes, and a public concerned about the risks associated with recycling or reusing medical waste.

To overcome these barriers, it is important to have a strong commitment from healthcare organisations and governments, and to develop the infrastructure and technologies needed to treat medical waste in an efficient and sustainable way.

Starting from the *limitations shown*, which, however, as time goes by, we believe will be mitigated, but also from the fact that our work does not have a solid statistical apparatus, therefore, we will focus *our future research* on the same topic, but we will try to overcome these limits indicated here.

In particular, we intend to develop comparative approaches, referring to specific indicators found in other countries and to good practices in this field.

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