

# THE IMPACTS OF COVID-19 ON MUNICIPAL AND CLINICAL SOLID WASTE GENERATION IN SELANGOR THROUGHOUT 2019-2021

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**ABSTRACT:** Selangor, like many other Malaysian states, experienced various disruptions due to the COVID-19 pandemic. In addition to health and economic challenges, the populous state also faced notable issues regarding waste production. The pandemic has led to a dramatic rise in solid waste generation especially in its two largest sources, municipal solid waste (MSW) and clinical solid waste (CSW). Though, it is unclear which waste source is more affected by the pandemic. In the present study, the trend of solid waste generation in Selangor during the pandemic was investigated. A comparative statistical analysis was also made between the annual generation rates of both MSW and CSW, particularly spanning the period from 2019 to 2021. After collecting relevant numeric data from respective resources, the data is recorded into Microsoft Excel to generate graphs. The analysis uncovered that MSW exhibited an average annual generation rate of 4.52%, whereas CSW demonstrated a higher average generation rate of 33.03%. An upward trend was seen in both MSW and CSW generation in Selangor from 2019 to 2021, with CSW demonstrating a significantly higher generation rate. The increased generation of CSW during the COVID-19 pandemic emphasises the need for adhering to appropriate waste management practices. Failure to do so can result in serious consequences, including environmental harm.

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**KEYWORDS:** COVID-19, Pandemic, Municipal Solid Waste and Clinical Solid Waste.

## 1. INTRODUCTION

The COVID-19 pandemic refers to the global spread of the coronavirus disease [1]. In an effort to end the pandemic, the Malaysian government executed strict measures such as movement control orders (MCOs) and a national recovery plan (NRP) [2]. At this point, Malaysians were forced to adapt their lifestyles to the new normal. Goods were delivered as people remained at homes [3], increasing municipal solid waste (MSW) production. Additionally, medical staff worked extended hours to care for infected patients [4], escalating clinical solid waste (CSW) generation. This spike in Malaysia's waste production is particularly pronounced in Selangor, the most populous state of the country [5].

Solid waste is defined as any discarded solid items from human activities [6]. MSW comprises everyday materials produced by the public [7]; its management is under the control of KDEB Waste Management Sdn. Bhd. (KDEBWM). Conversely, CSW is infectious waste

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generated by medical centres [8]; its handling is directed by private companies, namely Radicare (M) Sdn. Bhd. and Cenviro Sdn. Bhd., which is monitored by the Department of Environment (DoE). The surge in Selangor’s waste production during the COVID-19 pandemic calls for the need of proper waste management practices to avoid threatening issues to the public and the environment.

The COVID-19 widespread has led the country to implement various measures, namely MCO and NRP. These measures resulted in a rise in Selangor’s waste generation, specifically MSW and CSW. During the period of the COVID-19 pandemic, MSW management in the state is overseen by KDEBWM. As for CSW management, it is controlled by Radicare (M) Sdn. Bhd. and Cenviro Sdn. Bhd.. However, it remains uncertain which waste source has been more impacted by the pandemic. The aim of this study is to investigate the trends of both MSW and CSW generation in Selangor during the COVID-19 period, from 2019 until 2021. Additionally, it aims to conduct a comparative statistical analysis on their generation rates to identify which waste source is more affected by the COVID-19 pandemic.

## 2. MATERIALS AND METHODS

In this study, Microsoft Excel is utilised. To construct graphs using this software, five steps are involved: data preparation, data selection, graph insertion, graph subtype choosing and final checking [9].

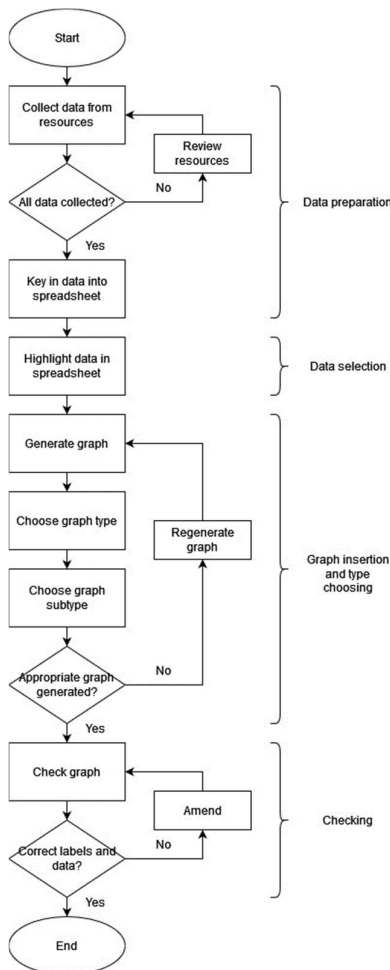


Fig. 1. Steps in generating a graph (Soni, 2022).

### 3. RESULTS AND DISCUSSION

This chapter discusses the study's outcomes. Sections 3.1 and 3.2 investigated the trends in MSW and CSW production in Selangor amid the COVID-19 pandemic. Section 3.3 then highlights which waste source is more notably impacted by the pandemic.

#### 3.1. Municipal Solid Waste (MSW)

This section elaborates on the yearly MSW generation in Selangor, from 2019 to 2021 [10]. In 2019, the production of MSW was relatively low. However, with the onset of the pandemic in 2020, there was a 4.99% increase in the state's MSW production from 2019. This escalation was attributed to the pandemic-related circumstances. The wide use of single-use items in 2020 to curb the spreading of the disease led to an upsurge in waste production. In 2021, a further rise of 4.05% from 2020 was seen. This increase can be attributed to the reopening of businesses and the implementation of delivery services. The disposal of packaging materials, in particular, played a role in contributing to the overall generation of MSW.

#### 3.2. Clinical Solid Waste (CSW)

Section 3.2 examines the annual CSW generation within the state, covering the timeframe from 2019 to 2021 [11]. In the absence of the virus in 2019, there was a comparatively low production of CSW. With the start of the pandemic in 2020, there was a 32% rise in CSW generation from 2019. This increase was driven by the increasing number of patients in healthcare facilities. Consequently, high volumes of COVID-19-related CSW were generated. Transitioning to 2021, a growth of 33.91% from 2020 was observed. This surge can be linked to the introduction of COVID-19 vaccinations, which led to an increase in the use of single-use medical instruments, further heightening the CSW generation.

#### 3.3. Comparison Of Generation Rates

This section compares the generation rates of MSW and CSW of Selangor from 2019 to 2021. To facilitate this comparison, a graph is created to illustrate the rates over the three-year period (Figure 2).

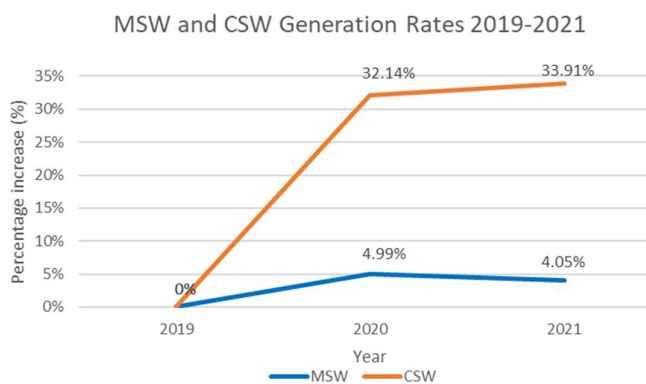


Fig. 2. Comparison of MSW and CSW annual generation rates 2019-2021.

It is evident that the MSW generation rate remained relatively low within the range of 4-5% from 2019 to 2021; its average generation rate is 4.52%. On the other hand, the rate of CSW generation exhibited a sharper incline of 32-34% in the same timeframe; its average generation rate is 33.03%. Comparing the average generation rates, it is evident that CSW exhibits a 28.51% greater variance when compared to MSW. The heightened rate of CSW generation is linked to the exceptional conditions happening during the COVID-19 pandemic. Medical practitioners were disposing of clinical disposables around the clock as they attended

patients. Furthermore, numerous doses and boosters of COVID-19 vaccinations were administered. This constant disposal led to a significant increase in CSW generation, surpassing the growth of MSW.

#### 4. CONCLUSION

From 2019 until 2021, a spike in generation was seen in both MSW and CSW. The average annual growth rate of MSW production is 4.52%, while CSW production is 33.03%. Though production of both waste sources was affected, CSW generation clearly had a more significant impact from the pandemic. This may be attributed to the fact that CSW such as used protective personal equipment (PPE), swab kits and COVID-19 vaccination wastes were only generated during the pandemic crisis, with no production prior to that. This proves that identifying effective CSW management practices is of higher importance. It is recommended that Selangor's CSW management companies take definite measures such as transport route optimisation, employee training and equipment investing. Transport route optimisation will not only reduce time, but it will minimise greenhouse gas emissions as well. Besides, employee training will raise awareness on the impacts of poor waste management, ultimately reducing environmental pollution. Lastly, investing in environmentally friendly equipment will greatly decrease harmful emissions towards the environment during waste disposal processes.

#### ACKNOWLEDGEMENT

The authors are thankful to the Department of Chemical Engineering and Sustainability at the Kulliyah of Engineering, International Islamic University Malaysia (IIUM) and the Ministry of Higher Education Malaysia for their assistance. The ministry funded this research through the IIUM-UMP-UiTM Grant Scheme (research grant no.: SRCG20-011-0011).

#### REFERENCES

- [1] World Health Organisation. (2023). Coronavirus Disease (COVID-19). World Health Organisation. [https://www.who.int/health-topics/coronavirus#tab=tab\\_1](https://www.who.int/health-topics/coronavirus#tab=tab_1)
- [2] Prime Minister's Office of Malaysia. (2021). National Recovery Plan.
- [3] Bernama. (2020, March 18). Malaysia's Covid-19 crisis sees 30% jump in delivery orders | Free Malaysia Today (FMT). Free Malaysia Today. <https://www.freemalaysiatoday.com/category/leisure/2020/03/18/malysias-covid-19-crisis-sees-30-jump-in-delivery-orders/>
- [4] Jarrar, M., Ali, N. B., Shahrudin, R., Al-Mugheed, K., Aldhmadi, B. K., Al-Bsheish, M., Alyouf, A., Albaker, W., & Alumran, A. (2023). The Impact of the Working Hours Among Malaysian Nurses on Their Ill-Being, Intention to Leave, and the Perceived Quality of Care: A Cross-Sectional Study During the COVID-19 Pandemic. *Journal of Multidisciplinary Healthcare*, 16, 119–131. <https://doi.org/10.2147/JMDH.S394583>
- [5] Department of Statistics Malaysia. (2022). Current Population Estimates, Malaysia, 2022.
- [6] United States Environmental Protection Agency. (2023). Criteria for the Definition of Solid Waste and Solid and Hazardous Waste Exclusions. United States Environmental Protection Agency. <https://www.epa.gov/hw/criteria-definition-solid-waste-and-solid-and-hazardous-waste-exclusions>
- [7] United States Environmental Protection Agency. (2016). Municipal Solid Waste. United States Environmental Protection Agency. <https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/>
- [8] Choi Yi, T., & Muhammad Noor Hazwan, J. (2021). Overview of Clinical Waste Management in Malaysia. In Review Article (Vol. 1, Issue 1).
- [9] Soni, P. (2022, April 15). How to Make A Line Graph In Excel With Two Sets Of Data. Career Karma. <https://careerkarma.com/blog/how-to-make-a-line-graph-in-excel-with-two-sets-of-data/>

- [10] KDEB Waste Management. (2023, April 5). KDEB Waste Management - Contact. KDEB Waste Management. <https://www.kdebwm.com/contact/>
- [11] Department of Environment. (2022). Department Of Statistics Malaysia 2022 Statistik Alam Sekitar Environment Statistics. [www.dosm.gov.my](http://www.dosm.gov.my)