Original research article

Quantum and management of BioMedical Waste generation both preceding and subsequent to the advent of covid-19 – a case study at srm kattankulattur

Ashika Poondla[1], Surya Joseph [2]

[1] *Consultant, Tamil Nadu Health System Reform Program,* [2]*Project Research Scientist-II(Non-Medical), ICMR, NIE.*

Corresponding Author
Dr. Ashika Poondla
Consultant,
Tamilnadu Health system Reform Program,
Teynampet, Chennai-06
Email ID : ashikapoondla95@gmail.com
Contact number : +91 90946 65959

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Abstract
Introduction: *The biomedical waste encompasses a wide range of contaminated infectious materials particularly from healthcare settings. Addressing the crucial aspects in managing biomedical waste efficiently to build resilience for health emergencies is most challenging.*
Objectives: *To figure out the flow of biomedical waste disposal at different facilities of COVID – 19. To identify the total, as well as the average amount of biomedical waste disposed in a day in each bin for 10 months from November 2019 to August 2020. (before and after COVID-19) in SRM hospital. To analyse the data of SRM hospital for type and nature of the biomedical waste maximum generated during COVID-19.*
Methods and Material: *A study was carried out from November 2019 - August 2020 to determine the change in the quantum of biomedical waste generation before and after COVID – 19 at SRMIST. A separate data log sheet was maintained to check the daily disposal of waste in each category from the wards. Sheet consists of name of the institution, month, a label "COVID - 19 Waste", timings, columns segregated for each colour bin, and total waste generated per day.*
Results: *The secondary data obtained was analysed using SPSS 26 trail version and MS Excel and Paired t test was performed. The results showed substantial contrast in waste production before and after COVID-19 across all waste categories following the emergence of the global pandemic.*
Conclusions: *The global pandemic showed a substantial contrast in waste production before and after COVID-19 across all waste categories. The need for enhancement in handling the waste generation mainly during health crises to be emphasized.*
Key words: *COVID-19, biomedical waste management, waste segregation process*

Introduction

Biomedical waste is defined as any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals, or in research activities pertaining there to, or in the production or testing of biologicals.[1]

According to the World Health Organization, **85%** of the total waste generated by health-care activities is general, non-hazardous waste. **Remaining 15%** is hazardous that is infectious, toxic or radioactive waste. The hospitals and other health facilities, laboratories and research centers, mortuary and autopsy centers, animal research and testing laboratories, blood banks and collection services, nursing homes for the elderly are the major sources of health-care waste. [2]

The healthcare facilities, on an average, produce an approximate of 250g of biomedical waste per bed, which is hazardous and requiring specialized

treatment and disposal. District hospitals with an average of 100 beds disposes approximately 25kg/day, while the community healthcare centers with 30 beds disposes waste of around 7.5 kg per day. The total medical waste generated in India in 2018 was reported as 550 TPD, projected to increase to nearly, approximately, 775.5 TPD by 2022, according to the Associated Chambers of Commerce and Industry of India. With 7% annual compound growth.[3]

The Government of India's data indicates that the country generates 484 TPD of biomedical waste per day from 1,68,869 healthcare facilities, with only 447 TPD undergoing proper treatment, relatively leaving 37 TPD untreated. The healthcare facilities utilizing the centralized biomedical treatment facilities is only1,31,837 in number, however 21,870 have their own treatment facilities.[4]

According to various other studies in healthcare settings, biomedical waste poses a significant hazard due to its potential to spread infections within (nosocomial transmission) and to individuals outside of these facilities, including waste handlers, scavenging staff, and the general public. Given the heightened generation of biomedical waste during the global COVID-19 pandemic, which necessitates increased hygiene and sanitation measures, effective management becomes crucial and challenging.

The aim of this study is to identify the quantity of biomedical waste generated before and after the onset of the COVID-19 pandemic at SRMIST Kattankulattur, Tamil Nadu, India. The previous studies focused on the management and disposal of biomedical waste. The present study results will determine the significant changes in the quantum of biomedical waste generation before and after COVID – 19 in the study area.

Material and methods

Study Area: Health care facilities of SRM hospital, Kattankulathur, Chengalpattu, Tamil Nadu, India.

Study period: 10 months (November 2019 to August 2020).

Study instrument: Biomedical Daily waste disposal from the wards was recorded in a data log sheet consisting of the institution's name, the month of waste collection, a label "COVID - 19 Waste" if collected from COVID-19 wards, timings, columns segregated for each color bin, and total waste produced per day and this log sheet was signed daily by the in-charge responsible for waste collection.

Study design: The Data were obtained from records that were submitted by institutions. The information on the overall collection of biomedical waste was retrospectively observed on a daily basis.

Inclusion Criteria: All types of biomedical waste generated from various healthcare facilities with SRM hospital during the period November 2019 to August 2020.

Exclusion Criteria: Waste generated from sources which is not associated with healthcare activities

Data analysis: The secondary data from the institution's records were imported into software (SPSS 26 trial version and MS Excel) for statistical analysis. A paired t-test was done to evaluate the significant difference between biomedical waste disposal before and after COVID-19 at a 5% level of significance. The calculation of total waste generated per day in kilograms involved figuring out the mean waste generated daily. This was achieved by dividing the total waste produced during the study period (the sum of waste in the red bag, yellow bag, puncture-proof container/blue bag, and sharp/white bag) by the number of study days.

Ethical Consideration: Since this particular study is utilizing secondary data, ethical approval is not really required. However, certain concentrated efforts will be purposefully made in order to make sure that the confidentiality and anonymity of any and all individuals or institutions that are represented in the dataset is safeguarded at all times.

Results

Quantification of flow of Biomedical waste during the global pandemic COVID-19 significantly differed between various facilities. The quarantine facilities initially followed disposal of medical mask and gloves. The hospitals generated a wide range of biomedical waste from persons working in the area of help desk, temperature recording station, waiting area, doctors chamber, sanitary staff, laboratory, screening area ,visitors accompanying young children and the elderly which includes full component PPE (components of PPE are googles, face shield, mask, gloves and coverall/gowns (with or without Aprons), head cover and shoe cover), Throat swab, Nasal swab, and the components used by sanitary staffs and the support staff from the areas like isolated or cohorted rooms for the patient, ICU, caretaker accompanying the patient and the visitor, etc.

Prior to the onset of COVID-19, in the year 2020, November exhibited a notably higher generation of infectious, contagious and sharp waste compared to other months and the volume of waste from glass wear was markedly elevated in the month of February 2020. Likewise, after the advent of COVID-19, the volume of waste in category sharp notified a elevation in the month of May, contagious & glass ware waste in the month of June and infectious waste in the month of July. Thus, the waste generated per day for infectious waste (yellow), contagious waste (red), glass waste (blue) and sharp waste (white) before the advent of COVID – 19 was comparatively higher that of the volume of biomedical waste collected after the advent of COVID – 19 in SRM hospital

Table 3.1 The quantum of biomedical waste disposed for 10 months from November 2019 to August 2020 (before and after covid-19) in srm hospital.

Month	Infectious waste	Glassware waste (blue)	Sharp waste	Contagious waste (red)	Total waste	Mean waste / day
	In Kilograms					
Year: 2019 to 2020						
19-Nov	6911.7	1048.3	169.9	6753.1	14883	496
19-Dec	6394.4	911.6	160.8	6233.7	13690.5	441.629
20-Jan	6178.1	821.35	120.55	5887.5	13007.5	419.596
20-Feb	5455.1	1498.8	127.8	5084.5	12166.2	419.524
20-Mar	4746.1	752.6	131.5	4543.1	10173.3	328.176
20-Apr	2417.2	205.3	73.7	2321.7	5017.9	167.263
20-May	2906.55	267.55	77.31	2816.4	6067.81	195.735
20-Jun	5412.9	379.3	51.1	3128.1	8971.4	299.046
20-Jul	4513.3	207.8	67.2	2343.6	7131.9	230.061
20-Aug	995.3	121.6	30.9	586.9	1734.7	55.95
Total	45930.65	6214.2	1010.76	39698.6	92,844.21	3,052.98

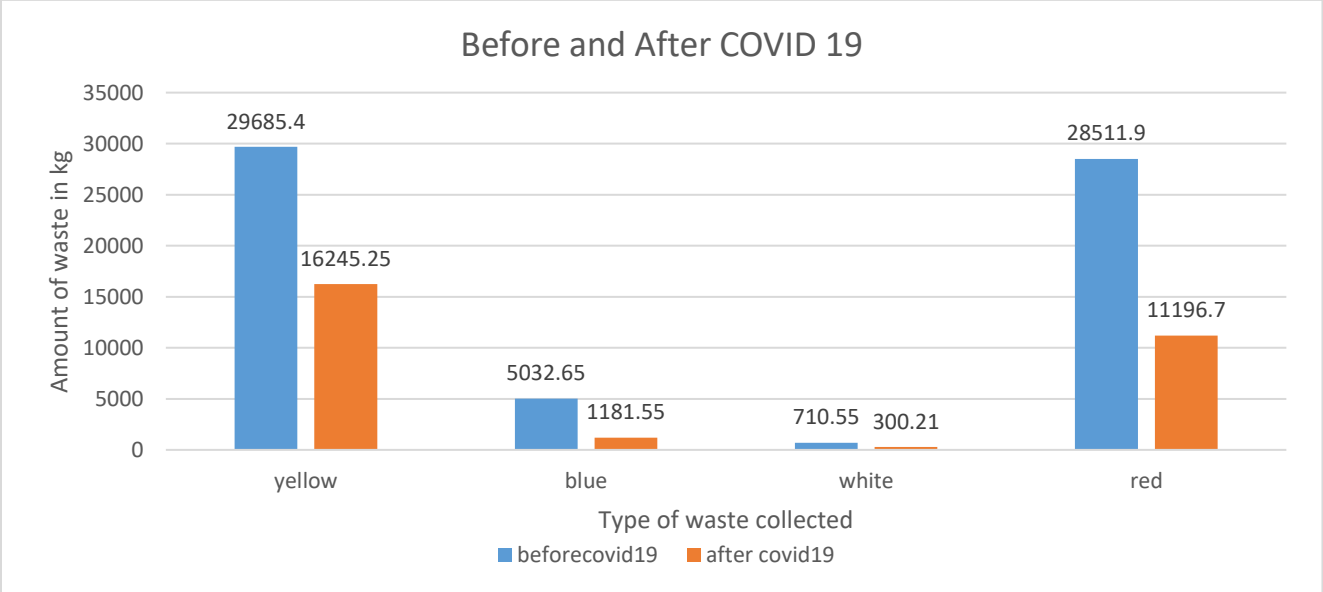
Table 3.2 Comparison of BioMedical Waste disposal before and after covid-19 using paired t- test

Type of waste	Mean	Std. deviation	Std. Error Mean	95% Confidence interval of the difference		t	df	Sig. (2 tailed)
				Lower	Upper			
Infectious	2688.0300	1716.0361	767.4347	557.2896	4818.7703	3.503	4	0.025
Contagious	3461.0400	741.5516	331.6319	2540.2820	4381.7979	10.436	4	0.000
Glassware	770.2200	323.8461	144.8284	368.118	1172.3281	5.318	4	0.006
Sharp	82.0680	17.0679	7.6330	60.8753	103.2606	10.752	4	0.000

The biomedical waste disposal data was compared before and after COVID-19 by paired t-test, considering $p < 0.05$ to be significant. The output results of the test are correlated in the table 3.2. in which the p value indicates a significant difference in the waste generation before and after covid-19 in the all the colored bins. At a 5-significance level, as p-values for infectious waste(P value 0.025), contagious waste(p value 0.000), glassware waste(p value 0.006), sharp waste(p value 0.000) are all less than $\alpha = 0.05$, it is concluded that there is a significant difference between waste generation before and after COVID-19 thus we do not accept the null hypothesis.

The waste generated from our hospital was comparatively less, after the advent of COVID-19. This reduction could be attributed to limited use of disposables also as this hospital suspended all other elective procedures from the month of April to August 2020.Regarding the type and nature of waste generation, our study showed that infectious waste was more followed by contagious waste and glass waste before as well as after COVID 19(Fig 3.3).

Figure 3.3: Type and nature of BioMedical Waste disposed befor and after covid-19 in srm hospital.



Discussion

The total biomedical waste generated in the duration of 10 months was 92,844.21kgs. Our results showed a reduction in biomedical waste generation from April 2020. Stating that the reduction in biomedical waste generated in the earlier months of COVID-19 might be due to decrease in in-patient number as only COVID-19 patients were admitted and treated at SRM Hospital from the month of April to August 2020 contributing to the comparatively lower waste output during that period.

The quantities of infectious waste, contagious waste and glass waste showed the highest mean waste generation in June 2020, noticed a peak during that month and gradually declined in the subsequent months. following which, an unusual disparity in the generation of infectious waste was noted. This anomaly is noteworthy as the COVID-19 period is customary for contagious waste generation to surpass other waste types. Therefore, it can be inferred that the atypical increase in infectious waste may be attributed due to a lack of awareness regarding the segregation of infectious and contagious waste. The outcomes of the present study, along with the methods employed for biomedical waste disposal and management, can be generalized to private hospitals treating COVID-19 patients during the suspension of all other elective medical procedures.

The current study might induce information bias due to the impracticality of in-person observation concerning the utilization and disposal of medical equipment (the exact number) per individual per bed, credit to the global COVID-19 pandemic. There has been a significant rise in the need for accurate data despite the challenges faced in obtaining firsthand information due to restricted access and safety concerns. The lack of direct observation might have heightened the reliance on indirect sources of information - errors! and discrepancies in the reported data, therefore impacting the overall assessment of utilization rates and resource allocation strategies. As the global pandemic have undoubtedly increased the complexity of data collection processes regarding medical equipment usage it is crucial to adapt strategies to minimize information bias and enhance the accuracy of decision-making in healthcare settings.

Challenges and learning

The continuously evolving nature of research related to the novel coronavirus and scarcity of research studies directly comparing the generation of biomedical waste before and after the emergence of COVID-19 was challenging in finding references during the study period. Secondly, the significant obstacle emerged was confidentiality of information about COVID-19 patients. This limitation impeded the acquisition of crucial data like daily count of in-patients, the analysis of medical waste disposed of by each patient per bed per day etc,. Also, the unusual discrepancies in waste generation like unexpected increase in infectious waste compared to contagious waste during the COVID-19 period, presented challenges in the interpretation. The current study uncovered a reduction in the generation of biomedical waste following the initiation of COVID-19 measures due to decrease in the number of in-patients which underscores the direct influence of pandemic-related changes on waste generation. The examination of waste disposal trends indicated a peak in infectious, contagious, and glass waste generation in June 2020 aligning with a likely surge in COVID-19 case. This highlights the correlation between waste trends and the prevalence of the virus. Also, unusual disparity in waste generation questioned the level of awareness and adherence to proper waste segregation practices which in turn emphasized the really critical need for awareness and education pertaining to proper waste segregation, particularly during health crises.

On summation, the study's outcomes and methodologies were deemed applicable to private hospitals treating COVID-19 patients during the suspension of elective medical procedures. This insight can offer valuable guidance for similar healthcare settings facing comparable operational

challenges. The challenges faced including limited studies and confidentiality constraints, were offset by valuable insights into the impact of COVID-19 measures on waste generation and the necessity for ongoing education in waste management practices. Enhancing understanding among healthcare workers and staff could contribute to more effective waste management practices.

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Conflict of interest None declared

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