

Healthcare Waste Management (HWM) in Hyderabad (Sindh): A Comparison of Government, Semi-/Non-Government, and Private Hospitals

Sehreen Moorat*, Hiba Pervaiz, Sasuee Rajpar

Liaquat University of Medical and Health Sciences, University in Jamshoro, Sindh, Pakistan.

ABSTRACT

Background: Population expansion and greater accessibility to healthcare have increased the production of medical waste. Along, it is a crucial concern of the government and the healthcare industry for the environment and public safety. Hospitals, dentist offices, clinics, clinical laboratories, and other facilities providing healthcare are among the facilities that produce medical waste. When it comes to handling hospital wastes, developing countries are resource-constrained due to which chances of the spread of infectious diseases increase.

Objective: The main purpose of this study was to determine the percentage of hospitals that follow healthcare waste management practices. Along with how well-versed healthcare providers were in terms of awareness, knowledge, and practices.

Methodology: A survey-based study was performed to obtain healthcare waste disposal data from government, semi-government and private hospitals in the region of Sindh. The obtained survey data was fed to the SPSS in the form of statistics to observe the meaningful results related to healthcare waste management.

Results: The average waste generation maximum at private hospitals is found to be 71.2%, in government hospitals it is 25% and in semi-govt/NGO hospitals it is 3.8%. Whereas, it is also observed that more waste management techniques were followed at private hospitals than at government or semi-government.

Conclusion: It is necessary to spread awareness among healthcare practitioners and medical staff on healthcare waste management. Also, the guidelines and policies should be strictly followed to protect the environment and public health.

Keywords

Healthcare waste management, medical waste, survey, SPSS, waste management techniques.

*Address of Correspondence

reen_gopang@yahoo.com

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INTRODUCTION

Nowadays, the healthcare industry is one of the fastest-growing industries in the world¹. The expenditure on health is increased globally and remains rising every year. According to the WHO report worldwide around 7.8 trillion dollars were spent on health which is 10% of the world's gross domestic product (GDP)². Globally the population is estimated to increase by around 8.6 billion by 2020 and 9.8

billion by 2050³. An increasing population and diseases day by day can also increase the expenses of health. Therefore, this increasing population would need more healthcare involvements which ultimately increases the generation of healthcare waste.

As the diseases are continued to grow, they affect the population aged above 50 years⁴. The vulnerability increases if the person has already any chronic condition. An increase in the disease increases the cost of multiple morbid conditions (MMCs)⁵. MCCs not only increase the use of specialist care, primary care, and elevated use of medications and hospital admissions. These frequent visits to the hospital increase the use of healthcare disposal items which are extensively used in the healthcare industry.

Contingent characterization of waste has no importance due to waste heterogeneity in nature. Therefore, the focus is on infectious waste and its proper disposal and ways to treat that waste. Infectious waste and toxic waste require special handling to avoid the spread of diseases in the environment⁶.

There are numerous types of waste reported in the literature, among which a few are listed below:

- The general category includes paper, plastics, and disposable food.
- Pathological waste includes body tissues, organs, limbs, and body fluids.
- Chemical waste includes; disinfectants, swabs, and heavy elements.
- Infectious wastes include waste from patients with infections, natural body excretions, and waste contaminated with blood.
- Genotoxic wastes include medications used for cancer.
- Sharps include blades, capillary tubes, reusable

pipettes, and shattered glass intravenous needles.

It can be observed from figure 1 that 80.30% of the waste produced by the healthcare industry is an infectious waste. Whereas, the remaining 19.70% of waste is divided among pathological, pharmaceutical, cytotoxic, chemical wastes, and sharps.

The techniques followed to discard the healthcare waste include;

- Shredding is the process of cutting or de-shaping waste into little bits. It minimizes the volume necessary for efficient disposal with autoclave and sterilizing procedures. It also prevents infectious sharps and waste from being reused also it is an alternative to combustion⁸.
- Incineration is a high-temperature, dry oxidation method of converting organic and flammable waste to synthetic, non-flammable material, leading to a reduction in waste weight and volume, at temperatures ranging from 600°C to even more than 1000°C under appropriate conditions, through burning, thermal decomposition, or gasification⁹.
- Steam sterilization is the use of non-incineration systems such as autoclaves and hydroclaves to treat pathogenic microorganisms in hazardous hospital waste has been advocated. Even though steam sterilization methods kill or stop germs from growing, microbial regeneration and the danger of lingering chemical hazards are the main drawbacks to employing these systems¹⁰.

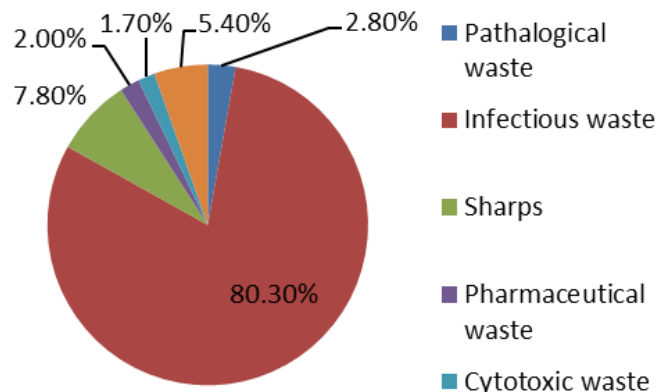


Figure 1. Percentage of waste produced by the healthcare industry⁷.

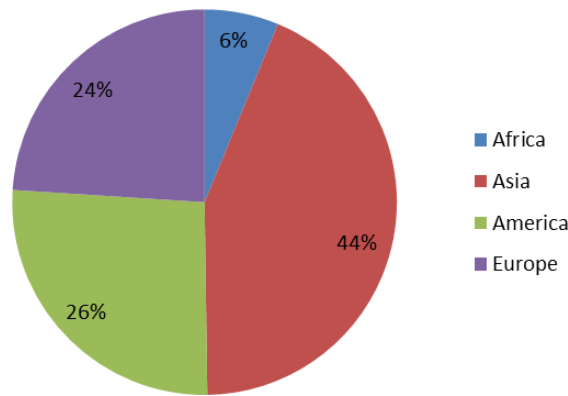


Figure 2. HCW generation Worldwide¹¹.

Figure 2 depicts the production of healthcare waste in 4 major continents of the world. Among these Africa has the lowest percentage which is 6%. Whereas, the highest waste is produced by Asia followed by America and Europe with 44%, 26%, and 24% respectively. The percentage of waste also has a relation with the population in the continent which relatively affects the number of people hospitalized each day. As can be observed from figure 2 Asia has the highest rate of production of waste due to its densely populated countries with high resource constraints¹². Developing countries have less of facilities and awareness about hygiene practices. Pakistan being the 4th most populated country in Asia follows fewer practices of healthcare waste management. Therefore, this research aimed to determine hospital waste management practices in the region of Sindh, the level of knowledge about those practices in hospital staff, incarnation methods followed by the hospital, and to understand the current waste management situation in Sindh from multiple standpoints. The obtained information is fed into the SPSS in the form of statistical data to observe the meaningful results related to healthcare waste management.

METHODOLOGY

This research is based on the primary data to survey different hospitals. To obtain the primary information qualitative methods were used such as questionnaires (open and close-ended), interviews, and observations. These questionnaires were filled by meeting the hospital personnel like medical superintendents (MS) in

government hospitals and hospital representatives in private hospitals (Figure 3).

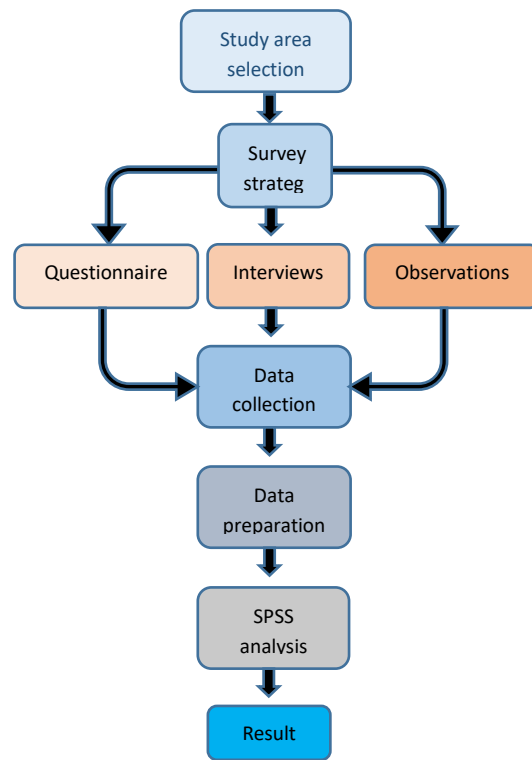


Figure 3. Flow chart of the methodology

The above flow chart represents the steps followed in this research. In this study, the targeted area selected was Hyderabad. It has been conducted from 52 hospitals among which 45% were government hospitals, 5% were NGO hospitals located in small areas of Hyderabad, and 50% were private hospitals. A survey strategy made is built

on questionnaires, interviews, and direct observations. The data is composed of government, private and semi-government hospitals of different cities in Sindh. The data composed through questionnaires, interviews, and observations are arranged in a proper structure in an MS Excel sheet. To get the results, different statistical tests are applied.

Questionnaire

The questionnaire was developed by taking help from secondary data to find the most convenient and relevant questions related to HCW. This questionnaire was divided into sections which cover a total of forty questions. Section 1 covered the basic information about the hospital and its staff. The second section contains the waste generated by hospitals per day and the color-coded system of bins they followed. A third section was about techniques they used to dump the waste. These questions help in this research regarding generating meaningful information related to healthcare waste management in Hyderabad.

Sample size

It is a difficult task to gather data about HCW management from all hospitals of Hyderabad, Sindh region. Therefore, to accumulate the information in regards to health center waste control practices in the hospitals. It was important to select the sample size. To determine sample size the following Cochran equation is used¹³:

$$n = Z^2SD^2/e^2 \dots\dots\dots (1)$$

This equation is only for a simple random sample.

- Z is the significance level.
- SD is the standard deviation.
- e is the desired level of precision (i.e. the margin of error).

In this study, the value of 'Z' is 1.96, the value of 'p' is 0.20, 'q' is obtained by subtracting the value of 'p' from '1', the value of SD is obtained by multiplying the value of 'p' & 'q' and the value of 'e' is 0.109. By putting these values in equation¹, we obtained the number sample size which is 52 hospitals.

RESULTS

The analysis of data from the survey questionnaire was fed into SPSS. In SPSS, the chi-square test was performed which is used when the relationship between two categorical variables is required. After collecting a random sample of hospitals, and administering a survey to this sample, the frequency distribution of hospital waste management is manually observed within the sample. Then the chi-square test is performed in SPSS to validate the observed frequencies.

Table 1 contains the results of the waste generated by each bed each day. This data is obtained from government, private, and NGO-based hospitals. The horizontal title shows the frequency of waste in Kgs generated in percentage, which is randomly divided into 0.5%, 1%, 1.5%, 2%, 2.5%, and 3%. While it is observed that in 13 government hospitals, 3.8% hospitals generate 0.5 kgs of waste per day, 5.8% generate 1 kg, 7.7 % generate 1.5kgs, 3.8% generate 2 kgs and 3.8% of hospitals generate 3 kgs of waste per day per bed. In total the waste generated is 25% in government hospitals and in private hospitals, the waste generated is 71%. The chi-square test suggest that in 52 hospitals the result is significant ($p < 0.01$). Table 2, 3, and 4 show the chi-square obtained results and its likelihood ratio for waste generated per day/bed, techniques used to discard waste, and waste storage timing, respectively. In table 2, the value of test statistic is 9.385 with the degree of freedom 15. The corresponding p-value of the statistic is $p = 0.857$. Table 3 shows the result of techniques used to discard waste. The value of test statistic is 10.173 with the degree of freedom 15. The corresponding p-value of the statistic is $p = 0.809$. The footnote for this chi-square test pertains to the expected cell count assumption (i.e., expected cell counts are all greater than 5): no cells had an expected count less than 5, so this assumption was met. Whereas, table 4 shows the waste storage timing. The value of test statistic is 8.818 with the degree of freedom 6. The corresponding p-value of the statistic is $p = 0.184$. The footnote for this chi-square test pertains to the expected cell count assumption no cells had an expected count less than 5 and the minimum expected count is 0.02.

Table 1. Waste generated per day/bed.

Hospital type		Frequency of waste generated in each hospital per bed/day in %.						Total
		.50 kg	1.00 kg	1.50 kg	2.00 kg	2.50 kg	3.00 kg	
Govt	No of Hospitals	2	3	4	2	0	2	13
	% of waste generated in each hospital per bed per day	3.8%	5.8%	7.7%	3.8%	0.0%	3.8%	25.0%
NGO	No of Hospitals	0	1	1	0	0	0	2
	% of Waste generated in each hospital per bed per day	0.0%	1.9%	1.9%	0.0%	0.0%	0.0%	3.8%
Private	No of Hospitals	6	6	9	11	2	2	37
	% of Waste generated in each hospital per bed per day	11.5%	13.4%	17.3%	21.2%	3.8%	3.8%	71.2%
Sub Total		8	11	14	13	2	4	52
		15.4%	23.2%	26.9%	25.0%	3.8%	7.7%	100.0%

Table 2. Chi-Square - Waste Generated Per Day/Bed.

Variables	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.385 ^a	15	.857
Likelihood Ratio	9.836	15	.830
N of Valid Cases	52		

Table 3. Chi-Square Test of Techniques Used to Discard Waste.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.173 ^a	15	.809
Likelihood Ratio	10.931	15	.757
N of Valid Cases	52		

a. 22 cells (91.7%) have an expected count of less than 5. The minimum expected count is .02.

Table 4. Chi-Square Tests of Waste Storage Timing.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.818 ^a	6	.184
Likelihood Ratio	9.058	6	.170
N of Valid Cases	52		

a. 9 cells (75.0%) have an expected count of less than 5. The minimum expected count is .02.

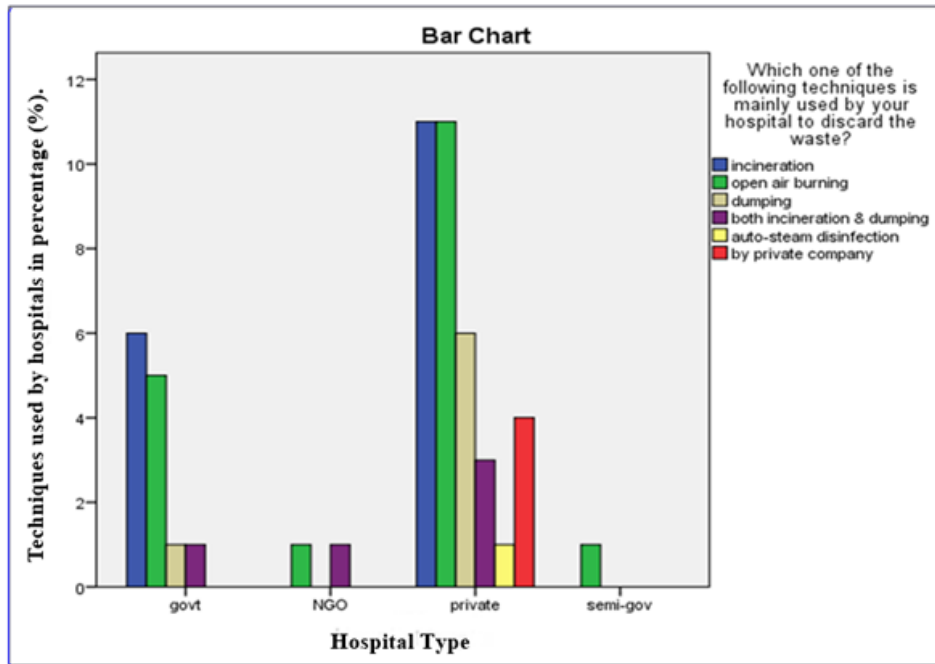


Figure 4. The Technique Used to Discard Waste.

Figure 4 shows the techniques used to discard waste by government, private, semi-private, and NGO-based hospitals. It is observed from the figure that private hospitals follow the incineration and open-air burning around 11.5%. Whereas, the government follows incineration at 6 % and open-air burning at 5%. However,

private hospitals follow the techniques in a much better way as compared to government hospitals. Table 3 shows the chi-square test of waste dumping techniques.

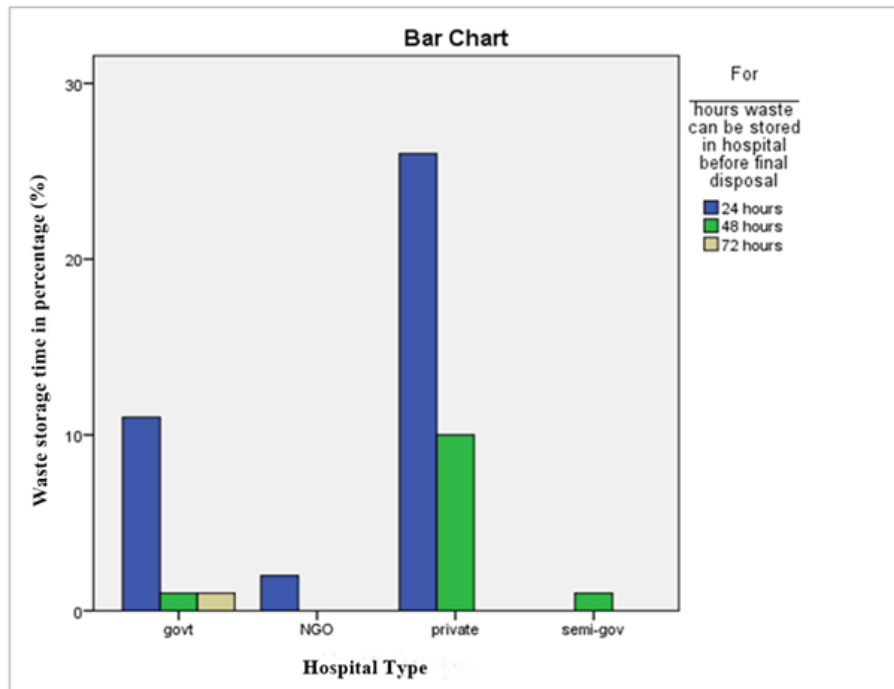


Figure 5. Time of waste storage.

Figure 5 shows the time of storage of waste followed by hospitals before dumping waste. Around 27% of private hospitals due to more facilities and availability of resources can store waste for 24 hours. Whereas, 10% store for 48 hours. Table 4 shows the chi-square test performed for storage time.

DISCUSSION

Pakistan Environmental Protection Agency (PEPA) has the set of rules for hospital waste management. Unfortunately, due to lack of awareness and avoidance by many hospitals the rules are not fully followed. As a result to that violence of HWM rules, PEPA has right to take strict action against those hospitals. It is essential to manage the hospital waste since improper disposal results in the subsequent repurposing of hazardously contaminated disposal materials for the production of various plastic goods for residential use. To protect human health and the environment, it is necessary to have safe management of hospital waste.

CONCLUSION

Medical waste management and disposal receive minimal attention, even though they are deemed dangerous due to their contagious and/or poisonous qualities. The results revealed that government hospitals require proper waste-handling techniques. The main cause of concern was a lack of effective employee training on healthcare waste management issues and the dangers that could result from improper treatment. Toxicity was found in all wastewater samples from the hospital, especially those from the laboratories. For the safety and health of waste handlers, insufficient steps were taken. The guidelines and recommendations were not implemented at most hospitals. Moreover, the training of Hospital Staff, HCWM Awareness, and handling of healthcare waste through using protective gear is more improved in private hospitals than that in government hospitals. Therefore, by considering the private hospital's management system there should be a separate healthcare department that handles the waste of the hospital without affecting the staff, and other public in government hospitals. However, the hospital waste management policy should state the proper handling, storage, transportation, and disposal of waste. The policy should be stated through appropriate legislation to protect the environment and public health. The action

plan and strategy should be designed with decision-making authorities for proper hospital waste management. A task force should which includes representatives from private and government hospitals should be assigned tasks to begin the process of adaption of policy in hospitals.

CONFLICTS OF INTEREST

None.

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None.

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None.

LIST OF ABBREVIATIONS

WHO	World health organization
NGO	Non-governmental organization
HCW	Health care waste
SD	Standard deviation
SPSS	Statistical Package for Social Sciences
Df	Degrees of freedom

REFERENCES

1. Kenny C, Priyadarshini A. Review of Current Healthcare Waste Management Methods and Their Effect on Global Health. Healthcare [Internet]. 2021 Mar 1 [cited 2022 Oct 11];9(3). Available from: /pmc/articles/PMC7999172/
2. Global spending on health: a world in transition [Internet]. [cited 2022 Oct 11]. Available from: <https://apps.who.int/iris/handle/10665/330357>
3. Global Waste Management Outlook | UNEP - UN Environment Programme [Internet]. [cited 2022 Oct 12]. Available from: <https://www.unep.org/resources/report/global-waste-management-outlook>
4. Pimentel D, Cooperstein S, Randell H, Filiberto D, Sorrentino S, Kaye B, et al. Ecology of Increasing Diseases: Population Growth and Environmental Degradation. Hum Ecol [Internet]. 2007 Dec [cited 2022 Oct 12];35(6):653. Available from: /pmc/articles/PMC7087838/
5. Roca F, Lang PO, Chassagne P. Chronic neurological disorders and related comorbidities:

- Role of age-associated physiological changes. *Handb Clin Neurol*. 2019 Jan 1;167:105–22.
6. Sci-Hub | Hospital waste management and toxicity evaluation: A case study. *Waste Management*, 27(7), 912–920 | 10.1016/j.wasman.2006.04.019 [Internet]. [cited 2022 Oct 12]. Available from: <https://sci-hub.se/10.1016/j.wasman.2006.04.019>
 7. A Study to Investigate and Compare Groundwater Quality in Adjacent Areas of Landfill Sites in Lahore City [Internet]. [cited 2022 Oct 13]. Available from: https://www.researchgate.net/publication/272566911_A_Study_to_Investigate_and_Compare_Groundwater_Quality_in_Adjacent_Areas_of_Landfill_Sites_in_Lahore_City
 8. Jerolmack DJ, Paola C. Shredding of environmental signals by sediment transport. *Geophys Res Lett* [Internet]. 2010 Oct 1 [cited 2022 Oct 13];37(19). Available from: <https://onlinelibrary.wiley.com/doi/full/10.1029/2010GL044638>
 9. Makarichi L, Jutidamrongphan W, Techato K anan. The evolution of waste-to-energy incineration: A review. *Renew Sustain Energy Rev*. 2018 Aug 1;91:812–21.
 10. Panta G, Richardson AK, Shaw IC, Chambers S, Coope PA. Effectiveness of steam sterilization of reusable medical devices in primary and secondary care public hospitals in Nepal and factors associated with ineffective sterilization: A nation-wide cross-sectional study. *PLoS One* [Internet]. 2019 Nov 1 [cited 2022 Oct 13];14(11):e0225595. Available from: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0225595>
 11. Minoglou M, Gerassimidou S, Komilis D. Healthcare Waste Generation Worldwide and Its Dependence on Socio-Economic and Environmental Factors. *Sustain* 2017, Vol 9, Page 220 [Internet]. 2017 Feb 6 [cited 2022 Oct 12];9(2):220. Available from: <https://www.mdpi.com/2071-1050/9/2/220/html>
 12. Khan BA, Cheng L, Khan AA, Ahmed H. Healthcare waste management in Asian developing countries: A mini-review. <https://doi.org/10.1177/0734242X19857470> [Internet]. 2019 Jul 3 [cited 2022 Oct 12];37(9):863–75. Available from: <https://journals.sagepub.com/doi/full/10.1177/0734242X19857470>
 13. Naing NN. Determination of sample size. *Malaysian J Med Sci*. 2003;10(2):84–6.