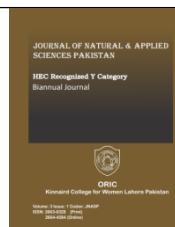




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A STUDY TO ASSESS HOSPITAL WASTE MANAGEMENT IN SHEIKHUPURA AND LAHORE BY USING GIS

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Abstract

This study investigates into the issue of hospital waste management in the cities of Lahore and Sheikhpura, Pakistan. The rapid growth in healthcare services and the lack of efficient waste management strategies have led to the accumulation of hazardous medical waste, posing significant threats to public health and the environment. Through a comprehensive analysis of the current state of hospital waste management, this research highlights the urgent need for improved regulations and guidelines for waste segregation, transportation, treatment, and disposal. The study employed a mixed-methods approach, including surveys, questionnaires, and GIS mapping, to assess the knowledge, attitudes, and practices of healthcare workers and sanitary staff. Findings emphasized the inadequacy of existing waste management practices and the necessity for enhanced training and awareness programs. Moreover, the study highlighted the inadequate number of dumpsites relative to the numerous hospitals, emphasizing the need for an urgent increase in appropriate disposal sites.



Keywords

Hospital waste management, healthcare services, medical waste, Pakistan, Lahore, Sheikhpura, waste segregation, waste disposal, environmental impact, public health

1. Introduction

Medical waste creation has significantly increased as a result of the fast growth of healthcare services and the growing global population. The healthcare industry is a fundamental foundation of every

society since it offers crucial services to sustain and enhance public health. The creation of significant volumes of hazardous hospital waste is a gloomy side effect of this sector's exponential expansion. Medical waste is defined by the World Health

Organization (WHO) as healthcare waste, which is trash produced by healthcare institutions, research facilities, and labs (WHO, 1991). This includes waste created by sources throughout the course of receiving medical care at home (WHO, 1999). This term is very wide, general, and imprecise. Healthcare or medical waste are other names for hospital waste. Poor treatment of this trash poses major threats to the environment, public health, and welfare of communities as a whole. Hospital waste management refers to the processing of garbage generated by hospitals using safety measures to prevent the spread of disease. The disposal of hospital and other medical waste requires additional caution since it poses significant health concerns. Sweepers in Pakistan gather hospital garbage, which is subsequently taken to the open dumps in the city. Government hospitals lack specialized waste management methods, and staff members typically treat all solid wastes improperly as a result of ignorance. Hospital waste is collected and dumped with regular city trash using municipal transportation (Ahmed 1997). Ordinarily, home and hospital garbage are combined and dumped along the roadway. Sometimes, in lieu of following any laws or restrictions, this garbage is just buried to be disposed of. The sad truth behind these actions is that, despite the availability of the technologies and equipment required to ensure proper hospital waste management in the nation, their implementation is hampered by staff and locals' ignorance of efficient disposal techniques and policies (Ul Haque 2006). However, Pakistan is at a turning point where it is critical to raise awareness about the dangerous effects that trash has on both human health and the ecosystem. The use of hospital waste management

technology also requires tight controls (Rasheed *et al.* 2005). Sheikhpura and Lahore, with their growing population and a burgeoning healthcare sector, faces unique challenges concerning the management of hospital waste. This comprehensive study aimed to investigate and analyze the current state of hospital waste management in both the public and private sectors in Sheikhpura and Lahore. By delving into the policies, practices, and infrastructure related to waste management, this research seeks to identify strengths, weaknesses, and opportunities for improvement in the existing waste management system. Hospital waste may transmit diseases including hepatitis B and C, HIV, skin allergies, TB, and cancer as well as hepatitis B and C. It is also exceedingly contagious and dangerous to human health. Medical facilities are there to help and to take care of the populace. These people really deliver healthcare and look after patients. Hospitals and other healthcare facilities must provide services to keep the people healthy. Hospitals directly serve people (Patil & Pokhrel 2005) by offering treatment and services to patients as well as indirectly by making sure that their personnel and society are in a clean and safe environment. They shouldn't be turned into an obtrusive and bothersome element of society as a result. The management of hospital waste in the public and private sectors of Lahore and Sheikhpura was the primary focus of this study since it is one of the most important and frequently disregarded concerns in Pakistan. Urgent attention is required to establish and implement comprehensive regulations and guidelines for the proper management of medical waste.

1.1 Study Area

The study area for this paper is Lahore and Sheikhupura. Lahore is the capital of Punjab and Pakistan's second largest metropolis. With a total surface area of 1772 km². It has a total population of 8.16 million people. The city selected for research is Lahore, the division of Pakistan. Different Private Hospitals, Public Hospitals and clinics are visited.

Whereas Sheikhupura is a city of Punjab with 3,030 km² (1,170 sq mi) total surface area. This study is conducted in city Sheikhupura, coordinates 31.7167° N, 73.9850° E. Sheikhupura district hospitals covered the districts of Ferozewala, Muridke, Sharaq Pur, Safdarabad.

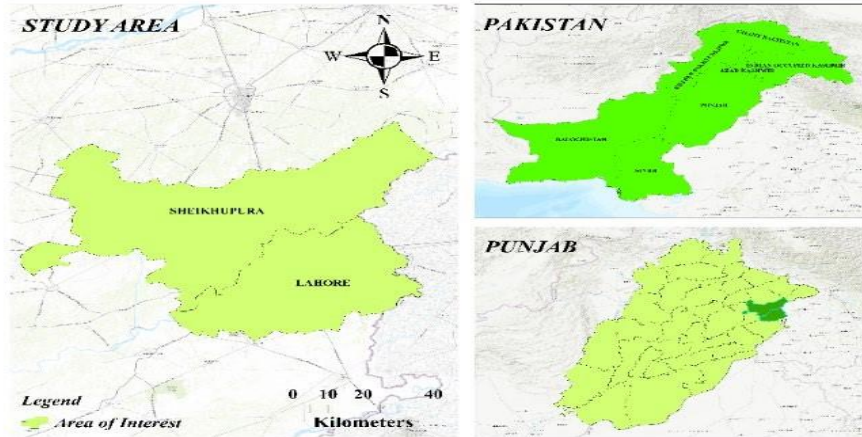


Figure 1: Map Showing Area of Study

Hospitals Location Map of District Lahore And Sheikhupura, Pakistan

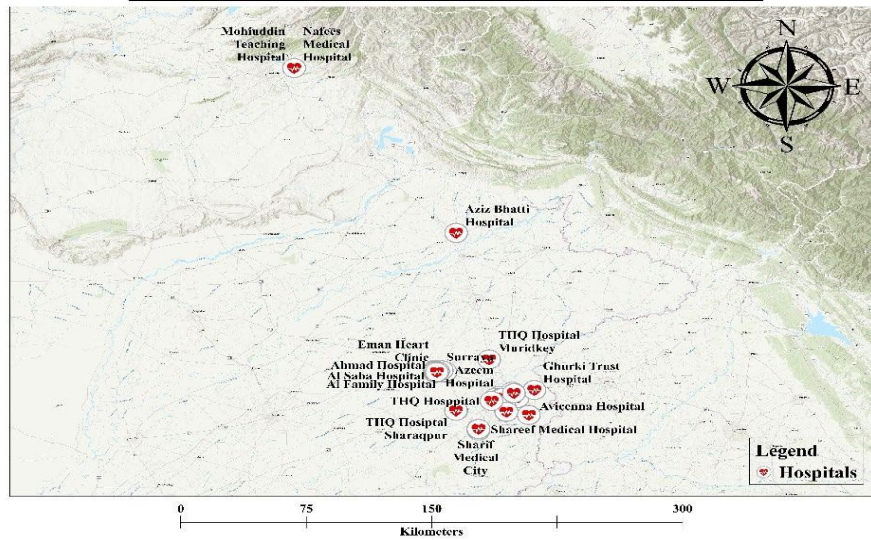


Figure 2: Showing Map of Sampling Sites

This map is displaying the locations of hospitals within the Lahore district and Sheikhupura district in Pakistan. A hospital location map typically illustrates the geographical distribution of various hospitals within a specific area, providing

information about their exact locations, names, and possibly other relevant details. In this case, the district of Lahore and the district of Sheikhupura are both located in the Punjab province of Pakistan. Lahore is the capital city of the province and is one

of the most populous and well-developed cities in the country. It serves as a significant cultural, historical, and economic hub of Pakistan. Sheikhpura, on the other hand, is another important district located in central Punjab.

2. Materials and Methods

The random sampling approach, which is used in this study, is well-known for its emphasis on fieldwork. In order to disseminate surveys and questionnaires, fieldworkers visited both private and public clinics and hospitals. The main goals were to analyze the harmful impacts of solid medical waste, and review the actions made by medical waste management. The information gathered from the surveys and questionnaires is statistically analyzed using a variety of graphs, charts, and software programs including Google Earth Pro for obtaining coordinates of dump sites, ArcGIS (Geographic Information System) 10.8 for Route Network

Mapping, ArcGIS Pro 3.0.2 for all maps and SPSS. To enable a geographical study of the data, hospitals were carefully marked on a map using GIS software. In the study, self-explanatory questions are used. Self-explanatory questions are open-ended, allowing respondents to give thorough, descriptive responses without being constrained by a predetermined range of possibilities. The goal of this strategy is to collect qualitative data using fieldwork, surveys, and questionnaires in order to determine the negative consequences and assess the efficacy of medical waste management procedures. After the data has been gathered, it was examined using a variety of programs and methods, such as GIS and SPSS. These software tools enable researchers to conduct comprehensive statistical analyses, generate charts and tables, and draw meaningful conclusions from the collected data.

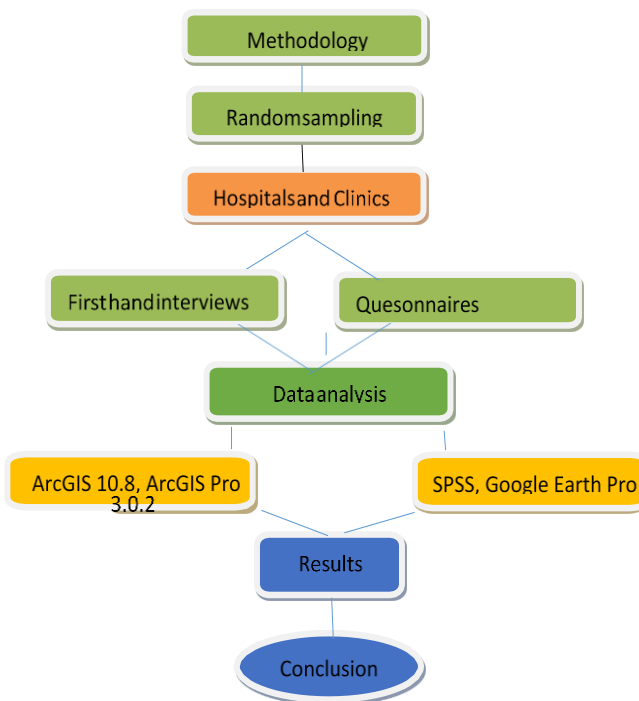


Figure 3: Showing Methodology of Study

3. Results and Discussion

ROUTE MAP OF CLOSEST DUMPSITE TO HOSPITALS IN LAHORE AND SHEIKHUPURA

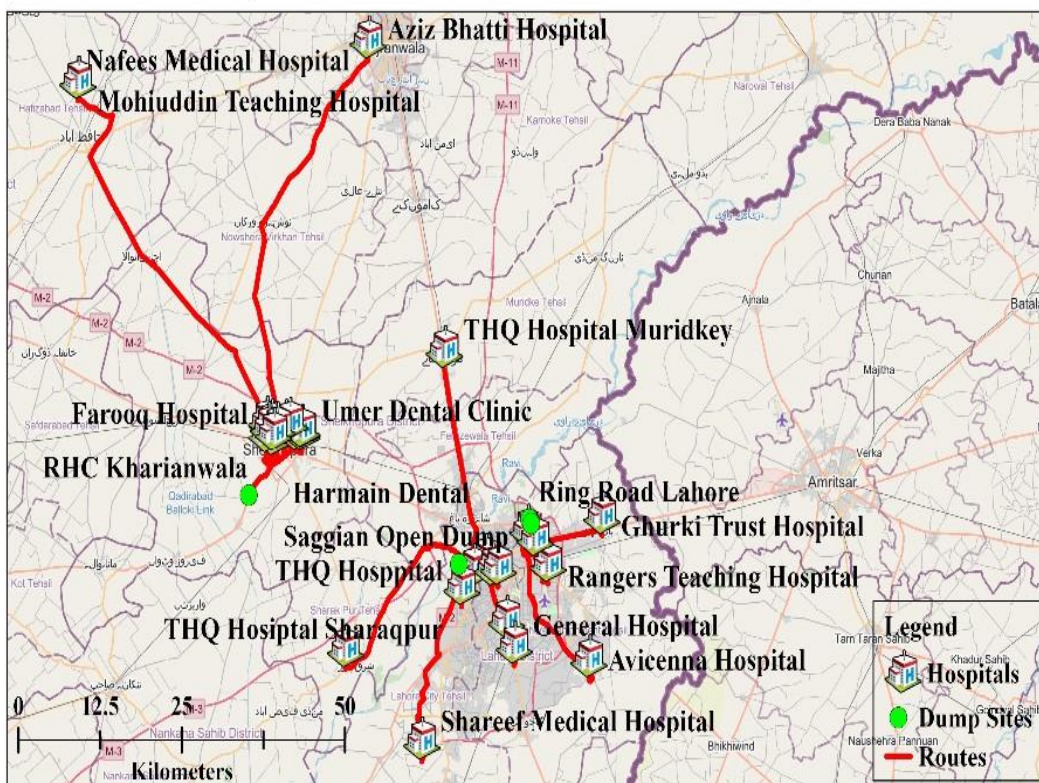


Figure 4: Showing Closest Dumpsites to Hospitals

A route map is a visual representation that outlines the best pathways from one location to another. In this case, the route map described is illustrating the paths from the closest dumpsites to hospitals in Lahore District and Sheikhupura District (Figure 4). Additionally, it highlights three specific dumpsites using green dots, which are the RHC Kharianwala, Ring Road Lahore, and Saggian Open Dump which are closest to the hospitals mentioned in above map. The inclusion of the specific dumpsites, RHC Kharianwala, Ring Road Lahore, and Saggian Open Dump, is particularly important as it allows for a targeted analysis of the impact of these specific dumpsites on nearby hospitals. By highlighting these

dumpsites with green dots, the map is drawing attention to their immediate significance in the context of the healthcare infrastructure in the Lahore and Sheikhupura Districts. The results of the current study show that there are altogether 3 dumpsites from Sheikhupura and Lahore which are RHC Kharianwala, Ring Road Lahore, and Saggian Open Dump which are not enough according to the number of the hospitals. There need to be more dump sites for the medical waste. The ANOVA test was employed in SPSS to examine whether there are significant differences in the mean outcome across various dumpsites in Lahore and Sheikhupura.

Table 1: ANOVA of Sheikhpura

		Method			
Null hypothesis		All means are equal			
Alternative hypothesis		Not All means are equal			
Significance level		$\alpha = 0.05$			
<i>Equal variances were assumed for the analysis.</i>					
Factor Information					
Factor	Levels	Values			
Dumpsite	2	RHC Kharianwala, Saggian Open Dump			
Analysis of Variance					
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Dumpsite	1	675.28	675.280	339.17	0.000
Error	19	37.83	1.991		
Total	20	713.11			
Model Summary					
S	R-sq	R-sq(adj)	R-sq(pred)		
1.41102	94.70%	94.42%	93.57%		
Means					
Pooled StDev = 1.41102					
Dumpsite	N	Mean	St. Dev	95% CI	
RHC Kharianwala	19	8.682	1.425 (8.005, 9.360)	Saggian Open 2 28.000 1.131 (25.912, Dump 30.088)	

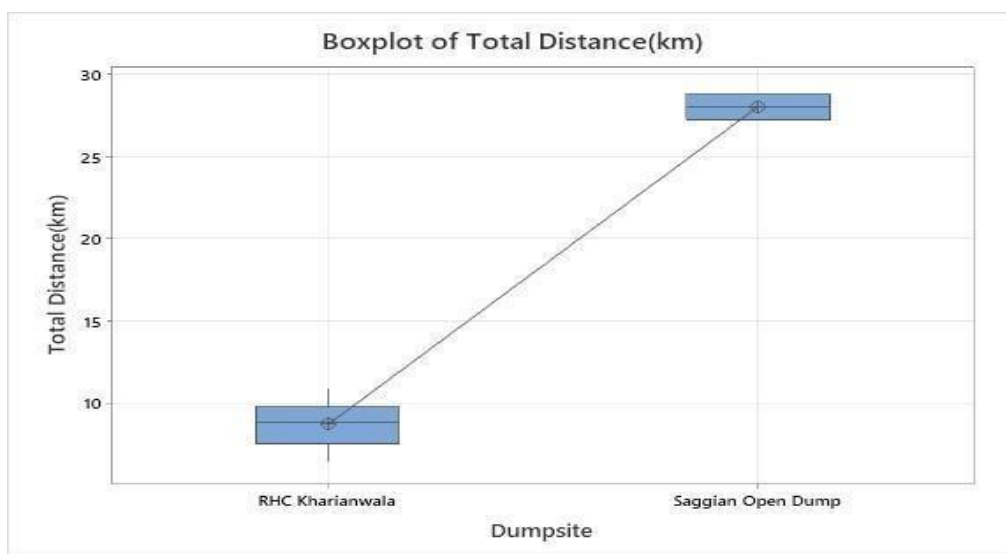


Figure 5: Showing Boxplot of Total Distance

The graph illustrates the distance between RHC Kharianwala and the Saggian open dump, showing a distance of 27 kilometers. This distance is crucial for understanding the logistics and environmental implications of waste disposal from RHC Kharianwala to the dumpsite. It indicates the transportation requirements and associated costs, as well as the potential environmental impact of transporting waste over this distance. Additionally, this distance can inform decisions regarding waste management practices, such as the need for efficient transportation methods or the consideration of alternative disposal sites closer to the healthcare facility. Overall, the graph provides valuable insight into the spatial relationship between the healthcare facility and the waste disposal site, facilitating

informed decision-making in waste management planning. The F-Value of 339.17 obtained from the test is indicative of a substantial difference between the group means. This suggests that the variability among dumpsites is much larger than what would be expected by random chance alone. The associated p-value of 0.000 is extremely low, essentially zero. In hypothesis testing, a low p-value is indicative of strong evidence against the null hypothesis. In this context, the null hypothesis would typically state that there is no significant difference in mean outcomes across dumpsites. Therefore, with such a low p-value, there is compelling evidence to reject the null hypothesis. Consequently, it is reasonable to conclude that the mean outcome differs significantly across the different dumpsites (Figure 5).

Table 2: ANOVA for Lahore

		Null hypothesis		Method		All means are equal	
		Alternative hypothesis				Not all means are equal	
		Significance level				$\alpha = 0.05$	
		Rows unused				4	
<i>Equal variances were assumed for the analysis.</i>							
Factor Information							
		Factor		Levels		Values	
Dumpsite		3		Mehmood Booti Open Dump, RHC Kharianwala, Saggian Open Dump			
Analysis of Variance							
	Source	DF	Adj SS	Adj MS	F-Value	P-Value	
Dumpsite		2	2505	1252.7	5.07	0.024	
Error		13	3213	247.2			
Total		15	5718				
Model Summary							
	S	R-sq	R-sq(adj)		R-sq(pred)		
	15.7214	43.81%	35.17%		0.00%		
Means							
	Dumpsite	N	Mean	St. Dev	95% CI		
	Mehmood Booti Open Dump	5	15.68	8.75	0.49, 30.87		
	RHC Kharianwala	3	45.8	34.4	26.2, 65.4		
	Saggian Open Dump	8	12.74	8.79	0.73, 24.75		
<i>Pooled StDev = 15.7214</i>							

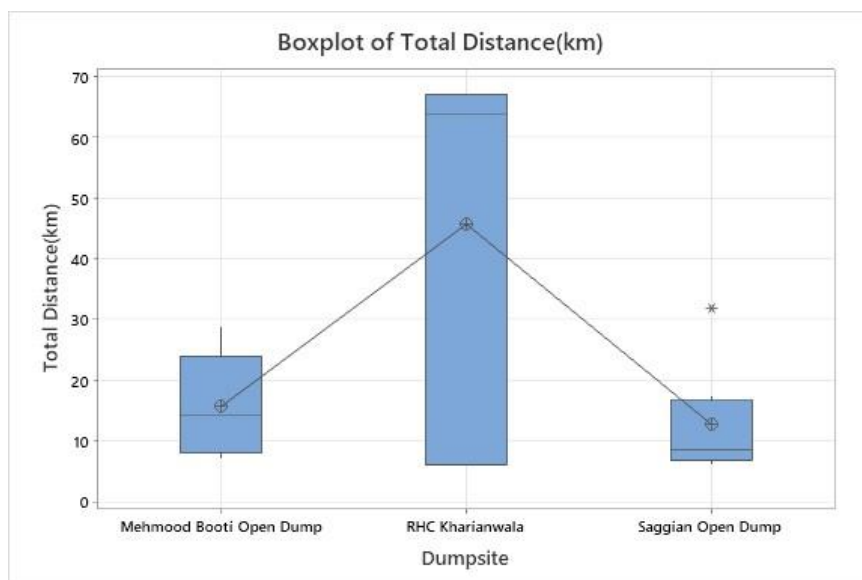


Figure 6: Showing Dump sites have lower mean distances

Table 3: ANOVA RESULTS

Method:					
Categorical predictor	(1, 0) coding				
Rows unused	4				
Regression Equation					
Total	= 15.68 + 0.0 Dumpsite_Mehmood Booti Open Dump + 30.1 Dumpsite_RHC				
Distance(km)	Kharianwala - 2.94 Dumpsite_Saggian Open Dump				
Coefficients					
Term	Coef	SE	Coef T-Value	P-Value	VIF
Constant	15.68		7.03	2.23	0.044
Dumpsite					
RHC Kharianwala	30.1		11.5	2.62	0.021 1.30
Saggian Open Dump	-2.94		8.96	-0.33	0.748 1.30
Model Summary					
S	R-sq	R-sq(adj)	R-sq(pred)		
15.7214	43.81%	35.17%	0.00%		
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	2	2505	1252.7	5.07	0.024
Dumpsite	2	2505	1252.7	5.07	0.024
Error	13	3213	247.2		
Total	15	5718			
Fits and Diagnostics for Unusual Observations					
Total					
Obs Distance(km)		Fit Resid		Std Resid	
12		6.08 45.76 -39.68		-3.09 R	
<i>R Large residual</i>					

The ANOVA results indicate a significant difference between the mean distances of at least one dumpsite compared to the others, so the null hypothesis is rejected. The RHC Kharianwala dumpsite seems to have a notably higher mean distance, while Mehmood Booti and Saggian Open Dump sites have lower mean distances, based on the provided data and analysis. Choice of dumpsite significantly affects the total distances (Figure 6).

4. Conclusion

In conclusion, the findings of this study underscore the critical importance of effective hospital waste management in protecting public health and the environment. The lack of adequate waste management facilities, coupled with insufficient awareness and training among healthcare and sanitary staff, poses a significant challenge to the safe disposal of medical waste. The integration of waste management specialists and environmental health experts within healthcare institutions is vital to enhance the efficiency of infection control measures. It is imperative that healthcare facilities establish clear strategies and procedures for the segregation, transportation, treatment, and disposal of medical waste, alongside regular training programs to enhance awareness and foster a culture of responsible waste management within the healthcare sector.

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