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Abstract

The improper disposal of solid waste, particularly in developing countries, poses significant threats to the natural environment and public health, leading to increased pollution and disease prevalence. Hospital-generated solid waste, characterized by its heightened toxicity and contagion potential, further exacerbates these risks when mismanaged. This study undertakes an evaluation of the solid waste management (SWM) practices implemented at Pakistan Institute of Medical Sciences (PIMS) Hospital in Islamabad, with a specific focus on assessing their impact on the staff responsible for SWM. The data collection process encompasses on-site visits to check and compare the hospital wastes' data available at hospital servers as well as by the structured questionnaires. According to the gathered data, PIMS Hospital generates an annual total of 61,030 kilograms of hazardous waste and 254,866.9 kilograms of non-hazardous waste. Given its status as the capital's healthcare facility, PIMS Hospital maintains a well-established and satisfactorily functioning standard of SWM system. This system includes the segregation of hazardous and non-hazardous waste at the point of generation, facilitated by a color-coded scheme. Non-hazardous waste is then transported to a secure covered storage site using specialized trolleys, while hazardous waste is safely disposed of through the utilization of on-site, double-chambered incinerators. Data analysis underscores the heightened occupational risks faced by SWM personnel, including an increased likelihood of sharp injuries, and disease exposure, as well as the prevalent experience of stress and anxiety. The study's findings necessitate the imperative adoption of standardized practices for the proper handling, treatment, and disposal of solid waste by the involved staff. Furthermore, a critical recommendation arises from the need for routine health monitoring of SWM workers by qualified medical professionals through established mechanisms to mitigate the potential transmission of diseases to their family members. Such measures are paramount in safeguarding the health and well-being of both the SWM staff and the broader community.

Keywords: Risk waste, Environment, Hospital waste, Solid waste management

1. Introduction

On a global scale, the insufficient and improper management of hospital waste is a pressing issue in numerous developing nations (Chartier, 2014). The consequences of mishandling such waste are substantial, with far-reaching implications for public health and the environment (Ali, Wang, & Chaudhry, 2016; Adeel, 2016; Chartier, 2014; Ross, 2011). Key factors contributing to the rising rate of hospital waste production include rapid population growth, an increasing number of healthcare facilities, widespread accessibility to healthcare services, and the extensive use of disposable medical products (Arab et al., 2008; Taghipour & Mosaferi, 2009). Globally, documented research in the field of medical waste management has consistently highlighted subpar practices in handling, treating, and disposing of biomedical waste across numerous healthcare institutions. Hospital waste comprises both high-risk waste and non-risk waste (Ali et al., 2016; Arab et al., 2008; Chartier, 2014; Organization, 2018; Ross, 2011; Taghipour & Mosaferi, 2009).

The World Health Organization (WHO) defines medical waste (health care or clinical waste) as, the type of waste that is generated by medical staff and carries vast varieties of materials from already utilized needles and syringes to un-cleaned medical kits, medical equipment, symptomatic samples, body organs, blood, and radioactive materials (WHO, 8 February, 2018). Medical waste is divided into two main categories, risk waste and non-risk waste. Infectious waste, pathological, pharmaceutical, sharps, chemicals, Geno-toxic, and radioactive wastes comprise risk waste while garbage and general day-to-day waste produced by foodstuff leftovers and their packaging constitute non-risk waste. Biomedical waste contains a small quantity of infectious waste but has a high potential to transmit diseases (Azam, Parveen, Singh, & Azam, 2020; Pal & Sarangi, 2018). Therefore, hospital waste additionally to the prospect for patients and workers associated with the management of wastes poses a significant threat to public health and also the majority components of the environment (Mathur, Patan, & Shobhawat, 2012). It is crucial to ensure the effective management of harmful medical wastes since they constitute a serious risk to human life, health, and the environment (Furtak-Niczyporuk, 2017). Solid waste management (SWM) is an art to minimize, identify, carve up, assemble, manage, transfer, store, treat, and then dispose the health-care waste according to the guidelines. One estimate shows that hospital waste threatens the lives by killing 5.2 million people (including 4 million children) every year from waste-related diseases (Amin, Gul, & Mehrab, 2013).

Management of solid waste is a prominent issue in developing countries. Due to limited data availability, unskilled labor, and a lack of SWM knowledge, strategic decisions about waste management in developing countries are typically based on assumptions rather than objective assessments (Alam et al., 2021). Pakistan as a developing country on the globe lacks the appropriate waste management and disposal systems which brings serious environmental and public health concerns. International Trade Administration mentioned that Pakistan lacks essential infrastructure regarding hospital waste management (Administration, 13 October, 2019). It is further stated that the medical waste produced in Pakistan either ends up in incinerators, landfills, and some other recycling spots or is generally recycled by scavengers despite reaching its definite disposal sites. Hospital waste management is one of the major environmental concerns in Pakistan, which may significantly increase the exposure of infectious pollutants (Anwar, Malik, & Asim, 2013). Moreover, WHO enlists the reasons for improper waste management in developing countries including Pakistan, insufficient knowledge about the health hazards

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related to health-care waste, unskilled and inexperienced waste management staff, poor waste management and disposal systems, inadequate human and financial support and the least preference to the subjects that are linked with clinical waste (WHO, 8 February, 2018). Although humanity has produced waste for ages, the volume of waste produced has dramatically increased with the fast expansion of civilization (Poluszyńska, 2020). Previous studies on hospital waste management are extremely rare compared to other environmental wastes in Pakistan (Ali et al., 2016). Whereas, the risk of disease transmission is substantially high due to poor hospital waste management practices. Due to high population growth in Pakistan, waste generation in hospitals is raised consequently increasing the risk of diseases.

Table 1: Related works, Methods, literary contributions and limitations

Source	Data and Methods	Literary Contributions	Limitations
(Mahmood et al., 2011)	-Standardized checklist was used for the collection of data regarding practices of waste management from nursing and sanitary staff. Uses descriptive cross-sectional survey	Government sector hospitals exhibited superior waste collection and transportation practices due to their more effective organizational structure, practices, and adequate funding.	Only 6 Wards in each hospital were randomly selected for observation and survey
(Amin et al., 2013)	Fifteen hospitals were randomly selected and the data from these hospitals was collected through questionnaire. Uses case study approach for Observational and cross-sectional data collection	Most hospitals in District Peshawar lack proper waste management plans except few	- Data reliability was not evaluated - Detail impacts on SWM staff not evaluated
(Ali et al., 2016)	Hospital's waste was quantified using a digital balance.	Waste generation rate identified	The study emphasized waste generation rate, overlooking staff training and awareness aspects. -Impacts on SWM staff not evaluated -Omitted issues associated with improper management of infectious medical waste
(Sobia et al., 2014)	Medical waste underwent a 7-day analysis following stratified random sampling of collected samples.	Characterized hospital waste and identified areas for improvement	- Did not address the impact on hospital employees
(Zeeshan et al., 2018)	- Data collection in Peshawar teaching hospitals via Questionnaires. -Fisher's exact and Wilcoxon rank-sum test were used for the comparison of public sector teaching hospitals and Private Sector Teaching hospitals	- Hospitals lacked proper waste management plans and procedures regardless of public or private setting teaching hospitals.	-Data reliability not assessed. -Impact of SWM staff was not evaluated
(Fatima & Asad, 2018)	- Interviews with Lahore hospital's staff to evaluate SWM process	- Gap between waste collection and hospital cleanliness due to un-trained staff and weak monitoring	-Respondents do not include paramedic and labors involved. -Impact on SWM staff was not evaluated.
(Ullah et al., 2011)	- Direct interviews from trainees -Uses 7-S Total Quality Management technique for outcome analysis after training	Significant improvement observed in waste management after staff training	Impact on SWM staff was not evaluated
(Kumar et al., 2015)	- Quasi-experimental pre and post technique applied to evaluate knowledge, attitude and practices in Rawalpindi hospitals	Findings, IHWM training could be a good way to improve health workers' knowledge, attitudes, and practices about infectious waste management	Impact on SWM staff was not evaluated.
(Janjua, 2003)	- Semi-structured interviews with general practitioners -Chi square test and the Fisher exact test were applied to compare the practices of city and village doctors Uses Site visits, Structure Questionnaire for SWM practices and detail assessment on Impact of SWM staff. In addition application of Statistical techniques for data reliability	- complete disregard for syringe disposal and waste management practices results in the spread of hepatitis in the waste management staff	-Only waste due to injections and other sharp material considered. - Detail impact on SWM staff was not evaluated.
This Study		SWM process is satisfactory However Spread of diseases is common due to improper use of PPE	Comparison with other hospitals in the vicinity

Several studies have investigated waste management practices in hospitals across Pakistan, with a focus on different regions. The study in (Mahmood, ud Din, Mohsin, & Javed, 2011) aims to raise awareness among sanitary staff about proper waste

segregation, collection, and transportation to protect both staff and the environment. They found that while waste segregation processes were similar in public and private hospitals, waste collection and transportation practices were better in government hospitals due to improved funding and structure. A study (Amin et al., 2013) in Peshawar revealed that many hospitals in the district did not have proper waste management plans in place, highlighting the need for better waste management strategies. The authors in (Ali et al., 2016) assessed waste management processes in the 12 district hospitals, in Gujranwala, Pakistan. They discovered significant waste generation, with pediatric and gynecology wards producing the most waste. The study pointed out poor waste segregation, storage, transportation, and disposal practices. The authors in (Sobia, Syeda, & Muhammad, 2014) conducted a study characterizing hospital waste in Lahore in 2014. They found that a significant portion of the waste was plastic, and infectious waste was not managed effectively, with ash from incineration often being disposed of improperly. The authors in (Zeeshan et al., 2018) investigated the enforcement of national hospital waste management rules in Peshawar. Their study revealed that many teaching hospitals did not have proper waste management plans, procedures, or training for staff, highlighting the need for stricter adherence to regulations. The authors in (Fatima & Asad, 2018), in their study at Lahore emphasized the gap between waste collection and hospital cleanliness due to untrained staff and weak monitoring. Proper budget allocation, management, supervision, and monitoring were suggested as solutions. The authors in (Ullah, Ahmed, Malik, & Khan, 2011) used the Total Quality Management (TQM) approach to improve waste management at Shalimar Hospital in Lahore. Their training program resulted in significant improvements in waste disposal strategies. A study carried out by (Kumar, Somrongsong, & Shaikh, 2015) in Rawalpindi on intensive healthcare waste management (IHWM) training found that IHWM training improved knowledge, attitudes, and practices among healthcare workers regarding infectious waste management, highlighting the importance of regular training programs. A brief summary of relevant works is presented in Table 1.

Compared to research addressing other forms of environmental waste in Pakistan, previous studies on hospital waste management are conspicuously scarce. Paradoxically, the suboptimal practices in hospital waste management carry a significantly heightened risk of disease transmission. This risk is exacerbated by the nation's burgeoning population, resulting in an elevated volume of waste generated within healthcare facilities, thereby intensifying the potential for disease transmission. The main goal of this paper is to address the necessity to adopt the standardized practices for the proper handling, treatment, and disposal of solid waste by the involved.

The novel contributions of this work are as follows:

- The present work is dedicated to the evaluation of both the quality and quantity of solid waste generated at PIMS Hospital, along with its implications for the hospital's waste management personnel. This investigation encompasses the comprehensive analysis of the processes involved in solid waste collection, transportation, storage, and disposal, with the primary objective of identifying any existing deficiencies.
- Additionally, the research seeks to shed light on the impact of these processes on the staff responsible for waste management through a structured series of inquiries. The research serves as a fundamental cornerstone for prospective studies into the deficiencies within hospital waste management systems, substantiated by a wealth of empirical data.
- Furthermore, it is essential to underscore the critical significance of effective waste management practices in the vicinity of healthcare facilities. This not only contributes to heightened public awareness regarding environmental preservation and the sustainable utilization of natural resources but also plays a pivotal role in curbing the transmission of diseases.
- The formal and methodical examination of these aspects stands to benefit both the healthcare community and the broader public, emphasizing the importance of this research endeavor.

The current study aims to evaluate the quality and quantity of solid waste at Pakistan Institute of Medical Sciences (PIMS) Hospital Islamabad, Pakistan and its impacts on Solid Waste Management (SWM) staff. It investigates the processes of collection, transportation, storage, and disposal of solid waste to identify any deficiencies. In addition, it explores the impacts on relevant staff through a series of questions. This study establishes a baseline for future research on hospital waste management deficiencies and their repercussions on waste management staff at a study location supported by significant data facts. It emphasizes the significance of proper waste management in the vicinity of hospitals for raising public awareness of environmental conservation, natural resource preservation, and the spread of diseases.

2. Methodology

2.1. Study Area

The present study was conducted in Islamabad, the capital city of Pakistan. Islamabad is situated at approximately 33° 40' N to 33° 44' N latitudes and 72° 47' E to 73° 11' E longitudes. This city covers an area of 906 square kilometers and is known for its significance as the political and administrative hub of the country. Islamabad's population, according to the 2017 census, is approximately 2 million, with an average annual population growth rate of 2.7%. PIMS Hospital, located in Islamabad, Pakistan, stands as a prominent healthcare institution within the nation's capital. Established to provide advanced medical services and education, PIMS Hospital is renowned for its state-of-the-art facilities and a dedicated team of healthcare professionals. The hospital offers a wide range of medical specialties, including surgery, internal medicine, pediatrics, and more, making it a vital healthcare resource for the region. PIMS Hospital plays a pivotal role in serving the healthcare needs of the residents of Islamabad and the surrounding areas, ensuring access to quality healthcare and contributing significantly to the well-being of the community.

2.2. Data Collection and Study Design

This study employs a mixed-methods approach, combining both qualitative and quantitative research methods to comprehensively investigate hospital waste management practices and evaluate their impacts on relevant management staff. In the first step, quantitative data were gathered from the specified hospitals through site visits following the receipt of requisite

permissions from the relevant authorities, namely the Capital Development Authority (CDA) and PIMS, Hospital Waste Management authorities as shown in Figure 1.



Figure 1: Data collection and study design

The research design for this study is shown in Figure 2. Multiple site visits have been conducted on a daily basis to quantify the generation of risk and no-risk waste/annum at each ward of the PIMS, hospital. The data of hospital wastes is transmitted to the cloud server to manage and control the risks involved in dumping the hospital wastes at secure sites using computers. Qualitative Data was collected through a structured questionnaire based on recommendations by the WHO for the evaluation of HWM in developing countries (Prüss-Üstün & Townend, 1999) and expert opinion via interviews. The appended supplementary material comprises a questionnaire encompassing a total of 29 inquiries categorized into four distinct domains, namely waste collection, storage, disposal, and impacts. These inquiries were disseminated among a diverse cohort of respondents, including personnel engaged in SWM, medical practitioners, and paramedics. The questionnaire was filled out on-site with the help of local authorities who are directly involved in the management of medical waste including administrative officers, facility managers, trash collectors, incinerator operators, and laborers. During site visits, a separate checklist was used to ensure the reliability of the information provided through visual observations.

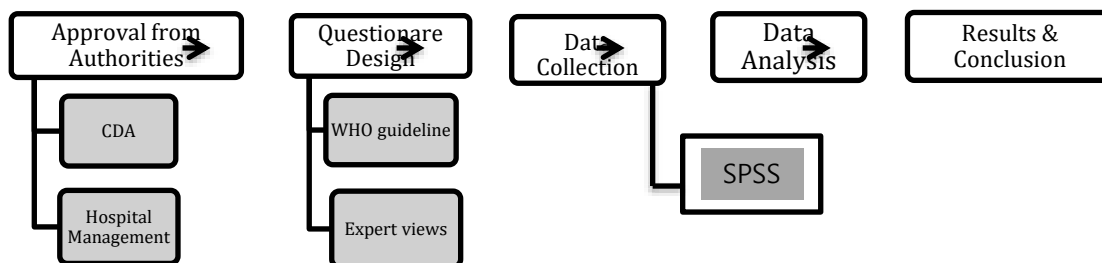


Figure 2: Methodology Flow Chart

Seventy copies of the questionnaire were distributed among SWM staff, doctors, and paramedic staff, out of which 45 were responded. Table 2 presents respondent categories, questionnaire distribution, and cumulative percentages, while Figure 3 visually represents the distribution of respondents across these categories using a pie chart.

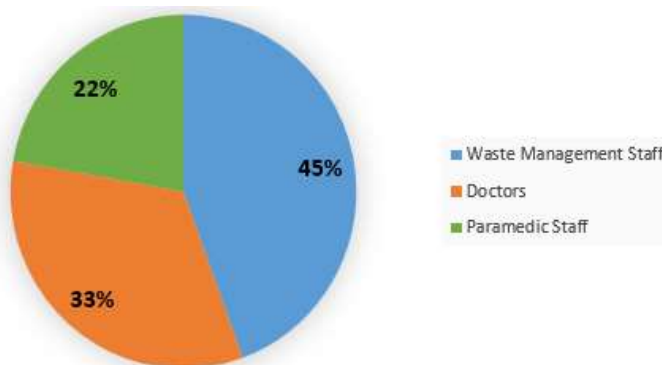


Figure 3: Categories of Respondents

Table 2: Grouping of Respondents

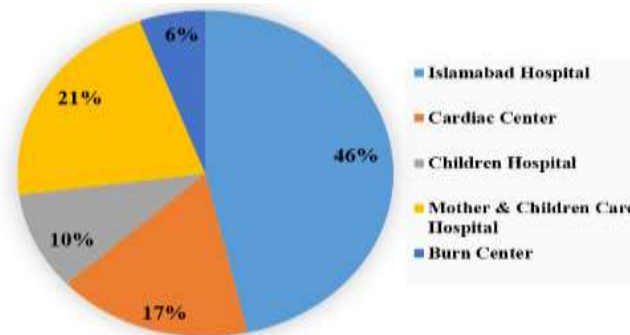
Respondents Type	No. of Questionnaires	Percentage	Cumulative Percentage
SWM staff	20	45	45
Doctors	15	33	78
Paramedic Staff	10	22	100
Total	45	100	100

The Statistical Packages for Social Sciences (SPSS) computer tool (Verma, 2012) was used to clean the data from outliers and improve its reliability by performing Cronbach's alpha test. It assesses the internal reliability of data, typically applied when the result is numeric, and the Cronbach's coefficient ranges between 0 and 1, with a higher value indicating greater data reliability. The Cronbach's alpha coefficient for the twenty-nine variables in our research stands at 0.881, indicating a robust level of internal consistency among the items. Correlation and Factor analysis tests were also performed using SPSS. A correlation test is used to assess any high and low correlation between two variables (0.9 or above). Computations indicate that none of the variables exhibit a high correlation, defined as 0.9 or greater. Consequently, no questions were deemed necessary for exclusion from the analysis. Factor Analysis using Kaiser-Meyer-Olkin (KMO) & Bartlett's Test was also performed to check the adequacy of the sample. The KMO and Bartlett's tests were applied to assess the sample adequacy for factor analysis, specifically with ten additional questions concerning the impact of SWM on individuals at PIMS Hospital, Islamabad. The obtained KMO value, which stands at 0.786, surpasses the threshold of 0.5, affirming the sufficiency of our sample for this analysis. The supplementary section of this article contains a comprehensive presentation of the data evaluation results obtained through the utilization of SPSS. Subsequently, the conclusive outcomes were subjected to rigorous analysis to derive pertinent conclusions and formulate recommendations of scholarly significance.

3. Results & Discussion

3.1. Quantity of Risk and Non-Risk Waste

The quantity of risk waste generated is contingent upon the number of beds and patient turnout in each ward. A comprehensive investigation conducted at PIMS, Islamabad Hospital revealed that the facility, housing a total of 668 beds, experience a daily patient influx ranging from 1400 to 1600, encompassing both OPD visitors and Accident and Emergency cases. Consequently, PIMS Hospital generates an annual amount of risk waste constituting approximately 46% of the total waste produced. Similarly, at the Mother & Children Care Center, comprising 140 beds, the risk waste generation accounts for 17% of the total waste output. In contrast, the Cardiac Center, housing 102 beds, generates 21% of the non-risk waste. Moreover, the Children's Hospital, with 254 beds, generates 10% of the risk waste, while the Burn Center, having 24 beds, contributes to 6% of the risk waste, as depicted in Figure 4.

**Figure 4: Total Risk Waste Generated Annually**

Islamabad Hospital, the largest ward at PIMS Hospital, encompasses various departments, including the OPD, Intensive Care Unit (ICU), Coronary Care Unit (CCU), Operation Theater (OT), and private wards. According to the findings of the study, Islamabad Hospital contributes significantly to the overall generation of non-risk waste, amounting to approximately 57% of the total, as illustrated in Figure 5. Moreover, the Children's Care Hospital generates 23% of the total annual non-risk waste, with an average daily patient turnout of 555. At the Mother & Children Care Hospital, which handles an average patient workload of 681 per day, 10% of the total non-risk waste is generated annually. Furthermore, the Cardiac Center contributes 8% of the total annual non-risk waste. Lastly, the Burn Center generates 2% of the total non-risk waste on an annual basis.

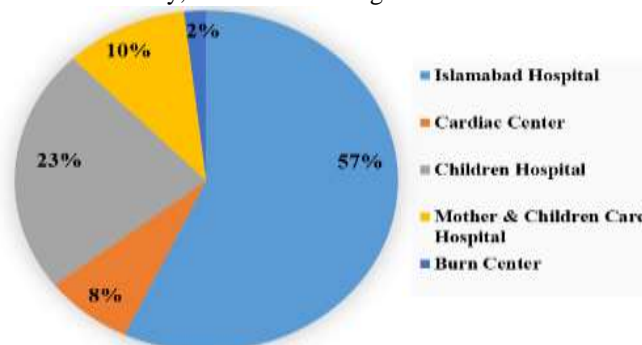
**Figure 5: Total Non-Risk Waste Generated Annually**

Table 3 presents the annual generation of both risk and non-risk waste per bed in each Ward/Unit of PIMS Hospital, Islamabad. Specifically, the data reveals that PIMS Islamabad Hospital generates 42.4 Kg/bed of risk waste and 217.6 kg/bed of non-risk waste. Similarly, the Cardiac Center produces 100.6 Kg/bed of risk waste and 187.3 Kg/bed of non-risk waste, while the Children's Hospital generates 23.4 Kg/bed of risk waste and 233.2 Kg/bed of non-risk waste. Additionally, at the Mother & Children Care Hospital, the figures stand at 93.1 Kg/bed of risk waste and 189.1 Kg/bed of non-risk waste, and at the Burn Center, the numbers are 145.3 Kg/bed of risk waste and 197.7 Kg/bed of non-risk waste, all on an annual basis.

Table 3: Risk and Non-Risk Waste at PIMS Hospital

S. No.	Unit	No of Beds	Risk Waste (Kg/Bed/Yr)	Non-Risk Waste (Kg/Bed/Yr)	Risk Waste (Kg/Yr)	Non-Risk Waste (Kg/Yr)
1	Islamabad Hospital	668	42.4	217.6	28323.2	145323.4
2	Cardiac Center	102	100.6	187.3	10256.1	19104.6
3	Children Hospital	254	23.4	233.2	5930.9	59220.1
4	Mother & Children Care Hospital	140	93.1	189.1	13034.0	26474.0
5	Burn Center	24	145.3	197.7	3486.0	4744.8
	Total	1188	404.7	1024.8	61030.2	254866.9

Furthermore, the table also depicts the annual generation of risk and non-risk waste per ward/unit. For instance, at Islamabad Hospital, the cumulative waste generation amounts to 28323.2 Kg of risk waste and 145323.4 kg of non-risk waste. At the Cardiac Center, the figures are 10256.1 Kg of risk waste and 19104.6 Kg of non-risk waste. Similarly, the Children's Hospital accounts for 5930.9 Kg of risk waste and 59220.1Kg of non-risk waste, while the Mother & Children Care Hospital generates 13034 Kg of risk waste and 26474 Kg of non-risk waste. Lastly, the Burn Center contributes 61030 Kg of risk waste and 4744.8 Kg of non-risk waste on an annual basis. The combined annual generation of risk waste and non-risk waste at PIMS Hospital, Islamabad amounts to 61030 Kg and 254866.9 Kg, respectively. These findings provide valuable insights into the waste management and disposal challenges faced by the hospital.

3.2. Evaluation of SWM Process at PIMS, Hospital

The present study includes site visits conducted at PIMS Hospital, Islamabad, to evaluate the hospital's SWM procedures. The investigation indicates that the hospital adheres to a generally satisfactory waste management protocol, comprising the following stages. Nevertheless, during the assessment, some deficiencies have been observed and documented.

3.2.1. Waste Generation

The waste generation process encompasses the production of waste across all wards/units of PIMS Hospital, Islamabad. An estimated amount of 300-450 kg per bed of risk waste and 1000-1550 kg of non-risk waste per bed is generated at PIMS, Hospital annually. The hospital comprises five distinct wards/units, each contributing to the overall waste generation. Firstly, Islamabad Hospital generates an average of 475.7 kg of solid waste per day. Secondly, the Cardiac Center produces approximately 80.4 kg of solid waste daily. Thirdly, the Children's Care Hospital accounts for an average of 178.4 kg of garbage generated per day. Fourthly, the Mother & Children Care Center contributes approximately 108.2 kg of waste daily. Additionally, the burn facility generates an average of 22.5 kg of solid waste per day. These figures provide crucial insights into the magnitude of waste production within the various units of PIMS Hospital, Islamabad.

3.2.2. Waste Collection & Segregation

In this context, the term "collection" pertains to the systematic gathering of waste materials from different wards within PIMS Hospital. A site examination was conducted, revealing the implementation of a waste collection system involving three distinct types of contrasting-colored containers, each possessing a capacity of 50 liters as shown in Figure 6. These containers are strategically placed at various locations, including the entrances to all wards, adjacent to doctors' offices, emergency rooms, operating rooms, and the Outdoor Patient Department (OPD).



Figure 6: Collection and segregation of waste at PIMS, Hospital

At PIMS Hospital, waste segregation is initiated at the point of generation, where designated containers lined with plastic bags are utilized. The waste segregation process is carried out based on color coding: yellow-colored containers are dedicated to the collection of Risk waste, blue-colored containers are designated for Non-Risk waste, and red-colored containers are specifically utilized for the collection of sharp waste as shown in Figure 7. This approach facilitates an organized and efficient waste management system within the hospital premises.



Figure 7: Transportation, Storage and Disposal at PIMS, Hospital at Islamabad

3.2.3. Waste Transportation, Storage and Disposal

Transportation in the context of waste management involves the conveyance of waste materials from their points of generation to designated locations for segregation and ultimate disposal. The study reveals that at PIMS Hospital, six four-wheeled carts are utilized for the transportation of waste to the storage and disposal site as shown in Figure 7. It is noteworthy that these carts are subjected to regular maintenance and cleaning to prevent waste spillage and potential injuries.

The establishment of a proper storage facility is imperative to ensure a secure waste management process, thereby preventing adverse impacts on the environment and natural habitats. Accordingly, at PIMS Hospital, the risk waste is stored in a covered area adjacent to the incineration facility as shown in Figure 7. Conversely, the non-risk waste is stored in an open space in the hospital's backyard until it is subsequently collected by the staff of the CDA.

Regarding disposal, the risk waste is appropriately handled within the prescribed time frame, utilizing a two-chambered Incinerator as shown in Figure 7. However, there are observed delays in the proper disposal of non-risk waste, primarily attributed to the involvement of other responsible departments. This situation raises concerns about potential environmental contamination and the transmission of diseases that may arise due to the untimely disposal of non-risk waste.

3.3. Impacts on SWM Staff members

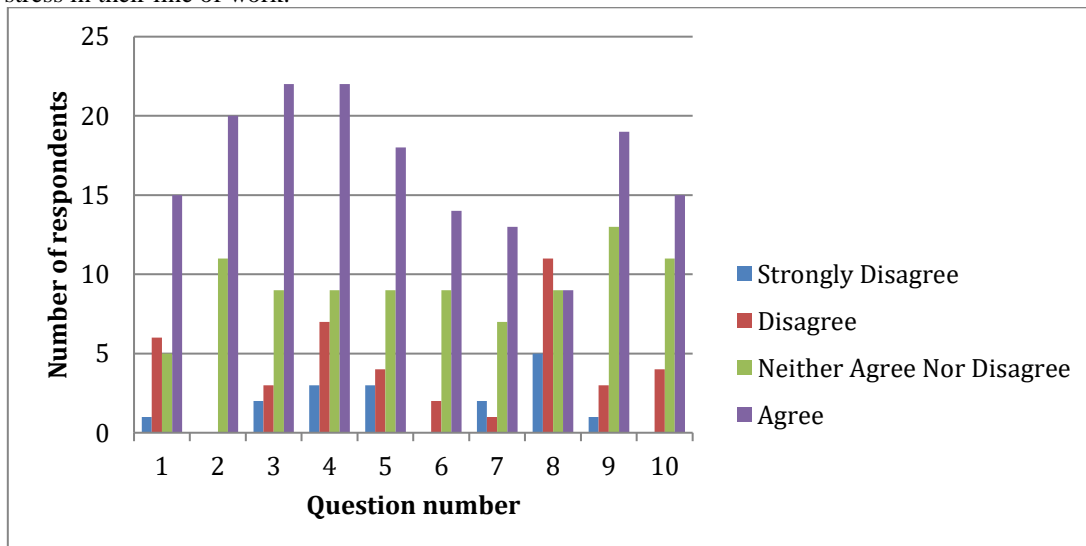
Results in Table 4 and Figure 8 indicate that among the total respondents, 33% agreed, and 40% strongly agreed that viral diseases are common among the SWM Staff at PIMS. Furthermore, 11% of respondents remained neutral, while approximately 14% disagreed with this statement. The staff reported encountering various viral infections, including Flu, Influenza, Measles, Hepatitis, and HIV/AIDS during their duty hours. In contrast, when asked about the prevalence of bacterial diseases such as Diphtheria, Tetanus, Typhoid, and Tuberculosis among the Waste Management Staff, about 44% of the respondents disagreed, 31% strongly disagreed, and 24% remained neutral. This indicates that the incidence of viral diseases among the working staff is higher compared to bacterial diseases.

Regarding the transfer of diseases from the SWM Staff to their families, 49% of the respondents agreed, 20% strongly agreed, and 20% remained neutral, while about 7% disagreed. This suggests that the families of the staff are at a higher risk of contracting viral infections. Moreover, 49% of the respondents agreed, 9% strongly agreed, and 20% remained neutral, while 16% disagreed, and 7% strongly disagreed that there is a high death rate due to infectious diseases among SWM Staff compared to other professionals. This highlights the heightened risk faced by these staff members due to their direct contact with infectious waste and contaminated sharps, which pose a threat to their lives. Concerning psychological well-being, approximately 40% of the respondents agreed, 24% strongly agreed, 20% remained neutral, 9% disagreed, and 7% strongly disagreed that SWM Staff suffers from negative psychological problems. These problems include sleep disorders, anxiety, and fatigue, affecting their social life.

Table 4: Impacts of SWM on Staff

S. No.	Description	Linguistic Description Frequencies				
		Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	Viral diseases (Hepatitis, HIV/AIDS, Mumps, Flu, and Influenza) are more common among the waste management staff.	1	6	5	15	18
2	Bacterial diseases (typhoid, tuberculosis, tetanus, diphtheria) are more common among waste management staff.	0	0	11	20	14
3	The transmission of disease to the family members of SWM Staff is possible in rare cases.	2	3	9	22	9
4	The death ratio of waste management staff is higher.	3	7	9	22	4
5	SWM has negative psychological effects on Working staff.	3	4	9	18	11
6	SWM staff gets needle sticks/sharp injuries during segregation and handling Wastes.	0	2	9	14	20
7	SWM staff is at great risk of contracting corona.	2	1	7	13	22
8	The salary of SWM staff easily fulfills their basic needs.	5	11	9	9	11
9	The workers of SWM spend less time with family on a daily basis.	1	3	13	19	9
10	Excessive working hours cause fatigue, stress, and anxiety among SWM staff.	0	4	11	15	15

Furthermore, approximately 44% of the respondents agreed, 31% strongly agreed, 20% remained neutral, and 4% disagreed that solid waste management staff is susceptible to needle and sharp injuries. The improper use of personal protective equipment (PPE) was identified as the reason behind these injuries, emphasizing the importance of making PPE mandatory for workers handling waste. Additionally, about 29% of the respondents agreed, 49% strongly agreed, 16% remained neutral, and approximately 5% disagreed that Waste Management Staff is at a high risk of contracting COVID-19. Many working staff members reported contracting the virus during their working hours, with some experiencing repeated infections. Regarding the salary and fulfillment of basic needs, it was observed that the salary of most SWM Staff at PIMS is insufficient to meet their needs. Approximately 24% of the respondents agreed, 24% strongly agreed, 20% remained neutral, 24% disagreed, and 11% strongly disagreed that their salary adequately fulfills their basic needs. Moreover, about 42% of the respondents agreed, 20% strongly agreed, 29% remained neutral, and 7% disagreed that the SWM staff works under a tough timing schedule, with their duties being more demanding compared to other professionals. Lastly, concerning anxiety and stress, approximately 33% of the respondents agreed, 33% strongly agreed, 24% remained neutral, and 9% disagreed that SWM Staff frequently experiences anxiety and stress in their line of work.

**Figure 8: Responses for SWM Impacts**

The results obtained on waste management practices and the working conditions of the SWM staff at PIMS Hospital, Islamabad, reveal several noteworthy findings. Viral diseases are common among the staff, with a significant percentage of respondents agreeing or strongly agreeing with this observation. The working staff reported encountering various viral infections, including Flu, Influenza, Measles, Hepatitis, and HIV/AIDS during their duty hours. This highlights the need for comprehensive preventive measures and proper training to mitigate the risks associated with viral diseases. On the other hand, respondents were less inclined to associate bacterial diseases like Diphtheria, Tetanus, Typhoid, and Tuberculosis with the

SWM staff, suggesting that the incidence of viral diseases is relatively higher. This finding emphasizes the importance of focusing on infection control measures to protect the staff from potential viral infections. The results also indicate that the staff's families are at risk of contracting viral infections due to the nature of their work and the potential for disease transmission. This underscores the need for heightened awareness and precautions to safeguard the health of staff members' families. The study reveals that SWM staff is at high risk of needle and sharp injuries, which can lead to various infections. The improper use of PPE is identified as a contributing factor to such injuries, highlighting the necessity of enforcing strict compliance with PPE protocols to reduce occupational hazards. Moreover, the working staff reported facing negative psychological issues such as sleep disorders, anxiety, and fatigue, which can significantly impact their well-being and social life. Addressing these psychological challenges is essential for ensuring a healthy and motivated workforce.

The findings also shed light on the inadequate salary of many SWM staff members at PIMS Hospital, which leaves them struggling to meet their basic needs. This underscores the importance of fair compensation and improved working conditions for the staff to ensure their well-being and job satisfaction. Ultimately, this constrains the ability to embrace appropriate therapeutic alternatives for their ailments, which on occasion encompass notably substantial costs. In addition, the study reveals that the working hours and duties of the SWM staff are demanding and challenging compared to other professionals. This highlights the need for support and recognition of their efforts to maintain an efficient waste management system. Lastly, the ongoing COVID-19 pandemic has further amplified the risks faced by the staff, with a considerable percentage reporting contracting the virus during their working hours. This emphasizes the critical role of providing proper protective measures and continuous monitoring to protect the staff from infectious diseases.

The results highlight both the strengths and areas for improvement in waste management practices and working conditions for the SWM staff at PIMS Hospital, Islamabad. Addressing the identified issues, such as viral infection risks, needle injuries, psychological well-being, fair compensation, and improved safety measures, will contribute to creating a safer and healthier working environment for the staff and enhance the overall efficiency of waste management at the hospital. These findings can serve as a foundation for developing targeted interventions and policies aimed at ensuring a sustainable and effective waste management system in healthcare settings.

4. Conclusion

In conclusion, this comprehensive research has provided valuable insights into waste management practices and working conditions for the SWM staff at PIMS Hospital, Islamabad. The results have highlighted both the strengths and areas that require attention in the hospital's waste management system. According to results, PIMS Hospital produces 61030 kg of risk waste and 254866.9 kg of non-risk waste per year. The findings of this study highlight the satisfactory waste management practices adopted at PIMS Hospital, Islamabad, and particularly concerning risk waste. The implementation of color-coded containers, segregation at the point of generation, and the utilization of well-maintained transportation carts contribute to an efficient waste management system. However, the delays in non-risk waste disposal require urgent attention to prevent adverse environmental impacts and health hazards. To ensure a sustainable waste management approach in hospital settings, collaborative efforts between relevant departments and regular monitoring of waste disposal processes are essential. Further research and improvements in waste management protocols can significantly contribute to maintaining a safe and eco-friendly hospital environment.

The findings revealed that viral diseases are common among the staff, with a significant proportion of respondents reporting encountering various viral infections during their duty hours. This underscores the need for stringent infection control measures, proper training, and adequate PPE to mitigate the risks associated with viral infections. While bacterial diseases were not strongly associated with the SWM staff, it is essential to maintain vigilance and preventive measures to safeguard against potential outbreaks. The management should focus on promoting proper waste handling practices and safety protocols to minimize the risk of bacterial infections. The study also shed light on the impact of the SWM staff's work on their families, with a considerable percentage reporting concerns about disease transmission. Thus, comprehensive awareness campaigns and health education initiatives are warranted to ensure that staff members take appropriate precautions to protect their families' health. Moreover, the results highlighted the prevalence of needle and sharp injuries among the staff, primarily attributed to improper use of PPE. The hospital administration must enforce strict compliance with PPE protocols and implement adequate safety measures to reduce occupational hazards. Psychological well-being emerged as a significant concern, with respondents reporting negative psychological effects, including sleep disorders, anxiety, and fatigue. Addressing these mental health challenges through counseling and support programs will contribute to a healthier and more motivated workforce. Furthermore, the demanding working hours and duties of the SWM staff compared to other professionals underscore the importance of acknowledging their efforts and providing necessary support to optimize their efficiency and effectiveness. Lastly, COVID-19 pandemic has heightened the risks faced by the staff, with a notable percentage reporting contracting the virus during their working hours. Therefore, maintaining strict adherence to infection prevention and control measures and ensuring access to vaccination and regular health check-ups are crucial for safeguarding the health of the staff.

Overall, the study's findings serve as a foundation for developing targeted interventions and policies to enhance waste management practices and the working conditions of the SWM staff at PIMS Hospital, Islamabad. By addressing the identified challenges and building upon the existing strengths, the hospital can establish a sustainable and effective waste management system that prioritizes the health and well-being of both the staff and the community it serves.

5. Future Work and Recommendations

To ensure the effectiveness of the SWM process, adherence to the following measures is imperative. The waste management staff must strictly comply with the guidelines issued by the government, leaving no room for violation of rules under any circumstances. Paramount consideration should be given to the health and well-being of the sanitary staff, for which the provision of necessary equipment, such as glasses, gloves, rubber boots, and masks, is essential to mitigate the risk of injuries. Hospitals should prioritize the recruitment of highly trained sanitary staff, equipped to handle various waste management situations competently. To facilitate their work, an ample supply of high-quality containers should be made available, ensuring

the convenience and efficacy of waste disposal. The designated waste storage areas must be carefully chosen to guarantee smooth segregation without encountering any hindrances. Additionally, these areas should be free from the presence of insects, worms, ants, birds, bats, or any other organisms that may compromise the waste management process. Furthermore, the disposal of waste in landfill sites should be restricted to only the concerned waste management agency, with access denied to other living organisms, including humans and animals. The significance of prioritizing the health of the sanitary staff cannot be overstated, and therefore, adequate PPE, such as glasses, gloves, rubber boots, and masks, must be consistently provided to minimize potential health hazards and accidents. As a result, it is imperative to implement regular health check-ups for the SWM staff, administered by qualified medical professionals under hospital supervision. This proactive approach aims to mitigate the risk of life-threatening illnesses and alleviate any cascading effects that may impact their family members. We emphasize that rigorous adherence to government guidelines, prioritization of the sanitary staff's health, provision of necessary equipment, optimal waste container management, strategic waste disposal sites, and regular health check-ups are pivotal steps toward enhancing the efficacy of the SWM process and safeguarding the well-being of the personnel involved.

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