

DEVELOPMENT OF WASTE MANAGEMENT PLAN TO REDUCE  
OPERATIONAL COSTS ASSOCIATED WITH INFECTIOUS  
HEALTHCARE WASTE MANAGEMENT



By

Kaenat Nasir

(Registration No: 00000400814)

NUST Business School

Department of Executive Masters in Business Administration

National University of Sciences & Technology (NUST)

Islamabad, Pakistan

(2024)

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Kaenat Nasir

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A thesis submitted to the National University of Sciences and Technology, Islamabad,

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Supervisor: Ms. Kishwar Sameen Gulzar.

Nust Business School

National University of Sciences & Technology (NUST)

Islamabad, Pakistan

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## BUSINESS PROJECT ACCEPTANCE CERTIFICATE

It is Certified that final copy of EMBA Business Project written by Kaenat Nasir Registration No. 400814 of EMBA 2K22 has been vetted by undersigned, found complete in all aspects as per NUST Statutes/Regulations/MS Policy, is free of errors, and mistakes and is accepted as fulfillment for award of EMBA degree. It is further certified that necessary amendments as pointed out by GEC members of the scholar have also been incorporated in the said business project.

Signature of Supervisor with stamp: Ms. Kishwar Sameen Gulzar

Date: \_\_\_\_\_

DR. M FAWAD KHAN  
Assistant Professor  
Program Head (EMBA)  
NUST Business School, Islamabad

Programme Head Signature with stamp: Dr. Muhammad Fawad Khan

Date: \_\_\_\_\_

Signature of HoD with stamp: Dr. Asfia Obaid

Date: 13/11/25

DR ASFIA OBAID  
Professor  
HoD Management & HR  
NUST Business School, (NBS)

Countersign by

Signature (Dean/Principal): \_\_\_\_\_

Date: \_\_\_\_\_

Principal & Dean  
Dr. Naukhez Sarwar  
NUST Business School

## **AUTHOR'S DECLARATION**

I, Kaenat Nasir, hereby state that my EMBA Business Project titled “Development of waste management plan to reduce operational costs associated with infectious healthcare waste management” is my own work and has not been submitted previously by me for taking any degree from National University of Sciences and Technology, Islamabad or anywhere else in the country/ world.

At any time if my statement is found to be incorrect even after I graduate, the university has the right to withdraw my EMBA degree.

Name of Student: Kaenat Nasir

Date: 30.04.2024

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## ABSTRACT

In the face of escalating healthcare costs and the imperative for sustainable operations, this project proposes the implementation of a comprehensive waste management plan tailored for hospital settings to significantly cut operational expenses. The primary objective of this initiative is to streamline waste segregation, reduce waste volume, and enhance recycling processes, thereby lowering disposal costs and minimizing environmental impact.

The methodology encompasses a detailed analysis of current waste management practices at a mid-sized tertiary care hospital, identifying major areas of inefficiency pertaining to waste management. This includes categorization of waste types (hazardous, non-hazardous, and recyclable) and an assessment of the existing disposal processes. Subsequently, a customized waste management plan is devised, incorporating advanced segregation techniques. Training programs for staff on best practices in waste handling and compliance are integral components of the strategy.

Projected outcomes include a reduction in overall waste management costs and a decrease in hazardous waste production through improved segregation accuracy. These results not only signify substantial cost savings but also contribute to the hospital's environmental stewardship.

The findings of this project are expected to offer valuable insights into how hospitals can implement effective waste management strategies to both reduce operational costs and promote sustainability. This aligns with broader health sector goals of enhancing efficiency and environmental responsibility. The scalability of this plan suggests that similar strategies could be beneficial across various healthcare facilities, advocating a shift towards greener and more cost-effective operations in the healthcare industry

## Introduction

Isn't it ironic that hospitals and healthcare delivery systems that are meant to cure people of illnesses and safeguard their health, themselves can become a source of spreading infections? As per UN Basel Conventions, healthcare waste is considered to be the second only to the nuclear waste in terms of the danger and threat it poses to the environment and the humanity. The waste from the healthcare setups, if not managed properly, can pose serious harm to the health and well-being of people. Health care waste constitutes the waste generated from clinics, laboratories, hospitals, research facilities, and other healthcare establishments. Not only this but the waste generated from activities like dialysis, intravenous infusions, catheterizations, insulin injection etc are also considered to be healthcare waste. As per WHO statistics, out of the total waste generated in a healthcare facility about 85% is non-hazardous, non-infectious or general waste while only 15% is hazardous, infectious and clinical waste. The composition of this infectious waste ranges from sharps, pharmaceuticals and cytotoxic waste to pathological and radioactive waste. The exposure to this infectious waste can put the population at risk of various acute and chronic infectious diseases including hepatitis A, B, C, D and HIV. In addition to that, various respiratory, gastro enteric and skin infections may also be caused due to exposure to this hazardous waste.

Financial constraints present significant operational challenges for hospitals in effectively managing their waste. These constraints stem from various factors that limit the availability of funds for waste management initiatives. Hospitals often operate within tight budgetary constraints, allocating funds to essential healthcare services such as patient care, medical equipment, and staff salaries. As waste management is not typically considered a revenue-generating activity, it may receive lower priority in budget allocations.

Moreover, Compliance with waste management regulations and standards entails significant costs, including investments in infrastructure, equipment, training programs, and disposal methods. Hospitals may struggle to allocate sufficient funds to meet regulatory requirements, especially in regions where regulations are stringent or evolving. Establishing and maintaining infrastructure for waste segregation, storage, and disposal requires substantial capital investment. This includes construction of dedicated waste storage areas, installation of waste treatment technologies such as autoclaves or incinerators, and implementation of waste segregation systems. Hospitals operating on limited budgets may face challenges in funding these infrastructure projects. In addition to



capital investments, ongoing operational expenses including waste collection, waste transportation, and waste disposal also contribute towards financial burden of waste management. Costs associated with hiring waste management personnel, purchasing protective equipment, and maintaining waste handling equipment further strain hospital budgets. Hospitals must prioritize competing demands for limited resources, balancing the need for waste management initiatives with other critical healthcare priorities. Decisions regarding resource allocation may prioritize immediate patient care needs over long-term investments in waste management infrastructure and practices.

Not only this but economic fluctuations and uncertainties can impact hospital budgets, affecting their ability to allocate funds to waste management initiatives. Economic downturns, funding cuts, or changes in reimbursement rates may further exacerbate financial constraints, limiting hospitals' capacity to invest in waste management improvements. In summary, financial constraints present significant operational challenges for hospitals in effectively managing their waste. Limited budgets, high compliance costs, infrastructure investments, operational expenses, competition for resources, and economic uncertainties all contribute to the financial burden of waste management.

In addition to that, disparities in resource allocation between rural and urban facilities, as well as among various healthcare facilities, contribute to inequities in waste management practices. Hospitals located in urban centers or well-resourced institutions often enjoy better access to infrastructure and resources for waste management compared to their counterparts in rural or underserved areas. Such disparities not only undermine efforts to ensure public health and environmental sustainability but also exacerbate existing inequalities in healthcare service delivery.

The current business project focuses on conducting a comprehensive case study of Kulsum International Hospital, a tertiary care facility in Islamabad, with the primary objective of assessing its existing healthcare waste management practices. The project aims to delve into the intricacies of waste management within the hospital premises, particularly focusing on the management of infectious healthcare waste. By closely examining current practices, the project seeks to identify areas for improvement and inefficiencies that contribute to operational costs. The ultimate goal is to develop a customized waste management plan tailored to the specific needs of Kulsum International Hospital, with a focus on reducing costs associated with infectious waste

management. Moreover, the project endeavors to instigate a cultural shift within the hospital environment through the design and implementation of a comprehensive training plan. This plan aims to empower staff members with the knowledge and skills necessary to minimize waste generation at the source, thereby addressing the root cause of waste management challenges and fostering a sustainable approach to healthcare waste management.

## Literature Review

In a global context, the improper and inefficient management of healthcare waste poses a significant challenge, particularly in developing nations. The ramifications of mismanaged healthcare waste are profound, affecting both public health and the environment substantially. Key factors contributing to the rise in healthcare waste include population growth, an increase in healthcare infrastructure, greater accessibility to medical services, and the widespread use of disposable medical products. Research published on a global scale highlights widespread deficiencies in the handling, treatment, and disposal of biomedical waste across numerous healthcare settings. Both small and large quantities of hospital waste bear a significant risk of causing infections and injuries. There is a substantial risk of transmission of blood-borne diseases such as AIDS, hepatitis B, hepatitis C, and tuberculosis to housekeeping sanitation workers due to poor waste management practices of clinical staff. In several low- and middle-income countries, healthcare and municipal waste are often processed together, exposing workers and the public to severe health hazards. A WHO survey from 2005 in 22 developing countries, including Pakistan, found that 18-64% of the waste disposal techniques used were inadequate. Studies specific to Pakistan report that approximately 2 kg of waste per bed per day is produced, of which 0.1-0.5 kg is considered hazardous, with mismanagement occurring at every stage from segregation to disposal.

Healthcare Waste encompasses all refuse created by hospitals, private clinics, other medical facilities, diagnostic centers, research institutions, and dental offices. Managing healthcare is critical for environmental and public safety due to its potentially infectious or toxic nature. Healthcare waste is generally categorized into two types: general or non-infectious waste, which accounts for 80% of total healthcare waste, and infectious healthcare waste, which makes up the remaining 20%. Infectious healthcare waste suspected of containing pathogens in sufficient amounts to cause disease, is thus a critical environmental concern. Poor management of infectious

healthcare waste can lead to severe human harm through sharp object injuries, infectious diseases transmission, environmental degradation, and groundwater contamination.

Healthcare waste management reflects the quality of care a hospital can provide. Especially in developing nations, hospitals struggle with effectively monitoring healthcare waste due to improper waste sorting or the unsafe disposal of untreated infectious healthcare waste with municipal trash, leading to serious environmental and health risks. Effective healthcare waste management requires precise source-separation of hazardous materials and their categorization into infectious or toxic subcategories. Common issues include misplacement of infectious healthcare waste into non-hazardous streams, which can spread infections, and the incorrect sorting of non-contaminated waste into hazardous categories, unnecessarily increasing infectious healthcare waste volumes and disposal costs.

Globally, 10-25% of healthcare is deemed infectious. In developing countries, the proportion of infectious healthcare waste in the total waste stream can be as high as 63%, compared to 51% in industrialized nations. Effective sorting practices can significantly reduce these percentages. The volume of healthcare waste generated varies by the type and size of the medical facility and is also influenced by a country's economic status. Developed nations typically produce more medical waste due to better-funded health systems. For example, healthcare waste production in a hospital from a developed country can be up to 200 times greater than in a developing nation.

Healthcare waste generation rates are an essential metric for assessing waste management efficacy. Numerous studies have documented these rates across different countries. For example, large hospitals in Korea have reported infectious healthcare waste generation rates ranging from 0.14 to 0.49 kg per bed per day, assuming full bed occupancy. In contrast, the average rate in Bangladesh is about 0.25 kg per bed per day, with varying rates observed in other countries such as Iran, Greece, Taiwan, the Philippines, and Portugal. According to a 2011 WHO report, regions like East Asia, Eastern Europe, and the Middle East generate between 1.3 to 3 kg of infectious healthcare waste per bed per day.

# THE ORGANIZATION, TRENDS AND PRACTICES

## Kulsum International Hospital

Kulsum International Hospital stands as a prominent healthcare institution in Islamabad, operating with a capacity of 100 beds and catering to a diverse range of medical needs. Since its inception in 2010 as a specialized cardiac care center, the hospital has evolved into a comprehensive tertiary care facility, offering a wide spectrum of medical services. From general surgeries to intricate neurosurgeries, orthopedics, gynecology, and obstetrics, Kulsum International Hospital ensures a holistic approach to patient care. Renowned for its commitment to excellence, the hospital maintains exceptionally high-quality standards and boasts an impressive success rate in surgical procedures. Over the years, it has experienced remarkable growth, expanding from 20 beds to its current capacity of 100 beds. Despite being housed within the existing structure of Kulsum Plaza, the hospital has overcome logistical challenges through innovative retrofitting and makeshift arrangements to comply with regulatory standards and streamline operations in alignment with recommended guidelines.

Situated in the heart of Islamabad, Kulsum International Hospital enjoys a strategic location and attracts a steady flow of patients seeking advanced medical care. The hospital's reputation for excellence is further enhanced by its ISO certification and multiple national and international accreditations, reflecting its unwavering commitment to quality and patient safety. Boasting a dynamic environment with active outpatient, inpatient, and emergency departments operating round the clock, Kulsum International Hospital continues to serve as a beacon of healthcare excellence in the region. The presence of highly sought-after consultants and specialists further reinforces its position as a premier healthcare destination, offering top-tier medical expertise across various disciplines. Despite its retrofitting challenges, the hospital remains dedicated to providing superior healthcare services while adapting to evolving industry standards and best practices.

## Waste collection and disposal practices

At Kulsum International Hospital, waste collection and disposal practices are meticulously organized to ensure the safe and efficient management of both infectious and non-infectious healthcare waste. Given the hospital's division into three primary clinical sections – Outpatient Department (OPD), Inpatient Department (IPD), and Emergency Room (ER) – waste generation

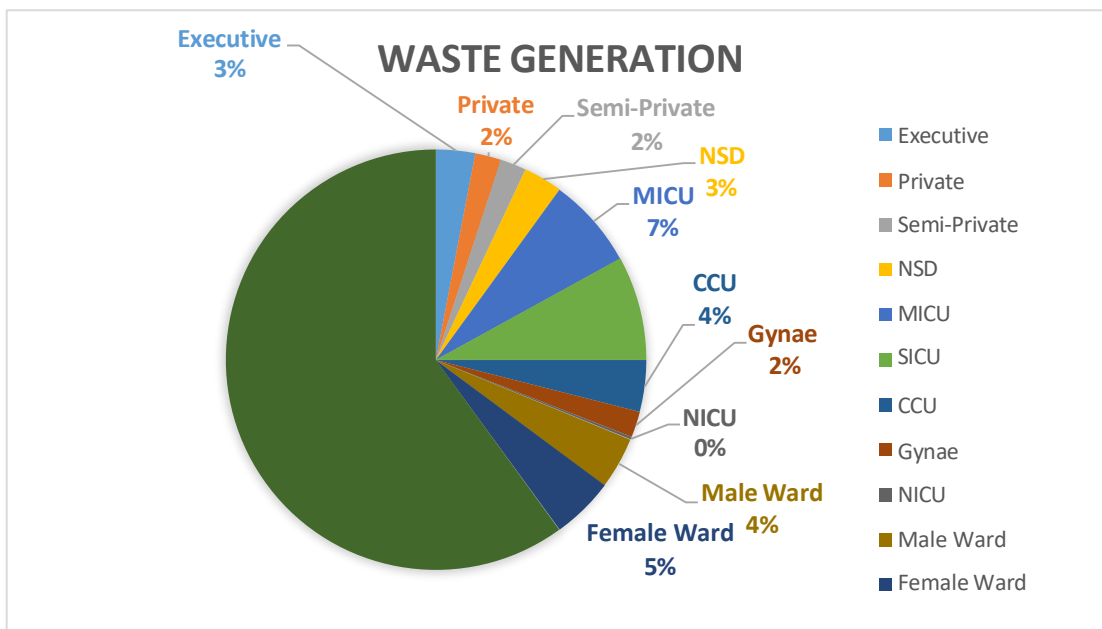
varies across these areas. However, the bulk of infectious healthcare waste is generated within the IPD, which comprises 11 units, including private wings, semi-private wings, executive wings, specialized units like NICU, MICU, SICU, NSD, CCU, Gynae wing, Male General Ward, and Female General Ward. Additionally, the hospital operates six fully functional operation theaters where major surgeries are conducted round the clock.

To manage the diverse streams of waste generated across these units, a dedicated housekeeping team oversees the periodic collection of waste. Non-infectious waste, typically generated in areas like OPD and administrative sections, is collected in white liners or waste bags, while infectious waste from IPD and operation theaters is collected in yellow liners. Each type of waste is segregated and collected in separate waste trolleys stationed across the hospital units, ensuring proper segregation from the point of generation. These waste trolleys are then transported to the central waste collection site within the facility.

At the central waste collection site, separate dumping sites are designated and marked for both non-infectious and infectious waste. Specialized waste boxes equipped with air conditioning systems are used to store the collected waste, maintaining optimal temperature conditions. Non-infectious waste is ultimately disposed of through municipal waste collection channels, while infectious waste undergoes a more stringent disposal process. An Environment Protection Agency (EPA) approved waste management company is tasked with collecting and transporting infectious waste for safe disposal and incineration. Before handing over to the waste management personnel, the non-infectious waste is meticulously weighed to ensure accurate record-keeping and proper disposal procedures. This systematic approach to waste collection and disposal at Kulsum International Hospital reflects the institution's commitment to maintaining high standards of cleanliness, safety, and environmental responsibility.

### Infectious Waste Generation Trends and Associated Operational Costs

The distribution of waste generation within Kulsum International Hospital underscores the significant impact of operation theaters on overall waste production. With a staggering 60% of the total waste emanating from these facilities, their pivotal role in waste management becomes evident. Moreover, the correlation between the weightier surgical procedures conducted in operation theaters and the corresponding increase in waste output highlights the need for tailored waste management strategies in these areas. Following closely behind, the Surgical Intensive Care Unit (SICU) and Medical Intensive Care Unit (MICU) contribute 8% and 7% of the



hospital's waste, respectively, reflecting their substantial patient turnover and critical care activities. Conversely, units like the Neonatal Intensive Care Unit (NICU) exhibit lower waste generation rates, attributed to their specialized nature, fewer patient turnovers, and consequently, reduced waste output per patient.

### Waste Collection and Operational Costs

The data presented in the table detailing waste generation at Kulsum International Hospital during the period from January to February 2023 underscores several key trends in healthcare waste management. A direct correlation is observed between the number of procedures performed in operation theaters and the volume of waste generated by the hospital, with an average waste generation of 2.38 kg per bed per procedure. This highlights the significant impact of surgical activities on overall waste production within the hospital, emphasizing the need for targeted waste

reduction strategies in these high-impact areas. Furthermore, the data indicates that the length of patient stay also plays a crucial role in waste generation, with longer stays correlating with higher rates of infectious waste generation. This relationship underscores the importance of proactive measures to mitigate complications and streamline patient care processes to reduce waste output. With an average waste generation of 2.72 kg per bed per day, the data underscores the ongoing challenge faced by Kulsum International Hospital in managing healthcare waste effectively while maintaining high standards of patient care and safety.

Month	OT Procedures	Bed days	Weight in Kg	Weight in Kg/bed day	Weight in Kg/ Bed and procedures	Rate per Kg	Transport Rate per Day (Rs.)	Amount in Rupees
Jan-23	315	2204	6183	2.81	2.45	47	750	290601
Feb-23	279	1902	5442	2.86	2.50	47	750	255774
Mar-23	311	2086	5450	2.61	2.27	47	750	256150
Apr-23	222	1603	3646	2.27	2.00	47	750	171362
May-23	326	2169	6046	2.79	2.42	47	750	284162
Jun-23	288	1981	5473	2.76	2.41	47	750	257231
Jul-23	279	2006	5511	2.75	2.41	47	750	259017
Aug-23	328	2176	6389	2.94	2.55	47	750	300283
Sep-23	316	2155	5989	2.78	2.42	47	750	281483
Oct-23	312	2045	5450	2.67	2.31	47	750	256150
Nov-23	322	2043	5532	2.71	2.34	47	750	260004
Dec-23	290	2182	5963	2.73	2.41	47	750	280261

## DELIVERABLE # 1: WASTE MANAGEMENT PLAN

Understanding the varying degrees of waste generation across different units within the hospital is crucial for devising targeted waste management initiatives. While operation theaters remain the primary contributors to waste production, optimizing waste reduction strategies in high-impact areas like SICU and MICU can further enhance overall efficiency and sustainability. By recognizing the unique waste dynamics of each unit, Kulsum International Hospital can implement tailored interventions to minimize waste generation, promote responsible resource utilization, and advance its commitment to environmental stewardship and patient care excellence.

### Formation of Waste Management Plan

The Waste Management Plan is a comprehensive document prepared by the Waste Management Officer for approval by the Waste Management Team. It serves as a roadmap for managing hospital waste in accordance with the established rules and regulations. The plan is based on internationally



recognized environmental management standards. The Waste Management Plan includes various components to ensure effective waste management within the hospital. Recognizing the importance of effective waste management to ensure the health and safety of patients, staff, and the environment, following waste management plan set in compliance with the rules set forth by the Government of Pakistan was implemented in Kulsum International Hospital.

#### Hospital Layout and Disposal Points

The hospital layout has been mapped to identify waste disposal points for every ward and department. These points are categorized based on the type of waste they handle, distinguishing between risk and non-risk waste. Central storage facilities for both types of waste have been designated to ensure proper containment and disposal.

#### Resource Requirements

A detailed inventory of the types and quantities of containers, waste bags, and trolleys required annually has been compiled. This ensures that the hospital has a sufficient supply of resources for waste collection and disposal activities.

#### Timetables and Responsibilities

Timetables for waste collection from each ward and department were established. Additionally, clear duties and responsibilities were assigned to different categories of hospital staff involved in waste management, ensuring accountability and efficiency.

#### Special Waste Management Procedures

Separate policies and SOPs were listed for management of special waste that required autoclaving or treatment prior to final disposal. Contingency plan for storage or disposal of risk waste in emergency situations was also devised to address unforeseen circumstances that require special attention.

#### Training Programs

Comprehensive training courses and programs on waste management were developed to ensure that all hospital staff members are adequately trained in waste handling procedures and emergency response protocols. Regular refresher courses were planned to be conducted to reinforce knowledge and skills.

## Emergency Procedures

Detailed emergency procedures for dealing with incidents related to waste management have been established. These procedures outline steps to be taken in the event of accidents or spillages to minimize risks to personnel and the environment.

## Waste Minimization and Reuse

To minimize waste generation, Kulsum International Hospital has implemented purchasing and stock control measures to avoid overstocking of date-limited pharmaceutical and other products. Additionally, waste recycling programs have been initiated to return unused or waste chemicals for reprocessing and to promote waste reduction practices in all hospital departments.

# COMPOSITION OF WASTE MANAGEMENT TEAM

In the waste management rules outlined by the Government of Pakistan's Ministry of Environment, the Waste Management Team plays an essential role in ensuring effective management of hospital waste. Here's a detailed overview of the Waste Management Team as per the rules:

1. **Chairman - Medical Superintendent (MS):** The Medical Superintendent, as the head of the hospital, serves as the Chairman of the Waste Management Team. They are answerable for overall coordination and implementation of waste management measures within the hospital.
2. **Members:** The Waste Management Team comprises various members from different departments within the hospital, as well as external representatives:
  - **Heads of All Hospital Departments:** Each department within the hospital is represented by its respective head. The head of departments are to ensure the waste management SOPs and protocols were strictly complied to within their departments.
  - **Infection Control Officer:** Responsible for providing advice on infection control standards and training requirements related to waste disposal.
  - **Chief Pharmacist:** Responsible for managing pharmaceutical waste and ensuring proper procedures are in place for its disposal.
  - **Radiology Officer:** Responsible for managing radioactive waste and ensuring

compliance with safety standards.

- **Senior Matron:** The member would be responsible for training of all head nurses, team leaders, registered nurses and nursing assistants; in addition to training the staff working in various diagnostics departments including cardiology, radiology and laboratory
- **Head of Administration/Operations:** Shares responsibility with the Senior Matron for staff training and ensuring compliance with waste management procedures.
- **Hospital Engineer:** The member would oversee all the installations, safe operations and maintenance of waste storage facilities.
- **Head of Sanitation Staff:** Oversees the sanitation staff responsible for waste collection and disposal.
- **Other Designated Hospital Staff:** Additional hospital staff members may be designated by the Medical Superintendent to serve on the Waste Management Team as needed.
- **Public Representative:** Nominated by the District Coordination Officer, or in the case of hospitals in the Islamabad capital territory, by the Federal Agency.
- **Representative of Provincial Agency or Federal Agency:** A representative from the relevant provincial or federal agency is included as a member.

The Waste Management Team is responsible for the preparation, monitoring, and periodic review of the Waste Management Plan. They supervise all actions taken to ensure compliance with waste management regulations, conduct regular meetings to discuss waste management strategies, and oversee staff training initiatives. Additionally, the team collaborates with external agencies and regulatory bodies to uphold the highest standards of waste management practices at Kulsum International Hospital.

#### Designation of Waste Management Officer:

The Medical Superintendent of Kulsum International Hospital has designated a staff member to oversee waste management activities within the hospital premises. As per government regulations, this individual's role is pivotal in overseeing the implementation of the Waste Management Plan and ensuring adherence to waste management protocols.

### **Responsibilities of the Designated Officer:**

1. **Day-to-Day Implementation:** The designated officer is responsible for the daily implementation of the Waste Management Plan at Kulsum International Hospital, ensuring that all waste management activities are conducted efficiently and in compliance with government regulations.
2. **Waste Collection:** He oversees the internal collection of waste bags and containers on a daily basis, ensuring timely disposal of waste to the central storage facility. The officer coordinates with the supply chain management department to maintain an adequate supply of waste management materials.
3. **Waste Storage:** Ensuring the correct use of central storage facilities for both infectious and non-infectious waste is a key responsibility. The designated officer takes measure to maintain a hygienic environment by ensuring that the waste bags are not thrown at undesignated places and is supervised at all points of time.
4. **Waste Disposal:** The concerned person has to ensure that the waste from the storage site is safely handed over to the respective focal persons/vendors for collection of infectious as well as non-infectious waste. The waste disposal has to be carried out within the specified period of time ensuring that that the storage facility is not overburdened beyond its capacity.
5. **Staff Training:** The designated officer liaises with department heads and other relevant staff members to conduct training sessions on waste management procedures. They ensure that all hospital personnel are sensitized about their duties and responsibilities as per the Waste Management Plan, emphasizing proper waste segregation and handling practices.
6. **Incident Management:** In the event of accidents or spillages, the designated officer promptly implements emergency procedures outlined in the Waste Management Plan. They conduct thorough investigations, record incident reports, and review them to identify areas for improvement, thereby mitigating hazards and ensuring the safety of hospital staff and patients.

## SORTING AND TAGGING OF WASTE AT POINT OF GENERATION

Implementing a waste management plan to optimize healthcare waste management is a critical endeavor for hospitals seeking to enhance operational efficiency and reduce costs. Kulsum International Hospital (KIH) embarked on an innovative initiative as part of their project to develop and implement a comprehensive waste management plan. This initiative involved the tagging of waste collection bags originating from different units within the hospital, with distinct colors assigned to differentiate between infectious and non-infectious waste. White bags were designated for non-infectious waste, while yellow bags were allocated for infectious waste collection.

The utilization of color-coded waste bags not only facilitated the segregation of waste streams but also enabled the hospital to track the source of infectious waste more effectively. By tagging each yellow bag with the name of the respective unit from which it originated, KIH aimed to gain insights into which units were generating the highest volumes of infectious waste and identify any emerging trends in waste generation patterns.

This strategy holds significant implications for optimizing waste management practices within the hospital setting. Firstly, it allows for targeted interventions to be implemented in units that are identified as major contributors to infectious waste generation. By pinpointing these areas, KIH can implement targeted training programs and initiatives to educate staff on proper waste segregation practices, thereby reducing the overall volume of infectious waste generated.

Furthermore, the tagging of yellow bags with unit names enables KIH to establish accountability and responsibility for waste management practices at the unit level. Units can be incentivized to adopt more sustainable waste management practices by providing feedback on their waste generation rates and encouraging initiatives to minimize waste generation where feasible.

Additionally, this initiative facilitates data collection and analysis to monitor trends in infectious waste generation over time. By systematically tracking the quantity of infectious waste generated by each unit, KIH can identify fluctuations or anomalies in waste generation patterns and proactively respond with appropriate measures to address any issues that arise.

From a cost optimization perspective, this strategy enables KIH to streamline waste management processes and allocate resources more efficiently. By accurately identifying the units responsible for generating infectious waste, the hospital can allocate resources such as personnel and equipment based on demand, thereby reducing unnecessary expenditures and optimizing operational costs associated with waste management.

## **WASTE AUDIT AND WASTE STREAM ASSESSMENT**

### Strategy Development

Before initiating the waste audit and waste stream assessment, KIH developed a comprehensive strategy outlining the objectives, scope, methodologies, and timelines for the project. The strategy was developed in alignment with internationally recognized environmental management standards and best practices in waste management.

### Planning Phase

During the planning phase, KIH assembled a multidisciplinary team comprising environmental health and safety specialists, waste management personnel, department heads, and other relevant stakeholders. This team collaborated to define the scope of the waste audit and waste stream assessment, identify key performance indicators (KPIs), and establish data collection protocols. Additionally, the planning phase involved securing necessary resources, such as equipment and personnel, and establishing communication channels to ensure effective coordination and collaboration throughout the project.

### Execution of the Waste Audit

The waste audit was conducted in a systematic and methodical manner to ensure accuracy and reliability of the data collected. The process involved the following steps:

#### a. Waste Segregation

Waste generated within the hospital premises was segregated into distinct categories, including biomedical, pharmaceutical, chemical, and general waste, to facilitate accurate classification and analysis.

#### b. Quantification

The volume of waste generated by each department and unit within the hospital was quantified using standardized measurement techniques. This involved physically weighing and recording the amount of waste generated over a specified period.

#### c. Characterization

Each waste stream was characterized based on its composition, hazardousness, and disposal requirements. This involved identifying any hazardous or regulated waste streams that required special handling or treatment.

#### d. Data Collection

Data related to waste generation, segregation, collection, storage, transportation, and disposal practices were collected through direct observation, interviews with staff, and review of documentation such as waste management records and disposal manifests.

### Waste Stream Assessment

Simultaneously, an assessment of the existing waste stream was conducted to evaluate the effectiveness of current waste management practices. This involved:

#### Review of Current Practices

Existing waste management procedures, including segregation, collection, storage, transportation, and disposal methods, were evaluated to identify strengths, weaknesses, and opportunities for improvement.

#### Compliance Assessment

Compliance with regulatory requirements and industry best practices was assessed to ensure that the hospital's waste management practices were aligned with applicable standards and regulations.

#### Identification of Gaps

Any gaps or deficiencies in current waste management practices were identified, along with their potential impacts on operational efficiency, environmental compliance, and cost-effectiveness.

#### Analysis and Reporting

Following the completion of the waste audit and waste stream assessment, the collected data was analyzed to identify trends, patterns, and areas for improvement. This analysis formed the basis for the development of actionable recommendations and strategies to optimize waste management

practices within the hospital. A comprehensive report summarizing the findings of the waste audit and waste stream assessment was prepared, documenting key observations, insights, and recommendations for improvement. This report served as a valuable resource for informing decision-making and guiding the development of the hospital's waste management plan.

Month	OT Procedures	Bed days	Weight in Kg	Weight in Kg/bed day	Weight in Kg/ Bed and procedures	Rate per Kg	Transport Rate per Day (Rs.)	Amount in Rupees
Jan-24	276	2204	3676	1.67	1.48	47	750	172772
Feb-24	254	1933	2998	1.55	1.37	47	750	140906
Mar-24	241	1954	2744	1.40	1.25	47	750	128968

### Implementation of Recommendations

Finally, KIH implemented the recommendations arising from the waste audit and waste stream assessment to improve waste management practices. This involved developing and implementing targeted interventions, such as staff training programs, process improvements, and infrastructure upgrades, to address identified gaps and enhance overall waste management efficiency and effectiveness.

By strategically planning and executing the waste audit and waste stream assessment, KIH was able to gain valuable insights into its waste generation patterns and existing waste management practices. This information served as a foundation for developing and implementing a comprehensive waste management plan aimed at optimizing operational efficiency, reducing costs, and promoting environmental sustainability within the hospital.

## INCIDENT REPORTING SYSTEM

Implementing a robust incident reporting and management system through the Hospital Management Information System (HMIS) was a proactive strategy employed by Kulsum International Hospital (KIH) to optimize the generation and management of infectious waste, thereby reducing operational costs. The utilization of HMIS's dedicated module for incident reporting and management facilitated efficient tracking, analysis, and resolution of waste management-related issues across the hospital.



### Introduction of Incident Reporting Module

KIH integrated a specialized module within its HMIS specifically designed for incident reporting and management related to waste management practices. This module provided a user-friendly platform accessible to all hospital staff members, enabling them to promptly report any observed violations or deviations from the established waste management plan.

### User Accessibility and Reporting Process:

The incident reporting module was made accessible to end-users across various departments and units within the hospital. Staff members were encouraged to report incidents related to waste management through the module, ensuring a decentralized and participatory approach to incident reporting.

The reporting process involved the following steps:

- End users witnessing a violation of waste management protocols would log into the HMIS and access the incident reporting module.
- They would then input details of the incident, including the nature of the violation, its severity, location, date, and any other relevant information.
- Additionally, users could provide insights into the frequency of occurrence, enabling the system to track recurring issues and patterns.

### Analysis and Documentation

Data captured through the incident reporting module was systematically analyzed to identify trends, recurring issues, and areas requiring corrective action. Incident reports were categorized based on the type of violation, severity level, department/unit involved, and frequency of occurrence.

The system facilitated the generation of comprehensive reports and dashboards, providing stakeholders with real-time insights into the status of waste management practices across the hospital. These reports served as valuable tools for decision-making and strategic planning aimed at improving waste management efficiency and compliance.

### Corrective Action and Continuous Improvement:

Upon receiving incident reports, designated personnel within the hospital's waste management team would initiate appropriate corrective actions. These actions could include:

- Conducting targeted training sessions to address specific issues or areas of non-compliance.
- Implementing process improvements or workflow modifications to prevent recurrence of incidents.
- Revising and updating the waste management plan based on insights gained from incident data analysis.

The incident reporting module facilitated a cycle of continuous improvement, whereby lessons learned from past incidents were leveraged to enhance waste management practices proactively. By promptly addressing reported issues and implementing corrective measures, KIH aimed to minimize the generation of infectious waste and optimize its management, ultimately contributing to operational cost reduction and environmental sustainability.

## **DELIVERABLE # 2 - Driving Cultural Change through Trainings**

Kulsum International Hospital (KIH) has initiated a comprehensive training program as a core component of its continuous learning initiative to educate its medical, paramedical, support, and administrative staff on correct waste segregation practices. Recognizing the critical role of staff education and awareness in optimizing healthcare waste management, KIH has adopted various modes of training to ensure comprehensive coverage and effectiveness.

### **Classroom Training**

Classroom training sessions are conducted to provide theoretical knowledge and understanding of waste segregation principles, regulations, and best practices. These sessions are facilitated by qualified trainers who cover topics such as the classification of healthcare waste, proper segregation techniques, handling procedures, and the importance of adherence to waste management protocols. Interactive discussions, case studies, and multimedia presentations are utilized to engage participants and reinforce learning outcomes.

## On-the-Job Training

On-the-job training (OJT) is integrated into daily work routines to offer practical, hands-on experience in waste segregation and management. Staff members receive personalized guidance and supervision from designated trainers while performing waste handling tasks in their respective work areas. OJT enables employees to apply theoretical knowledge in real-world scenarios, enhancing their skills and confidence in executing proper waste segregation practices.

## Waste Awareness Cultural Week

A Waste Awareness Cultural Week was organized as a dedicated initiative to promote waste management awareness and foster a culture of responsibility among staff members. Throughout the week, various activities, workshops, and events are organized to educate and engage employees on waste segregation, recycling, and environmental sustainability. Interactive sessions, competitions, and informative displays are used to convey key messages and encourage active participation.

# International Recommendations on Training for Waste Segregation

International organizations and guidelines emphasize the importance of staff training and education in improving waste segregation practices and optimizing costs associated with healthcare waste management:

- 1. World Health Organization (WHO):** WHO recommends comprehensive training programs for healthcare workers on waste management practices to minimize the generation of hazardous waste, ensure proper segregation, and reduce occupational health risks.
- 2. United Nations Environment Programme (UNEP):** UNEP highlights the significance of staff training in promoting sustainable waste management practices, including segregation, recycling, and waste reduction strategies.
- 3. International Organization for Standardization (ISO):** ISO standards such as ISO 14001 emphasize the need for employee training and competence development in waste management systems to achieve environmental objectives and regulatory compliance.

**4. Best Practices from Leading Healthcare Facilities:** Leading healthcare facilities worldwide prioritize staff training and continuous education as fundamental components of their waste management strategies. By investing in staff development, these facilities ensure a knowledgeable workforce capable of implementing effective waste segregation practices, minimizing waste generation, and optimizing resource utilization.

## THE FUTURE

Advances in artificial intelligence (AI), the Internet of Things (IoT), and blockchain technology offer innovative solutions to improve hospital waste management processes, addressing issues such as efficiency, sustainability, and regulatory compliance.

- **AI-driven Waste Sorting and Classification**

AI algorithms can analyze images and sensor data from IoT devices to automatically sort and classify different types of hospital waste. By leveraging machine learning techniques, AI systems can identify recyclable materials, hazardous substances, and bio-medical waste with high accuracy, streamlining the waste sorting process and reducing the risk of human error. This not only enhances efficiency but also ensures proper segregation and disposal of waste according to regulatory guidelines, minimizing environmental and health risks.

- **IoT-enabled Waste Monitoring and Optimization**

IoT sensors embedded in waste bins and disposal systems can continuously monitor waste generation rates, fill levels, and temperature conditions in real-time. This data can be analyzed to optimize waste collection schedules, route planning, and resource allocation, reducing unnecessary pickups and transportation costs. Additionally, IoT-enabled smart bins can alert hospital staff when bins are nearing capacity or if there are any anomalies detected, enabling proactive maintenance and timely interventions to prevent overflow or contamination incidents.

- **Blockchain-based Traceability and Accountability**

Blockchain technology can provide a transparent and immutable record of hospital waste management activities, including waste generation, handling, transportation, and disposal. Each transaction or event related to waste management is cryptographically recorded on the

blockchain, creating an auditable and tamper-proof trail of custody. This enhances transparency, accountability, and compliance with regulatory requirements, as stakeholders can easily verify the origin, destination, and treatment of waste throughout its lifecycle. Furthermore, blockchain-based smart contracts can automate compliance checks and ensure that waste management processes adhere to predefined rules and standards, minimizing the risk of non-compliance penalties and fines.

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