

# ASSESSING THE KNOWLEDGE, ATTITUDE, AND PRACTICE OF BIO-MEDICAL WASTE MANAGEMENT AMONG HEALTHCARE WORKERS IN HOSPITAL SETTINGS

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## Abstract

Effective bio-medical waste management is crucial for preventing the spread of infections, protecting the environment, and ensuring the safety of healthcare workers and the community. This research paper aims to evaluate the knowledge, attitude, and practice of bio-medical waste management among healthcare workers in hospital settings. The study will employ a cross-sectional survey design, targeting healthcare workers from various departments in selected hospitals. A structured questionnaire will be used to assess their knowledge regarding bio-medical waste segregation, storage, transportation, and disposal, as well as their awareness of associated risks and regulations. The attitude of healthcare workers towards bio-medical waste management will be explored, including their perception of its importance, their motivation to comply with guidelines, and their willingness to adopt proper waste management practices. Factors influencing attitude, such as training programs, availability of resources, and organizational support, will be examined. The study will also assess the actual practice of bio-medical waste management among healthcare workers, including segregation practices, usage of appropriate containers, adherence to disposal guidelines, and utilization of personal protective equipment. Compliance with regulatory standards, such as color coding and signage, will also be evaluated. Data analysis will involve descriptive statistics, correlation analysis, and regression modeling to identify the factors associated with knowledge, attitude, and practice of bio-medical waste management among healthcare workers. The findings will inform the development of targeted interventions and training programs to improve waste management practices in healthcare settings.

**Keywords:** Bio-medical waste management, healthcare workers, knowledge, attitude, practice

## INTRODUCTION

Medical Wastes or simply healthcare wastes indicate the solid as well as liquid forms of residual components that have been generated from the healthcare facilities (Arockiam JeyaSundar et al., 2020). It mainly includes waste other than general content being disposed of from any facilities such as body fluid like blood, or sample fluid being collected from patients, histo-pathological collection, sharp objects, chemical solution, and even radioactive components. These wastes are hazardous in nature and should be handled carefully with little exposure to the content. The waste generated from healthcare facilities is termed hazardous due to its composition which mainly contains toxic contents and to some extent non-hazardous substances. It can be recognized as a threat to both human

lives and to the ecosystem due to its infectious nature which mainly contains genotoxic, cytotoxic and radioactive substances. Thus, if not handled carefully and properly at the time of disposal, it can surely increase the chances of infection spread and even sometimes become the reason for endemic, epidemic and pandemic situations as well (Arockiam JeyaSundar et al., 2020).

Medical waste management has gained tremendous attention in recent times because of its extensive impact on human health as well as on the environment (Blenkharn, 2019; Woolridge & Hoboy, 2019). If anything, the total layout of the waste management and treatment system is repeatedly developing to build a greater and safe means of medical waste treatment to avoid any kind of unintended consequences. To say the least such waste content contains mainly infectious as well as toxic substances. In various countries, the medical waste content is often combined with other waste content (such as nonhazardous waste products) that are generated in hospitals or other facilities. This mixture is then frequently discarded at the site where general waste components are being disposed of. These types of activities have often held sight, especially in developing countries where the waste management facilities are not well-developed. In fact landfill, incineration and open burning of these hazardous wastes are common aspects (Woolridge & Hoboy, 2019).

The improper and inappropriate practices that have been raised in the underdeveloped parts of the world have become one of the main reasons for the exposure to numerous infectious diseases. It is well aware among everyone that waste dumping sites are the common habitat of rodents which carry harmful pathogens. Thus, when these types of infectious and hazardous waste materials are disposed of with the general waste, it surely has a radiating effect on the environment and on living beings. Thus, a substantial need to re-examine the gap in the management system and suitable establishment of a strategic and disciplined waste management system is an optimized indication.

When considering medical waste, the first thing that comes to mind is the toxicity it holds with its content and how strategically the hazardous components can be handled to avoid unprecedented incidents. To be exact, medical or healthcare wastes are the leading source to generate biomedical waste (Padmanabhan & Barik, 2019). Every time, the waste is generated from hospitals or any medical facilities, the main exposure of the content includes biomedical wastes that are generated from the diagnosis and treatment of the patients. It is highly contagious and if not handled properly, the individuals come in direct contact with the substances and even the indirect exposure has a harmful impact. The generation of this medical waste till its proper disposal has been configured as the important aspect, mainly in those countries where the hygienic maintenance is too low and the countries are densely populated. This entails the scenario of developing countries where the infrastructure of waste handling and treatment is still in a nascent stage. To say the least, the methods that are used still now for waste treatment may not be inconvenient since there is a generation of huge waste content, especially in recent times due to the surge of the Covid-19 pandemic. In fact, the waste content generated due to

Covid-19 patient treatment is highly contagious that if mishandled, the consequences would be devastated. Thus, the management of these biomedical wastes should abide by proper waste management method which includes strategic practices, infrastructure and policies.

### **Waste Generation by Healthcare Facilities**

The generation of healthcare waste by the medical facilities, such as hospitals, clinics, pharmaceutical units and laboratories is discharged into the waste units that are assigned by the healthcare authority (Jang, 2019). Here on the exploratory note, the waste content generated although handled by the healthcare facility is the main noticeable fact is how the wastes are managed. The management of this hazardous content varies among different healthcare units and even if required, the total management process is done haphazardly to avoid workload. This is truly a concerning part which has been observed mainly in developing countries. Even more, the methods applied for healthcare waste management seem to be not efficient and effective (Zafar, 2019). However, before diving deep into the facts of how these hazardous waste materials are managed, it is necessary to consider the exact amount of waste being generated from the units or facilities. Upon considering an annual rate, the average healthcare waste content generated from the in-patient facility is 85 per cent of the total waste (both hazardous and non-hazardous) (Wolff, 2018).

As a reminder, the total energy consumption by the in-patient facility is 240,000 BTU/ square feet. This quantity of energy includes all forms of energy consumption, may it be heating, cooling, or ventilation. Every year the amount of power consumption done by the in-patient facility has been estimated to be 31 KWh per square foot. Apart from this, the amount of water consumed by the hospital facilities has been estimated to be approximately 49 gallons/ square feet on an annual basis (Arockiam JeyaSundar et al., 2020; Wolff, 2018).

The majority of healthcare waste is generated in the form of the solid or liquid state, while few are in the gaseous forms. As stated above, the amount of waste generated has been estimated to be 85 per cent where most of the contents are in a solid form similar to the commercial wastes. Other than that the remaining 15 per cent contains hazardous and infectious materials which are thereby implicated as “red bag” waste or “regulated medical waste” (Wolff, 2018). “Regulated medical waste contains potentially infectious agents which are often treated through the process of incineration. Although in the past, incineration was a cost-time and efficient treatment for any kind of waste, at present the toxic content of healthcare waste which has increased at a tremendous rate has made the effectiveness of the incineration process less considerable. Even more, the estimation shows that fumes released from the medical waste incineration impact heavily on the environment due to the emission of enormous poisonous gases like dioxin or mercury and also on the public health, especially the workers present on the waste treatment site. Thus, on an advisory note, it can be stated that with the quantification of healthcare waste material both in content and in toxicity, the need for effective management infrastructure,

the regulatory system and amendment rules for waste handling should be revised and re-devised so as to bring a better opportunity to living condition for human and secure a healthy environment.

## **OBJECTIVES**

1. To evaluate the management practice and learning attitude of health professionals towards waste disposal and treatment in South Asian countries
2. To identify various types of healthcare waste products disposed of the hospitals and clinics

## **Regulations insisted on Medical Waste Management**

The regulatory note when considered for healthcare waste management states nothing but some policies and amendment rules for proper handling of hazardous wastes. In developed countries for example the United States increased awareness with the suitable establishment of regulatory and legislative acts to ensure proper waste management practices. Medical Waste Tracking Act (MWTa), 1988 has been introduced and enacted by the US Congress to instigate action against the incidents concerning medical waste that highly impact the beaches on the east coast (Woolridge & Hoboy, 2019). The incidents as elaborated in this section have highly concerned the regulatory body due to the imposition of health hazards from untreated and improper healthcare waste disposal. The main site of waste generation as mentioned in the study by (Woolridge & Hoboy, 2019) shows the private as well as government sectors. If anything, the Act has indicated an amendment for the "Solid Waste Disposal Act" (SWDA) being already under the coordination to regulate and focused on possible improvements & initiatives (Woolridge & Hoboy, 2019). Now showcasing the amendment Act along with the existing regulatory Act, the following has been included:

- Proper definition of medical waste and the establishment that can be incorporated to identify which medical waste need regulatory programs
- Establishment of cradles-to-grave tracking system that typically uses "generator-based tracking form"
- Requirement of management standards to strategically enhance segregation, storage, labeling, and transportation of medical waste content
- Establishment of the record-keeping device and penal code to include penalties for mismanagement

Under consideration of the MWTa Act since 1988, the regulatory practices has been fully revised the previous enforcements and thereby completely administered since 1992 (Woolridge & Hoboy, 2019). As it is already mentioned earlier, the MWTa Act of EPA, 1988 has been enacted by the US Congress to view the grave concern about medical waste management that holds a potential to readily damage public health. Thus, the need to ensure proper treatment and handling of healthcare waste seems to be a mandatory

step (Woolridge & Hoboy, 2019). Under such advent, the Environment Protection Agency (EPA) of the US has guided the nation with new enforcement and amendment Acts. It has determined the effect of infectious components as well as the risk factors encircled therein if being exposed even for a shorter period of time.

The suitable responsibility to promulgate the regulations and the enforcement jurisdiction has been therefore ultimately relegated in view of some uplifting movement among the states under the US. The United States being a top-listed developed country has surpassed the limit of improper or inappropriate waste management and reduced the effect of contagious elements by improvising the rules and regulatory Acts. This can set an example for other countries, especially for developing or underdeveloped countries where there is hugely lacking in the waste management system. It is understandable that there is resource constraint in developing countries which thereby instigate the reason for the improper waste management system. However, it should be noted that there is some evident failure from the regulatory bodies as well who think effective healthcare waste handling is an excess workload, a pretentious act. Thus, the only thing here to consider is a feasible plan to obliterate the issues in the proper handling of medical waste, if not financially but functionally with strategic measures.

By the end of 2017, several Acts have been revised and re-formulated by the US government to handle and dispose of the medical waste for consecutive 2-3 days, if not every day. Even more, there are certain regulations that undergo modification overall, in recent times for modernizing and accounting for the changes persevered by the waste handling industry. Now stating the historical fact, there are several schools, hospitals and even institutions that use open burning processes and incinerators to treat the generated waste from their unit and even from the small facilities surrounding them. But this traditional method seems to be not effective anymore; rather it holds a series of negative effects on the workers handling the waste content directly, especially with the release of toxic gaseous components (Zafar, 2019). In recent times, most of the waste contents have been shifted simultaneously to off-shore sites away from the generation site to avoid hazardous effects or contamination. However, as a matter of fact, the re-consideration of waste handling away from the generation site has instigated the use of various applications and tools which in turn make the waste management process more complicated and challenging (Woolridge & Hoboy, 2019).

The changes observed in the advent of waste management off-site have prompted DOT to close looking at the safe transport system for ensuring safe practices while handling the waste. In 2006, DOT PHMSA has passed other regulations to harmonize with the regulations of the United Nations (Woolridge & Hoboy, 2019). The regulations introduced by PHMSA have outlined the criteria encompassing the packing material, the labeling process, the documents necessary for shipping and the complete training process for the employees as per the European Agreement encircled for the transportation of any dangerous good (ADR). In fact, it can be implicated as a pre-emptive regulatory practice to promote consistency among the industries taking responsibility for waste

transportation. Thus, it can be stated herein that the healthcare waste management system is not a casual matter and it should be enhanced with proper and active regulatory actions to reduce the adverse impact. The regulations enforced by developed countries like the US, Europe and others should be distinctly mainly by other parts of the world unitedly to minimize the unintended effect. At the most, there should be the incorporation of strict legislation and regulatory norms in developing countries to rescue the detrimental impact and the first thing that should be emphasized in the modification process is the healthcare waste treatment method and the unhygienic condition that exist within.

### **Sustainable Management Practice for Solid Waste**

Healthcare Waste as mentioned earlier is generated from healthcare facilities, especially hospitals and clinics as well as from other units like research institutes, and from veterinary institutes. The waste products are generated mainly because of the diagnosis and treatment as well as due to the immunization process of patients (both humans and animals) (Awasthi et al., 2019). In fact, the amount of medical waste generated from any healthcare facility is more than the general biodegradable and non-biodegradable wastes and more or so it has increased at a tremendous rate due to the sudden emergence of the coronavirus (Covid-19) pandemic crisis. Healthcare waste is a constant threat to the ecosystem. It is true and inevitable. However, in recent times the threat has doubled due to the increased amount of healthcare waste generation, especially biomedical waste from the infected patients that have been diagnosed and treated. On a closer look, the main types of waste content include cytotoxic, genotoxic, radioactive and infectious materials (Awasthi et al., 2019).

The proper management of this waste from the moment it has been generated to the time it has been disposed of should be handled properly so as to avoid any unprecedented effect. In fact, it is the main cause of any endemic, epidemic or pandemic outbreak. In recent times, the emergence of the Covid-19 crisis is itself a deadly cause, the amount of waste generated due to the treatment has raised the effect more severely and drastically. The proper collection of medical waste along with the processing and disposal technique should be ensured so as to create a safe and secure environment for public and environmental biodiversity. Therefore, this achievement can only be possible if effective regulations as well as rules and policies have been recommended by the government and correspondingly exercised by the healthcare authority, professionals and personnel.

### **Healthcare Waste Management Scenario of Developing Countries**

The in-built scenario of the healthcare waste management system in developing nations has become a grave concern for researchers who have introduced numerous events upon emphasizing the practices, knowledge and competency of the nations. One of the main aspects that can be discussed here is the medical waste that is generated from the healthcare facilities is not handled or treated in an effective manner, lest it is dumped in the wasteyard just like other general or domestic wastes (Awasthi et al., 2019). It is not only an irresponsible way of managing such hazardous contents but also a grave

concerning threat to public health as well as to the ecosystem. Although the resource constraints in developing countries have restricted or incapacitated the good or responsible movement and under such conditions, dumping can be considered a cost-effective waste treatment, the possibility of ensuring a safe and healthy environment is surely doomed (Awasthi et al., 2019). Waste dumping in an open area or landfill is one of the reasons why there are innumerable negative effects on human health. Thus, addressing the fact to improvise the traditional waste management method is the highlight aspect.

The enlightening of the risks prevalent to improper handling of medical waste comes with the understanding of the knowledge, the awareness level and the practices that are ensured by the healthcare professionals. It determines the competency level of the healthcare workers to ensure the handling of healthcare waste in a proper manner. However, it is the main area of concern due to which various pieces of research have been conducted for highlighting the crucial facts and the gaps within the waste handling and treatment process. Coming to the risk factors, the direct risk is well-known which is based on direct exposure or contact with hazardous components, however, the indirect risks are prevalent in the disposal of sharp objects that have been already infected, certain wastes generated from human bodies and remnants of various cytotoxic compounds discarded after treatment & analysis (Awasthi et al., 2019).

Management of this healthcare waste in developing countries is one of the matters of current research where researchers have outlined the aspects prevalent to unclean and unhygienic conditions of healthcare facilities nationwide in developing countries. It is of utmost importance that the management of healthcare waste which typically contains biomedical content should be handled properly and even if the old conventional methods are not effective anymore, there must be the implementation of several contemporary techniques which would ensure a proper and systematic approach. For various decades, research has discovered the effect of several infectious diseases which not only cause human morbid conditions but are also circumstantial for various deaths. On such advent, the outrageous implications of infectious diseases include severe acute respiratory syndrome (SARS), 2003, Ebola virus, MERS-COV, HIV-AIDS and in recent times the most deadly occurrence of infection ever, the Covid-19 pandemic (Awasthi et al., 2019). The effect of all these infections has become complicated over time and become most severe with the last emergence of SAR-COV-2 viruses.

The prevalent risks from these infections are not only abode by harming the present life existence but also impair risk for the future and if more may cause the eradication of life from the earth, upon considering the effect of coronavirus pandemic. In the meantime, the generation of a huge amount of medical waste is highly expected since healthcare professionals are trying whole-heartedly to save lives. Although their motives to save lives are unconditional, the eminent practices needed to handle the healthcare waste generated from the treatment are nothing but an underrated part. It is mostly observed in the developing parts of the world, especially in developing countries. Thus, the only thing

to consider here is the coherent and responsible measures that can ensure proper practices in waste handling and therefore make sure to develop a better, safer and healthier environment for humans as well as for the environmental biodiversity.

### **Biomedical Waste- Generation and Impact**

The generation of healthcare waste has been addressed as an essential component of research because of its impact on public and environmental health. Various discussions have been raised with the primary focus on medical waste in the previous sections and how it has been an obstacle to a better life. Healthcare waste can be characterized by various forms based on its composition.

Among those classifications, the most outrageous effect comes with the consideration of biomedical waste that not only poses a serious threat to human life and to the environment but also makes the unintended possibilities more effective and plausible in real terms. Biomedical waste includes the various types of hazards or infectious materials that are discharged from hospital facilities, clinical facilities, pharmaceutical units, and laboratories after diagnosis, treatment, immunization, and experimentation (Manzoor & Sharma, 2019). The waste generated from the site contains highly toxic materials that if exposed to the total population can cause lethal damage.

The certain impact of biomedical waste is highly underrated in recent times, especially in its handling process (Wolff, 2018). According to the statistical representation from one of the studies conducted by (Manzoor & Sharma, 2019), there has been an increased portion of hospitals and nursing facilities with an increased human population. It is because of this rising that there is an impetuous growth in healthcare waste, especially biomedical and pharmaceutical wastes. The quality, as well as quantity of the waste, discharged from the healthcare facilities highly depends on the specification as well as the hospital standards (Manzoor & Sharma, 2019).

To say the least, this specification and standardization are the main determinants that not only help in estimating the waste content but also simulate the effective biomedical waste management system. In addition, the geographic location of the healthcare unit often identifies the type & the waste amount. The more highlighting fact here shows that hospitals that are present in the metropolitan cities simultaneously produce biomedical wastes of approximately 30 tons per day (Manzoor & Sharma, 2019).

It is really a concerning fact however, the treatment and diagnosis for detecting the disease are equally important. It is even more impactful in recent times with the emergence of the Covid-19 pandemic when an excessive amount of infectious waste is generated. Thus, the only recommended measure to incorporate and considered under such circumstances is to integrate a highly effective healthcare waste management system.



## CONCLUSION

The attitude of healthcare workers towards bio-medical waste management will be explored, including their perception of its importance, their motivation to comply with guidelines, and their willingness to adopt proper waste management practices. Factors influencing attitude, such as training programs, availability of resources, and organizational support, will be examined. The study will also assess the actual practice of bio-medical waste management among healthcare workers, including segregation practices, usage of appropriate containers, adherence to disposal guidelines, and utilization of personal protective equipment.

Compliance with regulatory standards, such as color coding and signage, will also be evaluated. Data analysis will involve descriptive statistics, correlation analysis, and regression modeling to identify the factors associated with knowledge, attitude, and practice of bio-medical waste management among healthcare workers. The findings will inform the development of targeted interventions and training programs to improve waste management practices in healthcare settings.

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