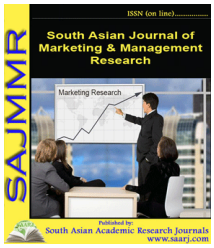
SAJMMR

ISSN: 2249-877X Vol. 11, Issue 10, October 2021, Impact Factor: SJIF 2021= 7.642

South Asian Journal of Marketing &Management Research (SAJMMR)

(Double Blind Refereed & Peer Reviewed International Journal)



DOI: 10.5958/2249-877X.2021.00095.3

AN OVERVIEW ON MEDICAL WASTE MANAGEMENT

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ABSTRACT

Medical waste management is examined in this article, covering typical sources, regulating laws, and treatment and disposal techniques. Medical waste law exists in many industrialized countries, however there is limited guidance on whether items may be classified as contagious. Because of the lack of clarity, sorting medical waste has become inefficient, resulting in an increase in the amount of trash treated for pathogens, which is often done by burning. This study shows that incorrectly classifying trash as infectious leads in greater disposal costs and more negative environmental consequences. The study indicates that improved healthcare worker education and standardized medical waste stream sorting are important routes for effective waste management in healthcare institutions, and that further research is needed given the tendency of growing medical waste generation with rising world GDP.

KEYWORDS: *Healthcare, Infectious waste, Medical waste, Separate collection, Waste management.*

INTRODUCTION

Medical waste management is one of humanity's many complicated and demanding problems as the world's population grows and demand for medical services rises. The World Health Organization (WHO) defines medical waste as "waste produced in the diagnosis, treatment, or immunization of humans or animals." Medical waste that is not properly managed and disposed of poses a high danger of illness or injury to healthcare workers, as well as a lower risk of infection or harm to the general public due to the spread of microorganisms from healthcare facilities into the environment.

The disposal of medical waste is a massive problem. The United States, as the world's leading producer of medical waste, produces approximately 3.5 million tonnes each year, with an average disposal cost of $790 per ton. Medical waste generation is rapidly increasing in the

developing world as access to medical services improves, allowing an increasing number of people to obtain contemporary medical treatment. The shift away from multi-use medical equipment toward safer, single-use medical gadgets is increasing medical waste generation in developing countries. The quantity of medical waste that has to be safely disposed of in developing countries is rapidly increasing as a result of these combined developments. A rapidly aging population is the primary cause of growing medical system consumption in the industrialized world, and this rising medical system usage is resulting in a rise in medical waste generation[1]–[5].

Medical Waste:

Medical waste is defined as "any solid waste produced in the diagnosis, treatment, or vaccination of human beings or animals, in related research, or in the manufacture or testing of biologicals" under the United States Medical Waste Tracking Act of 1988. The World Health Organization (WHO) estimates that 20 percent of these medical wastes include hazardous compounds, which may be infectious, poisonous, or radioactive. However, there is no internationally agreed-upon definition of medical waste, which presents a comparative difficulty since differing definitions make it impossible to draw meaningful comparisons across nations, or even between areas within countries. Furthermore, as described later in this study, the lack of a common definition of medical waste has resulted in a lack of standardization of medical waste streams and disposal receptacles[6], [7].

Medical Waste Generation:

The quantity of medical waste produced at various healthcare institutions is obviously of interest, and many studies have been conducted on the topic. Many variables influence the volume and composition of medical waste created, with one research focused on Italian hospitals showing that the kind of sanitary service provided had a significant effect on the amount of infectious waste produced. According to the research, short-term patients in rehabilitation services produce up to 52 percent of all infectious medical waste, followed by analytical labs (23 percent), operations (14 percent), dialyses (7 percent), and first aid (7 percent) (4 percent). In a comparable research conducted in Taiwan, the dialysis unit was found to produce the most infectious medical waste (23%) followed by the intensive care unit (17%), emergency care unit (17%), and outpatient clinic (17%). It is important to adopt a standard foundation for quantification when assessing medical waste production so that data from various areas can be compared. The sections that follow provide a study of medical waste generation for various nations based on a variety of variables.

The Application of a Waste Production Metric:

It's difficult to choose an acceptable measure for comparing healthcare facilities and levels of medical waste generation. The most common measure for calculating the quantity of medical waste produced at a hospital is to take the total kilos of trash generated each day and divide it by the number of occupied beds. This results in kg/bed-day, a metric that attempts to adjust waste generation in hospitals for both the number of illnesses treated and the severity of patient maladies, as a single patient with a serious illness may occupy a hospital bed for many days, whereas a patient with a less serious injury may only occupy a bed for a few hours[8]–[10].

Practices in Use:

This section provides a quick summary of current infectious medical waste disposal methods, with an emphasis on those used in industrialized countries. This overview is broken down into

three parts: trash collection at the healthcare institution, transportation to the treatment site, and final treatment and disposal.

i. Collection and Separation of Medical Waste:

Waste is usually divided into color-coded bins or bags in hospitals and other healthcare facilities, with each receptacle denoting a particular waste stream or waste category. The color assigned to each waste stream, as well as the kinds of trash that go into each stream, differs by area, with some utilizing the source of waste as a foundation for sorting, while others use the probability of pathogenicity of an item to decide its disposal waste stream. Because of the absence of uniformity, it is difficult for healthcare personnel to sort trash effectively, and they tend to err on the side of caution, discarding items in the infectious waste stream and generating excessive infectious waste production.

Indeed, most academic studies have shown that the majority of hospital trash is non-infectious, allowing it to be disposed of in municipal landfills and recycling programs. This incorrect sorting has serious consequences, since infectious trash has a large cost premium to dispose of. In the United States, for example, infectious waste disposal costs $0.79 per kilogram, a 560 percent premium over the average non-infected waste disposal cost of $0.12 per kilogram. In the United Kingdom, average infectious waste disposal costs are about £0.45 per kilogram.

ii. Transportation of Medical Waste:

Medical waste transportation refers to the transport and processing of trash from healthcare facilities to treatment locations, which may be on-site at a hospital or off-site at a central facility. The treated waste residue, usually ash from an incinerator or trash sterilized via autoclaving or microwaving, is transported to a landfill for ultimate disposal in a second transportation step. It is standard practice for healthcare institutions to have their infectious waste stream transported by a third-party company that has been hired to transport the trash from the facility to an authorized waste disposal facility. These companies collect trash from a few key locations across a healthcare institution and transfer it to a disposal site that can properly handle medical waste. However, there are problems with the trash disposal contracting procedure.

The employment of third-party trash disposal companies presents a problem in terms of incentives, since waste disposal companies, or the people who work for them, may make significant amounts of money by illegally disposing of garbage. In industrialized nations, medical waste disposal costs are very expensive, with hospitals in the United Kingdom often paying more than £450 per tonne for contractors to dispose of their medical waste, and hospitals in the United States routinely spending $790 per tonne. These high costs encourage third-party medical waste haulage companies to dispose of medical waste without treatment in unregulated and less costly methods rather than transporting it to a professional sterilizing facility. Waste truck operators in Ireland may make over $2000 by unlawfully dumping a truck full of medical waste instead of transporting it to a licensed disposal facility, providing a significant incentive for illegal dumping. Illegal medical waste dumping is becoming more common in developed countries, and it may be especially problematic if the country's infectious medical waste monitoring system is inadequate. Illegal dumping is a major problem since these untreated infectious waste deposits pose a public health concern owing to the possibility for disease release, as well as a drain on public money because medical waste cleaning expenses are very expensive.

iii. Medical Waste Disposal Methods:

The safe disposal of contagious medical wastes is a major issue, according to the WHO, which states that "at present, there are virtually no ecologically acceptable, low-cost alternatives for the safe disposal of infectious wastes." According to research, 49-60 percent of medical waste is burned, 20-37 percent is autoclaved, and 4-5 percent is handled using alternative technologies in the United States. However, worries about air pollution have raised doubts regarding incineration's appropriateness as a treatment technique. Furthermore, medical trash includes considerably more plastic than normal municipal solid waste, resulting in the production of polychlorinated dibenzo-pdioxins (dioxins) and polychlorinated dibenzofurans (furans), both extremely hazardous chemicals, when medical waste is burned. As a result, alternative treatment techniques such as autoclaving and microwaving to destroy any germs present have become more popular.

Current Incineration Disposal Issues:

In industrialized countries, the most common way of disposing of infectious medical waste is incineration, which involves burning the wastes at very high temperatures until only ash remains. After that, the ash is sent to a landfill and buried. Incineration offers the advantages of guaranteeing sterilization by reducing infectious waste to an unrecognizable ash, as well as decreasing trash quantities, which lowers transportation and disposal expenses. The release of unwanted chemicals into the atmosphere is, however, a significant disadvantage of the medical waste incineration process. In most industrialized countries, incinerator emissions are strictly controlled due to the nature of infectious healthcare waste, which generates hazardous gases in significant amounts when burned. Dioxins, furans, and mercury are the three most dangerous toxins produced by medical waste incineration.

i. Emission Standards for Incinerators:

In November 1990, when the United States Congress enacted changes to the Clean Air Act, setting emission limitations for dioxins, furans, and mercury, among other pollutants, healthcare waste incineration regulations in the United States became tougher (Hg). Because the new limitations in the act were based on the greatest possible pollution reduction via control technology, these amendments to the Clean Air Act were designed to promote the use of pollution control equipment on source exhausts. After the EPA published its 1994 inventory of dioxin emission sources, which identified healthcare waste incinerators as the largest source of dioxin and furan emissions in America, American laws focused on emissions from municipal and healthcare waste incineration. Based on the EPA's findings and their own studies, most industrialized countries have tried to decrease dioxin and furan emissions from trash incineration, following the American lead.

ii. Emissions from Incinerators:

- *Emissions of dioxins and furans:*

The production of dioxins, furans, and similar chemicals during the combustion process is one of the main problems connected with the burning of infectious waste from healthcare institutions, according to research. Dioxins are organic compounds that have four to eight chlorine atoms replaced for hydrogen atoms on the benzene rings and are linked by two oxygen atoms. Dioxins are very persistent poisons that have a half-life of 7-11 years in humans and are mainly caused by human activities. They're known to be extremely carcinogenic and to damage human reproduction. Furans are structurally similar to dioxins, but they only contain one oxygen atom

between the two benzene rings, yet they're just as deadly. The word dioxin will be used throughout this article to refer to dioxin, furan, and related chemicals.

- *Mercury emitted:*

In North America, trash incineration, both medical and municipal, is projected to account for 13% of anthropogenic mercury emissions, second only to coal combustion (at 55%) as an emissions source. Infectious medical waste incinerators are thought to be responsible for 9% of yearly mercury emissions in Canada. Furthermore, trash incineration accounts for at least 3% of worldwide anthropogenic mercury emissions. Because airborne mercury may easily enter the body via the lungs and deposit in fatty tissue, atmospheric mercury emissions represent a major health and environmental danger. This is worrisome since high mercury levels in the body have been linked to neurological, excretory, and reproductive system harm.

DISCUSSION

Medical trash is disposed of after it has been sterilized to make it safe to handle. Even non-recyclable waste, such as gauze or needles, must be rendered hygienic and non-hazardous before being disposed of. An autoclave is often used for this procedure. Medical waste is divided into four categories: infectious, dangerous, radioactive, and general. Highly infectious waste is defined as cultures and stocks of highly infectious agents trash from autopsies, animal corpses, and other waste materials that have been inoculated, infected, or in touch with such agents. Biomedical waste is often burned. An autoclave sterilizes trash or reduces its microbial burden to a point where it may be safely disposed of using steam and pressure. Many healthcare institutions utilize an autoclave to sanitize medical items on a regular basis.

CONCLUSION

Medical waste disposal is a subject that needs more research in order to satisfy the increasing worldwide demand. Medical waste output is growing as a result of rising healthcare use, which is placing strain on existing disposal systems due to a number of reasons. Current waste disposal methods include sorting trash at the point of disposal inside healthcare institutions, transferring infectious medical waste to a safe disposal location, where it is treated by incineration or autoclaving, and the leftover product is land filled. Both incineration and autoclave treatment have disadvantages, with incineration not producing harmful atmospheric emissions that have negative health and environmental consequences, and autoclave treatment not being able to handle all types of waste or producing a treated product that is universally accepted at landfills. The greatest approach to reduce the impact of medical waste is to generate less of it, and one of the most effective ways to do so is to guarantee that only contagious medical waste is sent for treatment; all other hospital trash should be handled like municipal home waste. Better training of healthcare personnel, as well as the adoption of standardized medical waste streams and disposal bin colors, may help achieve this.

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