CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187
https://zenodo.org/uploads/11551380

https://www.iajps.com/volumes/volume11-june-2024/08-issue-06-june-24/

Available online at: http://www.iajps.com *Review Article*

SURVEY OF BIOMEDICAL WASTE MANAGEMENT

Ms. Sakshi V. Jaiswal [1], Mr. Kanhaiya P. Bhansali[1], Mr Kaustubh S. Ugle [1], Pro. Mr.Naved Khan [2], Dr. K. Rajarajeswari [3]

Student of Pharmacy Department in Hospital Pharmacy,
Vardhaman Collage of Pharmacy, Koli, Karanja (Lad), Washim, Maharashtra, India

Abstract:

Biomedical waste management is an integral part of traditional and contemporary system of health care. Wefocuses on the identification and classification of Biomedical waste in Hospitals, Clinics, Pharmacy, Pathology Lab it's management and it's future prospective.

The constituents of this type of waste are various and hazardous. Biomedical Waste Management Rules, 2016 (BMWM Rules, 2016) Specify that every healthcare facility shall take all necessary steps to ensure that BMW is handled without any adverse effect on human and environmental health.

Then used colour coding and type of containers and labels for BMW containers or bags which should be non-washable and visible.

We aware in hospital, Pharmacy, pathology lab, to insect incineration process and used it.Because the incineration process safe and reduce the pollution.

Keywords: Bio-medical waste, Bio-medical waste management, Segregation, Collection, Transportation, Disposal.

Corresponding author:

Sakshi V. Jaiswal,

Student of Pharmacy Department in Hospital Pharmacy,
Vardhaman Collage of Pharmacy, Koli, Karanja (Lad),
Washim, Maharashtra, India

QR code

Please cite this article in press** Sakshi V. Jaiswal **et al, Survey Of Biomedical Waste Management.,Indo Am. J. P. Sci, 2024; 11 (6).

INTRODUCTION:

The biomedical waste (BMW) is defined as any solid, liquid, and waste material generated during the process of diagnosis, treatment, and immunization of human being or animal. This waste material could cause serious hazards and environment in case of improper management. All the hospital personnel are at therisk of developing fatal infections such as HIV, hepatitis B virus, and hepatitis C virus and injuries by these infectious materials. To avoid these hazards, BMW management system should be implemented in the hospital system. Most of this waste is not more dangerous than regular household waste. However, some types of health-care waste represent a higher risk to health.

The BMW generated in the dental clinics can be classified into sharp instruments, used disposable iterns, infectious waste (blood-soaked cotton, gauze, etc.) hazardous waste such as mercury and lead, and chemical waste such as film developer, fixers, and disinfectant. The largest BMW in our field is handling of mercury and disposal of lead. Dentist and dental personnel have been directly and indirectly exposed to mercury (Hg) emission from incinerator and Hg from wastewater from different sources. The release of amalgam during practice in clinics and hospitals wastewater or in solid waste is an important concern as these particles could be released into the environment [2].

Hospital waste management has been brought into focus in India recently particularly with the notification of the BMW (BMW management and handling) rules, 1998. The rules make it mandatory for health-care establishments to segregate, disinfect, and dispose their waste in eco-friendly manner.[3] A major issue related to current BMW management in many hospitals is that practice of biowaste regulation is unsatisfactory as some hospitals are disposing of waste in a haphazard improper and indiscriminate manner. Handling, segregation and mutilation, disinfection, storage, transportation, and final disposal are vital steps for safe and scientific management of BMW in any establishment. Health-care-associated infections result in increased length of stay, mortality, and health-care costs. [4]

India approximately generates 2 kg/bed/ day 3 and this biomedical waste encompasses wastes like anatomical waste, cytotoxic wastes, sharps, which when inadequately segregated could cause different kinds of deadly infectious diseases like Human immunodeficiency virus (HIV) hepatitis C and B infections, etc,4 and also cause disruptions in the environment, and adverse impact on ecological balance. [5],[6] Adequate knowledge amongst the health care employees about the biomedical waste management rules and regulations, and their understanding of segregation, will help in the competent disposal of the waste in their respective organizations.[7] Acceptable management of biomedical waste management begins from the initial stage of generation of waste, segregation at the source, storage at the site, disinfection, and transfer to the terminal disposal site plays a critical role in the disposal of waste. Hence adequate knowledge, attitudes and practices of the staff of the health care institutes play a very important role. [8],[4],[9] Teaching institutes play a critical role in the health care setup as it is from these places that the future health care professionals and all those persons involved in the care giving to the community are trained.[10] Studies documented from different parts of the country; still convey that there are gaps in the Knowledge, lacunae in the attitudinal component and inconsistency in the practice aspects which are matters of concern among the health care professionals [8],[11]-[15] carried out to assess the current knowledge, attitude and practices of the health care workers like doctors.

Waste means any useless, unwanted or discarded substance or material, irrespective of whether or not suchsubstance or material has any other or future use. This includes any substance or material that is spilled, leaked, pumped, poured, emitted, emptied or dumped onto the land or into the water or ambient air. Wastegenerated by health care activities includes a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals medical devices and

LITERATURE SURVEY:

V. Chitnis, et al., (2005) :- Histopathology specimens could be washed with water to remove formalin and then sent in yellow polythene bags to central common facility for incineration. The most important infectious material is bacteriology waste in the form of cultures/samples and needs to be autoclaved beforewashing/disposal.

H. Glasser, et al., (2012) :- Several steps to reduce the health risks associated with BMWI are suggested by the analyses. First, reduce metals input into the incinerator by alternative disposal; metallic "sharps" sterilization followed by grinding or solidification and landfill should reduce Cr+6 emissions to negligible levels. Second, introduce strict segregation programs, such as eliminate use of disposable flashlights in favor of alternatives, keep general wastes out of the incinerator and require manufacturers to reformulate products- require certification that products destined for the infectious waste stream not contain Pb, Cd or Cr. Third, reduce dependence upon

A. Sharma, et al., (2013) :- All measures should be adopted to inform the public about legislation regarding BM waste management, including the risks involved in scavenging discarded needles and other sharp items. This may not be easy as often it is illiterate and very poor people who are the scavengers.

K. Selvaraj, et al., (2013) :- Biomedical waste management rules should be followed in all hospitals and clinics. Bio medical waste, in addition to the risk for patients and medical personnel, also poses a threat to public health and environment. To assess the existing Knowledge and Practice of BMW among the general practitioners in Kanchipuram town, a Descriptive Cross sectional study was conducted using pre-tested structured questionnaire.

A. Tiwari et al., (2013) :- Hospitals, clinics, research centers and health care centers use wide variety of drugs including antibiotics, radioactive substances, corrosive chemicals, which ultimately contribute in Bio medical waste. In the country like India the total amount of municipal waste a city generates, only 1 to 1.5% is Bio medical waste, of which 10-15% is considered infectious. Whereas, In developed countries due to increased use of disposables the waste produced has been up to 5.24 Kgs per bed per day.

M. Capoor, et al., (2020) :-Thermal: Autoclaves: Steam treatment technologies Autoclaves sterilise a range of infectious waste (cultures, stocks, sharps, materials contaminated with blood and fluids), laboratory wasteand linen waste, medical instruments and for the treatment of BMW. Unlike instrument sterilisation autoclaves, waste-treatment autoclaves (prevaccum autoclaves) must treat the air that is removed at the start of the process to prevent the release of pathogenic aerosols through a high-efficiency particulate air filter before it is released and therefore require less time for action and have greater efficiency.

H. Bansod et al., (2023) :- Autoclaving is an alternate method of incineration. The mechanism of this process involved sterilization using steam and moisture. Operating temperatures and time of autoclaving is 121°C for 20-30 minutes. The steam destroys pathogenic agents present in the waste and also sterilizes the equipment used in the healthcare facility. Autoclaving has no health impacts and is very cost-friendly.

BIOMEDICAL WASTE

Hospitals, clinics, research centers and health care centers use wide variety of drugs including antibiotics, radioactive substances, corrosive chemicals, which ultimately contribute in Bio medical waste. In the country like India the total amount of municipal waste a city generates, only 1 to 1.5% is Bio medical waste, of which 10-15% is considered infectious. Whereas, In developed countries due to increased use of disposables the waste produced has been up to 5.24 Kgs per bed per day. In hospitals of United Kingdom's, France, Norway, Spain, Netherlands,

USA and Latin America, waste produce is 3.3 Kgs, 2.5 Kgs, 3.9 Kgs, 4.4 Kgs, 4.2 Kgs, 4.5 Kgs and 3.8 Kgs per bed per day respectively which is on very higher side as. Compare to developing country like India.

Most hospitals in India generate 1-2 Kgs per bed per day, except the tertiary care hospital (e.g. AIIMS and SKIMS) which produce waste on higher side. According to World Health Organization (WHO) estimates 85% of Bio medical waste is actually non-hazardous and around 10% is infectious while the remaining 5% is non-infectious but consists of hazardous chemicals like methyl chloride and formaldehyde (Glenn and Garwal, 1999). It is estimated, a city like New Delhi with about 40,000 beds generates about 60 metric tons of Bio medical waste per day. Bio medical waste, till recently was not being managed but it was simply 'disposed off. The disposal of Bio medical waste can be very hazardous particularly when it gets mixed with municipal solid waste and is dumped in uncontrolled or illegal landfills such as vacant lots in neighboring residential areas and slums. This can lead to a higher degree of environmental pollution, apart from posing serious public health risks such as AIDS, Hepatitis, plague, cholera, etc.

Johannessen et al (2000) opine that proper management of medical waste can minimize the risk both within and outside healthcare facilities. The first priority is to segregate wastes, preferable at the point of generation into reusable and non-reusable, hazardous and non- hazardous components. There are generally four key steps to medical waste management: segregation into various components, including reusable and safe storage in appropriate containers; transportation to waste treatment and disposal sites, treatment and final disposal.

Acharya and Singh (2000) also identified the medical waste management process to include, handling, segregation, mutilation, disinfection, storage, transportation and final disposal. According to Rao, Ranyal and Sharm (2004), the key to minimization and effective management of medical waste is segregation (separation) and identification of the waste. They recommend that the most appropriate way of identifying the categories of medical waste is by sorting the waste into colour coded plastic bags or containers. Medical waste should be segregated into containers/ bags at the point of generation. It should provide an easy access to waste collection vehicle (Srivastava, 2000). All disposable plastic should be subjected to shredding beforedisposing off to vendor. Final treatment of medical waste can be done by technologies like incineration, autoclave, hydroclave or microwave (Rao et al, 2004).

CLASSIFICATION AND COMPONENTS OF BIOMEDICAL WASTE

The World Health Organization (WHO) has classified medical waste into eight categories such as General Waste, Pathological, Radioactive, Chemical, Infectious to potentially infectious waste, Sharps, Pharmaceuticals, Pressurized containers.

Whereas, In India, Ministry of Environment and Forest, Government of India (1998) has notified Bio-medical Waste (Management & Handling) Rules - 1998, which describes ten categories as follows

SOURCES OF GENERATION OF BIOMEDICAL WASTE

Although the solid waste management has become one of the major topic of importance but still local bodiesare unable to give the proper attention towards some special sources of wastes out of which biomedical waste is one. The sources of biomedical waste can be categorized as primary and secondary sources according to the quantities produced. While minor and scattered sources may produce some biomedical waste in categories similar to Bio medical waste, their composition will be different.

Primary and Secondary Sources of Generation of Biomedical Waste

Primary sources		**Secondary sources**
Hospital	Medical College	Clinic
Nursing Home	Immunization centers	Ambulance Service
Dispensaries	Nursing Homes	Home treatment
Maternity home	Animal research centers	Slaughter houses
Dialysis center	Blood bank	Funeral Service
Research lab	Industries	Educational institutes

Hazards From biomedical waste

Implementation of rules and regulation of the biomedical waste management systems in India is major drawback of the whole system. The doctors, nurses, technicians, sweepers, hospital visitors, patients, rag pickers and their relatives are exposed routinely to Bio-Medical Waste and are at more risk from the many fatal infections due to indiscriminate management. Due to improper management of the biomedical waste this infectious waste gets mixed with solid waste. During the rainy season infectious substance may get added to the ground water and spreads hazardous diseases

Legislative Aspect In Relation To Biomedical Waste

Various central legislation related to biomedical waste management in India are as follows

1. The water (prevention and control of pollution) Act, 1974
2. The Air (prevention and control of pollution) Act, 1981
3. The Environment(Protection) Act, 1986
4. The hazardous waste(management and handling) rules, 1998
5. The Biomedical waste(management and handling) rules, 1998

It may be kept in mind that any person can report any alleged negligence in Management and Handling of Bio- Medical Waste to the appropriate authority.

OBJECTIVE AND GOLES

The objective of a project on biomedical waste management is to ensure the safe and proper disposal owaste generated from healthcare facilities like hospitals, clinics, and labs. The main goals include protecting the environment, preventing the spread of infections, and promoting public health. Proper management of biomedical waste involves segregating, collecting, transporting, treating, and disposing of the waste in a way that minimizes risks to human health and the environment. It's essential to follow guidelines and regulations to handle biomedical waste effectively.

Awareness in Hospital, Pharmacy, Pathology lab to insert the Incineration machine

1. Destruction of Pathogens:
 Incineration at high temperatures ensures the complete destruction of pathogens, including bacteria, viruses, and other microorganisms present in biomedical waste. This helps prevent the spread of infections and diseases
2. Volume Reduction:
 Incineration reduces the volume of waste by converting it into ash and gases. This helps in managing thelarge quantities of waste generated by healthcare facilities and minimizes the need for storage and transportation.
3. Elimination of Sharps:
 Incineration is an effective method for disposing of sharps, such as needles and syringes, which pose a significant risk of injury and infection if not properly managed. Incineration ensures their complete destruction.
4. Energy Recovery:
 Incineration can also generate heat or electricity through waste-to-energy technologies. This allows for the recovery of energy from the incineration process, contributing to sustainable waste management practices.
5. Compliance with Regulations:

Waste Category	**Waste Content**	**Components**	**Method of treatment and disposal**
Category 1	Human Anatomical Waste	(Anatomical waste is any waste products containing human (or animal) tissue, blood, or body parts)	Incineration /deep burial
Category 3	Microbiology & Biotechnology Waste:	(Wastes from laboratory cultures, stocks or specimens of micro- organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transferof cultures)	Local autoclaving / micro waving / incineration
Category 4	Waste Sharps:	(Needles, syringes, scalpels, blades,glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	Disinfections chemical treatment / autoclave / micro waving and mutilation shredding
Category 5	Discarded Medicine and Cytotoxic drugs:	(wastes comprising of outdated, contaminated and discarded medicines)	Incineration / destruction and drug disposal in secured landfills
Category 6	Soiled Waste:	(Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, linesbeddings, other material contaminated with blood)	Incineration , autoclaving / micro waving
Category 7	Solid Waste:	(Wastes generated from disposable items other than the waste [sharps] such as tubings, catheters, intravenous sets etc.)	Disinfections chemical treatment / autoclave / micro waving and mutilation shredding
Category 8	Liquid Waste:	(waste generated from laboratoryand washing, cleaning, housekeeping and disinfecting activities)	Disinfections by chemical treatment anddischarge into drains
Category 9	Incineration Ash:	(ash from incineration of any bio-medical waste)	Disposal in municipal landfill

CATEGORY AND COMPONENTS OF BIOMEDICAL WASTE

Category10	Chemical Waste:	(Chemicals used in production of biomedical, chemicals used in disinfection, as insecticides etc.)	Chemical treatment and discharges into drains

TYPICAL COMPOSITION AND CHARACTERISTICS OF INFECTIOUS WASTE

Particulars	Percent
Composition :	
Celluloid Material (paper & Cloth)	50-70%
Plastics	20-60%
Glassware	10-20%
Fluids	1-10%
Typical Characteristics :	
Moisture	8.5-17% by weight
Incombustibles	8% by weight

GENERAL METHODS EMPLOYED FOR DISPOSAL OF BIOMEDICAL WASTE IN VARIOUS COUNTRIES

Sr.No	Name of country	General Methods employed for Disposal of Biomedical waste	References
1	Mongolia	Open dumping or open burning, Incineration, Autoclaving	Shinee et al. (2008)
2	Iran	Landfill, Incineration, Sewers	M. H. Dehghani et al. (2008)
3	India	Landfill, Incineration, Autoclaving, Recycling – reuse	Yashasvi et al. (2012)
4	Bangladesh	Dumping	Hassan et al. (2008)
5	Malaysia	Landfill, Incineration, Recycling	Hossain et al. (2011)
6	Libya	Dumping, Incineration	Sawalem et al. (2009)
7	Greece	Recycling- Reuse, Pyrolytic combustion, Landfill	Tsakona et al. (2007)

NEED FOR BMW MANAGEMENT IN HOSPITALS

BMW threatens the health of medical staff, hospital-visiting patients, and people in the nearby community. Improper disposal leads to severe hospital-acquired diseases along with an increased risk of air and water pollution. Due to open-space waste disposal practices, animals and scavengers might get infected, leading tothe scattering of waste and the spreading of infections. In countering such activities, four major principle functions of BMW management are applicable: the placement of bins at the source of generation of BMW, segregation of BMW, removal or mutilation of the recyclable waste, and disinfection of the waste. BMW management methods aim predominantly to avoid the generation of waste and, if generated, then recover as much as possible [23].

BMW MANAGEMENT RULES IN INDIA

On March 28, 2016, under the Environment (Protection) Act, 1986, the MoEF notified the new BMW Rules, 2016 and replaced the earlier Rules (1988). BMW produced goes through a new protocol or approach whichhelps in the appropriate management of waste, i.e., its characterization, quantification, segregation, storage, transport, and treatment, all of which aim to decrease environmental pollution [24]. Problems with the improper management of BMW also shed light on the scavengers who, for recycling, segregate the potentially hazardous BMW without using gloves or masks. Strict rules have been implemented to ensure that there is no stealing of recyclable materials or spillage by some humans or animals and that it is transported to the common BMW treatment facility. The first solution to stop the spread of hazardous and toxic waste was incineration. Incineration is required in all hospitals and healthcare facilities that produce BMW. However, due to the absence of services that provide certified incinerators in a few countries, BMW has to be sent to landfills, which leads to land contamination and harms the environment [25].

Incinerators used for disposal might also lead to environmental pollution.

STEPS IN THE MANAGEMENT OF BMW

BMW management needs to be organized, as even a single mistake can cause harm to the people in charge. There are six steps in the management of BMW [27] surveying the waste produced; segregating, collecting, and categorizing the waste; storing, transporting, and treating the waste. Segregation is the separation of different type of waste generated, which helps reduce the risks resulting from the improper management of BMW. When the waste is simply disposed of, there is an increased risk of the mixture of waste such as sharps with general waste. These sharps can be infectious to the handler of the waste. Further, if not segregated properly, there is a huge chance of syringes and needles disposed of in the hospitals being reused. Segregation prevents this and helps in achieving the goal of recycling the plastic and metal waste generated [28]. According to Schedule 2, waste must be segregated into containers at the source of its generation, and according to Schedule 3, the container used must be labelled. The schedules of BMW (Management and Handling) Rules, 1998, which were initially ten in number, have now been reduced to four [29] . The collection of BMW involves the use of different colours of bins for waste disposal. The colour is an important indicator for the segregation and identification of different categories of waste into suitable coloured containers. They must be labelled properly based on the place they have been generated, such as hospital wards, rooms, and operation theatres. It is also very important to remember that the waste must be stored for less than 8-10 hours in hospitals with around 250 beds and 24 hours in nursing homes. The storagebag or area must be marked with a sign [28].

HOW TO PROPERLY MANAGE BIOMEDICAL WASTE

There are a number of steps that can be taken to properly manage biomedical waste. These steps include:

1. Classification: Biomedical waste must be classified according to its risk level. This will determine how it is handled and disposed of.
2. Containment: Biomedical waste must be contained in secure containers to prevent leakage andcontamination.
3. Labeling: Biomedical waste containers must be labeled clearly to identify the type of waste and itsrisk level.
4. Collection: Biomedical waste must be collected regularly and transported in secure containers.
5. Treatment: Biomedical waste must be treated to render it safe before it is disposed of. This may involve incineration, chemical treatment, or other methods.
6. Disposal: Biomedical waste must be disposed of in a secure landfill or other approved facility.

TYPES OF DUSTBINS AND ITS USES

Fig TYPE OF DUSTBINS AND ITS USES

<table>
<tr><td>Type Green Dustin</td><td>
</td></tr>
<tr><td>Type Blue Dustin</td><td>
</td></tr>
<tr><td>Type Red Dustin</td><td>
</td></tr>
<tr><td>Type Yellow Dustin</td><td>
</td></tr>
<tr><td>Type Black Dustin</td><td>
</td></tr>
</table>

INCINERATION

According to the World Meteorological Organization (WMO), year 2016 made history, with a record global temperature, exceptionally low sea ice, unabated rise of sea level and an increase of ocean temperature.

Extreme weather and climate conditions have continued into 2017. By three mean dataset used by WMO, 2016 was 0.83 °C +/- 0.10 °C warmer than average of reference period from 1961-1990, 0.52°C above 1981- 2010 average, 0.06 °C above previous highest value set in 2015 and it was also 1.1 °C above pre-industrial period.

With carbon dioxide reaching a record annual average concentration of 400 ppm (ppm) in the atmosphere, human activities influence over climate system has become more and more evident.

Other environmental problem is a growing amount of generated municipal solid wastes (MSW). As global population increases dramatically, there is also systematic changing consumption patterns, economic development, rapid urbanization and industrialization, because of this, MSW is being generated at a rate that outstrips capability of natural environment to assimilate it and of municipal authorities to manage it.

Moreover MSW is the fourth largest global emissions contributor; approximately 550 Tg of global methane emissions per year.

Recently waste-to-energy incineration is receiving a growing attention in many countries, due to need of promotion of renewable energy developments and pressure over an efficient land use. Incineration is suitable WtE technology for MSW energy recovery especially with non- biodegradable matter and low moisture content.

WtE plants have dual objective: reducing amount of waste sent to landfills and simultaneously, to produce useful energy (heat and/or power). However, some incineration plant suffers high ignition loss, due to high excess of air often required to attain an acceptable burnout, in addition to low efficiency induced by high internal energy consumption causes by waste handling.

WtE supply chain provides a method of simultaneously addressing problems of energy demand, waste management and GHG emissions, achieving a circular economy system (CES). In other words, CES is basedon "win-win" philosophy stating that a prosper economy and healthy environment can co-existed. Energy efficiency, an efficient energy transformations and effective energy recovery should be insured to avoid unnecessary entropy production but also to make processes more cost effective and ecofriendly.

Last generation of incineration plant is characterized by an improvement of chemical conversion process, and by advanced technologies of pollution control systems. Today there are efficient industrial units integrating destroying hazardous organic substances, recovering energy and materials, and saving landfill space.

There are 86 facilities in the United States recovering energy from combustion of municipal solid waste. Those 86 facilities have capacity to produce 2720 megawatts of power per year by processing more than 28 million tons of wastes. In the EU 28 in 2014, 27.3% of municipal wastes are incinerated (total incineration including energy recovery). In Japan, approximately 80% of MSW are incinerated, where energy recovery has been included in a certain proportion of waste incineration plants and Chinese Government put forward "The 12 th Five-Year Plan (2011-2015)", which specified that electricity generated from waste incineration technologies will grow by 10%, reaching a proportion of 30% of the total energy (mix) in 5 years.

volume of waste in a built-in compressor before delivery to the incinerator. Alternatively, at landfills, the volume of the uncompressed garbage can be reduced by approximately 70% by using a stationary steel compressor, albeit with a significant energy cost. In many countries, simpler waste compaction is a commonpractice for compaction at landfills.

Incineration has particularly strong benefits for the treatment of certain waste types in niche areas such as clinical wastes and certain hazardous wastes where pathogens and toxins can be destroyed by high temperatures. Examples include chemical multi-product plants with diverse toxic or very toxic wastewater streams, which cannot be routed to a conventional wastewater treatment plant.

Waste combustion is particularly popular in countries such as Japan, Singapore and the Netherlands, where land is a scarce resource. Denmark and Sweden have been leaders by using the energy generated from incineration for more than a century, in localized combined heat and power facilities supporting district heating schemes. In 2005, waste incineration produced 4.8% of the electricity consumption and 13.7% of the total domestic heat consumption in

Denmark. A number of other European countries rely heavily on incineration for handling municipal waste, in particular Luxembourg, the Netherlands, Germany, and France.

Fig INCINERATION MACHINE

METHODOLOGY:

Data collect from 1 Government Hospital, 2 Private Hospital,3-4 Pharmacy, Ayurveda Clinics are used to identify the type of waste the amount of waste generated and the which disposal technique follow. We makesome questions about the waste management and asking to them in survey. Awareness to insert incinerationprocess

VARDHAMAN COLLAGE OF PHARMACY KOLI KARANJA LAD

Assessment of Biomedical Waste

Tick the appropriate answer:

Your position:

☑Doctor/Dentist ☐Class IV employee ☐Nurse ☐Lab technician

Section1:Knowledge of biomedical (BM) waste generation, hazard sand legislation

1. Do you know about BM waste generation and legislation?
   Yes ☑ No ☐ Notsure ☐
2. What agency (ies) regulate(s) wastes generated at healthcare facilities?
   State ☑ Private ☐Do not know ☐
3. Do you think it is important to know about BM waste generation, hazard sand legislation?
   Yes ☑ No ☐ Some what ☐
4. Biomedical Waste (Management & Handling) Rules were first proposed in:
   ☐1997 ☑1998 ☐1999 ☐2000
5. Amendments to the Biomedical Waste (Management & Handling)Rules we made in:
   ☑2000 ☐2001 ☐2003 ☐2004
6. Which statement describes one type of BM waste:
   ☐Materials that may be poisonous, toxic, or flammable and do not pose disease-related risk.
   ☐Waste that is saturated to the point of dripping with blood or body fluids contaminated with blood.
   ☐Waste that does not pose a disease-related risk.
7. According to the Biomedical Waste (Management &Handling)Rules, waste should not be stored beyond:
   ☐12hours ☑48hours ☐72hours ☐96hours
8. One gram of mercury (source from dental amalgam)is enough to contaminate the following surface area of a lake:
   ☐20acres ☐30acres ☑25acres ☐15acres
9. Who regulates the safe transport of medical waste?
   ☐Pollution Control Board of India.
   ☑Transport Corporation of India.
   ☐College Administration.
10. Do you need a separate permit to transport biomedical waste?
    Yes ☐ No ☐ Cannot say ☑

PGD/MLT/0105/2021

Section2: Level of awareness on biomedical waste management practice

11. Do you know about colour-coding segregation of BM waste?
Yes ☑ No ☐ Not sure ☐

12. Do you follow colour-coding for BM waste?
Yes ☐ No ☑ Sometimes ☐

13. Is the waste disposal practice correct in your hospital?
Yes ☐ No ☐ Cannot comment ☑

14. Objects that may be capable of causing punctures or cuts, that may have been exposed to blood or body fluids including scalpels, needles, glass ampoules, test tube sand slides, are considered biomedical waste how should these objects be disposed of?
☐Black bags ☐Yellow bags ☐Clear bags ☑Sharps container

15. Documents with confidential patient information are to be disposed of into the paper recycling bins.
True ☐ False ☐ Do not know☑

16. The colour code for the BM waste to be autoclaved, disinfected is:
☑Red ☐Black ☐Yellow ☐Blue/white

17. The approximate proportion of infectious waste among total waste generated from a healthcare facility is:
☐10-20% ☐30-40% ☑50-60% ☐80-90%

18. The colour code for disposal of normal waste from the college is:
☑Red ☐Black ☐Yellow ☐Blue

19. All the following steps should be followed after an exposure with infected blood/body fluid and contaminated sharps EXCEPT:
☐Exposed parts to be washed with soap and water.
☐Pricked finger should be kept in antiseptic lotion.
☑Splashes to eyes should be irrigated with sterile irrigants.
☐Splashes to skin to be flushed with water.

20. All of the following statements about hazardous waste containers are true, except for:
☐Containers must be closed except when removing or adding waste.
☐Containers must be clean on the outside.
☐Contents must be compatible with the type of waste containers.
☐Any type of container, including food containers, can be used to contain hazardous waste.

Shree Medical Stores
Sailila Sankul, Mangrul Road
Karanja(Lad) Dist. Washim
22-05-2024.

Section3: Attitude/behaviour assessment towards biomedical waste

21. Safe management of healthcare waste is not an issue at all.
    Agree ☐ Disagree ☐ Cannot comment ☐
22. Waste management is teamwork/no single class of people is responsible for safe management.
    Agree ☐ Disagree ☐ Cannot comment ☐
23. Safe management efforts by the hospital increase the financial burden on management.
    Agree ☐ Disagree ☐ Cannot comment ☐
24. Safe management of healthcare waste is an extra burden on work.
    Agree ☐ Disagree ☐ Cannot comment ☐
25. Do you think that the college should organ is separate classes or a continuing dental education program to upgrade existing knowledge about biomedical waste management?
    Yes ☐ No ☐ Cannot comment ☐
26. Will you like to attend voluntarily program that enhance and upgrade your knowledge about waste management?
    Yes ☐ No ☐ Cannot comment ☐
27. Do you think that infectious waste should be sterilised from infections by autoclaving before shredding and disposal?
    Yes ☐ No ☐ Cannot comment ☐
28. Do you think that an effluent treatment plant ford is infection of infected water should be setup in dental colleges?
    Yes ☐ No ☐ Cannot comment ☐
29. Do you think it is important to report to the Pollution Control Board of India about a particular institution if it is not complying with the guidelines for biomedical waste management?
    Yes ☐ No ☐ Cannot comment ☐
30. Do you think that labelling the container before filling it with waste is of any clinical significance?
    Yes ☐ No ☐ Cannot comment ☐

RAMAR... DENTAL CLINIC
Post-Office Road,
At. MANGRULPIR Dist.Washim

Section4: Level of knowledge among nurses, doctors, attendants , lab technicians on needle- stick injuries.

31. Is needle-stick injury a concern?
Yes ☑ No ☐ Do not know ☐

32. Do you re-cap the used needle?
Yes ☑ No ☐ Do not bother ☐

33. Do you discard the used needle immediately?
Yes ☑ No ☐ Have not noticed ☑

34. Are you aware of consequences of needle-stick injury? ☑ Not concerned ☐

35. Have you sustained a needle stick injury during the last 12months?
Yes ☑ No ☐ Do not remember ☐

36. If yes, how many injuries? more than 10.

37. How did the most recent incident happen?
Poor disposal of needle ☐ Individual carelessness/accident ☑
Cannot remember ☐ Other (specify)

38. To whom did you report the injury?
Line manager ☐ Occupational health ☐
Infection scontrol ☐ Nobody ☑
Cannot remember ☐ Other (specify) ☐

39 Did you fill in an incident report?
Yes ☐ No ☑ Cannot remember ☐

40. Have you been fully in an inoculated against hepatitis B?
Yes ☑ No ☐ Not sure ☐

Thanku for your valuable time and cooperation

Dr. Keetish S. Chauhan
M. D. S.
(Conservative Dentistry & Endodontics)
Reg No. A-2522

1. Segregation: Segregate the biomedical waste into different categories, such as infectious waste, sharps, pathological waste, etc. This helps ensure proper handling and treatment.
2. Collection: Collect the segregated waste in appropriate containers that are leak-proof and labeled correctly. Use separate containers for each category of waste. Bio medical waste, in addition to the risk for patients and medical personnel, also poses a threat to public health and environment. To assess the existing Knowledge and Practice of BMW among the general practitioners in Kanchipuram town, a Descriptive Cross sectional study was conducted using pre-tested structured questionnaire.
3. Incineration Facility: Send the collected waste to a licensed incineration facility that follows allenvironmental and safety regulations. These facilities have specialized equipment for waste incineration.
4. Incineration Process: The waste is fed into the incinerator, where it is subjected to high temperatures. The heat generated during incineration helps destroy pathogens and reduce the volume of waste.
5. Emission Control: Incineration facilities have pollution control systems to minimize the release ofharmful gases and pollutants into the atmosphere. These systems include filters and scrubbers.
6. Ash Disposal: After incineration, the remaining ash is collected and disposed of in accordance withlocal regulations. Ash may be sent to a landfill or undergo further treatment if required.
7. Technology has allowed ash to have great uses after the incineration process. Ash can be used as theunderlay for new roads, used in concrete for construction and even used as a fertilizer if the waste isorganic.

ASH CHARACTERIZATION METHODS

The properties of ashes can be separated into two parts: physical properties and chemical properties. By knowing the properties of ashes, mainly chemical properties, we can ensure selection of the most suitableway for ash utilization.

Physical properties

1. Particle size distribution
2. Moisture content
3. Bulk density
4. Compressive strength
5. Permeability
6. Porosity

Chemical properties

1. Chemical composition
2. Loss on ignition
3. Heavy metals and leach ability
4. Organic constituents
5. Chloride content

CHARACTERIZATION OF INCINERATION ASHES

The composition of municipal solid waste varies over time and from country to country, due to the differences in lifestyle and waste recycling processes of a country; the ash content will vary too. Generally, the chemical and physical characterization of ash will depend on the compositions of the raw MSW, the operational conditions, the type of incinerator and air pollution control system design. The chemical composition shows that the major elements are Si, Al, Fe, Mg, Ca, K, Na and Cl. Further, SiO_2, Al_2O_3, CaO, Fe_2O_3, Na_2O, K_2O are the common oxides found in ash.

APPLICATIONS OF MSWI ASHES

After the above treatments, the ashes are much more usable. To determine the possibility of application, there are three main factors to address: suitability for processing, technical performance and environmentalimpact [99].

Type	Application	Composition%	Country	Authors
BA	Aggregate in concrete	up to 50% replace up to 15% of	France	[100]
BA	Aggregate in concrete	Cement	Slovenia	[101]
BA	Road base		Spain	[39]
BA	Absorbent for dyes		India	[29]

BA	concrete		Italy	[102]
Mixed ash	Cement clinker	up to 50%	Portugal	[103]
Mixed ash	Cement clinker	44%	Japan	[31]
Mixed ash	Cement clinker	15%	Taiwan	[30]
Mixed ash	Cement clinker	1.75%FA3.5%BA	Taiwan	[24]
Mixed ash	Aggregate in concrete		Spain	[27]
FA	Concrete	50%	France	[104]
FA	Eco cement	50%	Japan	[105]
FA	Ceramic tile Binder for stabilizing		China	[26]
FA	Sludge	45% 75%FA,20%SiO_2,	China	[32]
FA	Glass ceramic	5%MgO,2%TiO_2	Korea	[106]
FA	Glass ceramic(low melting temperature)	replace up to 30%of	China	[28]
FA	Cement clinker	raw material	China	[107]
FA	Blended cement	up to 45%	UK	[108]

Here, seven methods for the utilization of MSWI ash are reviewed, namely, cement and concrete production, road pavement, glasses and ceramics, agriculture, stabilizing agent, adsorbents and zeolite production.

CEMENT AND CONCRETE PRODUCTION

Since MSWI ash contains CaO, SIO2, Fe2O3, and Al_2O, and the fact that a considerable amount of cement was used for the production of mortar and concrete, the composition of fly ash and bottom ash is similar to the composition of raw materials for cement production. Thus, it could be a possible replacement of raw material in Portland cement production. R. Kikuchi has shown that the addition of MSWI ash for clinker production will shorten the setting time and decrease workability; he suggested that a delaying agent like gypsum should be added.

Cement production indeed consumes huge quantities of energy and emits large amounts of carbon dioxide, which is the major cause of global warming industry activities. One of the advantages of using MSWI ash as cement raw material is the reduction in carbon dioxide emissions, thus minimizing the global warming effect. As a large amount of energy is used to decompose the calcium carbonate (CaCO3) to lime (CaO), a huge amount of carbon dioxide is emitted during the process. Due to the fact that MSWI bottom ash and flyash is composed of lime instead of calcium carbonate, it can reduce the carbon dioxide emission. There are several technical problems discouraging this application; the high chloride content will affect the product quality, and the cycling effect in the cement kilns will cause rapid clogging and corrosion inside the heat exchangers. The high concentration of heavy metals will also be an environmental concern.

Pre-treatment of fly ash is recommended to remove the chloride and heavy metals content, also the quantities of MSWI ash added to the process should be carefully controlled in order to ensure the process safety as wellas product quality.

BENEFITS OF PROPER BIOMEDICAL WASTE MANAGEMENT

1. Protecting the health of healthcare workers, the public, and the environment
2. Preventing the spread of infectious diseases.
3. Reducing the risk of contamination of the environment.

4. Protecting workers from exposure to hazardous materials.
5. Reducing the cost of healthcare
6. Reduces health risks.
7. Minimizes environmental pollution.
8. Promotes overall cleanliness.
9. Complies with regulations.
10. Prevents accidents and injuries.
11. Improves public health.
12. Enhances waste disposal efficiency.
13. Reduces the spread of diseases.
14. Prevents unauthorized access to hazardous materials.
15. Increases awareness about proper waste handling.
16. Improves overall hygiene standards
17. Decreases the risk of cross-contamination.
18. Enhances the reputation of healthcare facilities
19. Supports research and development in waste management technologies
20. Contributes to a safer and healthier environment

CONCLUSIONS:

Proper biomedical waste management is essential to protect the health of healthcare workers, the public, andthe environment.

BMW is generated by healthcare facilities and can be hazardous and infectious. Improper handling can lead to health hazards. Collection, segregation, transportation, treatment, and disposal of BMW are important steps in its management. The color coding of bins, the use of technologies such as incineration and autoclaving, and attention to environmental impacts are also highly crucial. BMW management aims to reduce waste volume and ensure proper disposal. All those involved should strive to make the environmentsafer.

Biomedical waste management can provide valuable insights into current practices, identify areas for improvement, and help in implementing more effective waste management strategies. By analyzing the survey data, stakeholders can make informed decisions to enhance waste management processes, promote safety, and protect the environment. It's like shining a light on the subject to see where we can make positive changes and work towards a healthier and safer future for everyone.

Incineration is a valuable method used in biomedical waste management. It helps in effectively destroying harmful pathogens, reducing the volume of waste, and minimizing the risk of infections. By utilizing incineration, we can ensure proper disposal of biomedical waste and contribute to a safer and healthier environment for everyone. It's like a powerful tool in the waste management toolbox that plays a significantrole in maintaining cleanliness and safety in healthcare facilities and beyond.

Future Prospects:

Biomedical waste management is crucial for public health and environmental safety. In the future, there is a growing focus on sustainable and efficient methods for managing biomedical waste. This includes advancements in waste segregation, treatment, and disposal techniques to minimize the impact on human health and the environment. Technologies like autoclaving, microwaving, and advanced non-incineration methods are being developed to handle biomedical waste more effectively. Additionally, there is an emphasis on creating awareness and implementing regulations to ensure proper disposal practices are followed by healthcare facilities and waste management authorities. Overall, the future prospects involve innovative solutions and strict compliance to ensure safe handling and disposal of biomedical waste.

In the future, the prospects of biomedical waste management through incineration involve advancements in technology to make the process more efficient and environmentally friendly. There is a focus on developingincinerators that produce fewer emissions and have better control over air pollutants. Additionally, there are efforts to integrate energy recovery systems into incineration processes to generate electricity or heat from the waste. Strict regulations will continue to be implemented to ensure that incineration is carried out safely and in compliance with environmental standards. Overall, the future of biomedical waste management through incineration aims to balance the need for waste disposal with minimizing environmental impact.

REFERENCE:

1. Hossain MS, Santhanam A, Norulaini NN, Omar AM. Clinical solid waste management practices and itsimpact on human health and environment - A review. Waste Manag 2011;31:754-66.
2. Sood AG, Sood A. Dental perspective on biomedical waste and mercury management: A knowledge,attitude, and practice survey. Indian J Dent Res 2011;22:371.
3. Hegde V, Kulkarni RD, Ajantha GS. Biomedical waste management. J Oral Maxillofac Pathol 2007;11:5.
4. Gupta S, Boojh R. Report: Biomedical waste management practices at Balrampur Hospital, Lucknow,India. Waste Manag Res 2006;24:584-

91.
5. Lakshmikantha H. Report on waste dump sites near Bangalore. Waste management. 2006;26(6):640
6. Misra V, Pandey S.D. Hazardous waste, impact on health and environment for development of better waste management strategies in future in India. Environment International. 2005;31:417-31.
7. Kini B.S, Kumar, Kumar S, Reddy M, Nabar A.S, Kamath V.G, Kamath A, Eshwari K. Knowledge Attitudes and Practices regarding Biomedical Waste Management among staff of a tertiary healthcare centre in coastal Karnataka. J Pub Health Med Res. 2014;2(1):20-4.
8. Pattnaik S, Reddy M.V. Assessment of Municipal Solid Waste management in Puducherry (Pondicherry). India. Resources, Conservation and Recycling. 2010;54:512-20.
9. Mathur V, Dwivedi S, Hassan M.A, Misra R.P. Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. Indian J Community Med.2011; 36:143-5.
10. Radha R. Assessment of existing knowledge, attitude, and practices regarding biomedical waste management among the health care workers in a tertiary care rural hospital. Int J Health Sci Res.2012;2(7):14-19.
11. Verma L.K, Mani S, Sinha N, Rana S. Biomedical waste management in nursing homes and smaller hospitals around Delhi. Waste Management. 2008;28:2723-34.
12. Kumar S, Bhattacharyya J.K, Vaidya A.N, Chakrabarti T, Devotta S, Akolkar A.B. Assessment of the status of solid waste management in metro cities, state capitals, class I cities, and class Il towns in India: An insight. Waste Management. 2009;29:883-95.
13. Pandit N.B, Mehta H.K, Kartha G.P, Choudhary S.k. Management of biomedical waste: Awareness and practices in a district of Gujarat. Indian J Public Health. 2005;49:245-7.
14. Rao P.H. Report: Hospital waste management - awareness and practices: A study of three states in India.Waste Manage Res. 2008;26:297-303.
15. Kishore J, Goel P, Sagar B, Joshi T.K. Awareness about biomedical waste management and infection control among dentists of a teaching hospital in New Delhi, India. Indian J Dent Res. 2000;11:157-61.
16. "Biomedical Waste Management: A Review" by P. K. Gupta and Shishir Kumar:
17. Pruess A, Giroult E, Rushbrook P. Safe management of waste from health care activities. Geneva, Swisse: World Health Organization: 1999. [Cited 2012 august 4].
18. Info Nugget. Hospital Waste Management and Bio-degradable Waste. Delhi: Government of India, Press Information Bureau; 2003 [Cited 2014 February 6. Available from: http://pib.nic.in/infonug/infaug.99/i3008991.html.
19. Bio-Medical Wastes (Management and Handling) Rules: Gazette by Govt. of India (1998/2000).
20. Akter N, Chowdhury AMR, Kazi NM. Hospital Waste Disposal in Bangladesh with Special Reference to Dhaka City and its Environmental Evaluation. International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). 1999 February; Special Publication No. 87.
21. Joseph J, Krishnan ACG. Hospital waste management in the union territory of Pondicherry an exploration. Govt. of Pondicherry Institution, Pondicherry- 605006. 2004.
22. Patil AD, Shekdar AV. Healthcare waste management in India. J Environ Manage. 2001; 63: 211-20.
23. Datta P, Mohi GK, Chander J: Biomedical waste management in India: critical appraisal. J Lab Physicians. 2018, 10:6-14. 10.4103/JLP.JLP_89_17
24. Bhalla GS, Bandyopadhyay K, Sahai K: Keeping in pace with the new biomedical waste management rules: what we need to know!. Med J Armed Forces India. 2019, 75:240-5. 10.1016/j.mjafi.2018.12.003
25. Lup DT, Stroe AM, Chezan PM, Pica EM: The importance of waste incineration. Studia UBB Ambientum. 2018, 63:43-8. 10.24193/subbambientum.2018.1.04
26. Sharma R, Sharma M, Sharma R, Sharma V: The impact of incinerators on human health and environment.
27. Rev Environ Health. 2013, 28:67-72. 10.1515/reveh-2012-0035
28. Endris S, Tamir Z, Sisay A: Medical laboratory waste generation rate, management practices and associated factors in Addis Ababa, Ethiopia. PLoS One. 2022, 17:e0266888. 10.1371/journal.pone.0266888
29. Sahiledengle B: Self-reported healthcare waste segregation practice and its correlate among healthcare workers in hospitals of Southeast Ethiopia. BMC Health Serv Res. 2019, 19:591. 10.1186/s12913-019-4439-9
30. Singhal L, Tuli AK, Gautam V: Biomedical waste management guidelines 2016: what's done and what needs to be done. Indian J Med Microbiol. 2017, 35:194-8. 10.4103/ijmm.IJMM_17_105