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RESEARCH ARTICLE

BIOMEDICAL WASTE MANAGEMENT - AN UPDATE ON COVID 19

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Abstract

The concept of environmental hygiene and sanitation has been there in India since the time of Rig Veda. Biomedical waste is the most dangerous waste in the world . It pose a significant impact on health and the environment. Management of the bio medical waste which is becoming a challenging issue in India. Since the implementation of biomedical waste management rule 1998, every concerned health care professional should have knowledge about proper management and disposal of the biomedical waste. Protected and effective execution of waste management rules is not only a legal necessity but also a social liability. There is urgent need of extensive study on this medical waste and its management aspects. Proper waste management strategy is needed to ensure health and environmental safety.

Introduction:-

When the earth is sick and polluted, human health is impossible.... To heal ourselves we must heal our planet, and to heal our planet we must heal ourselves."
— Bobby McLeod

The air we breathe, the trees and flowers we admire, the water we drink, the sky we look up to, and the people we live with are all part of our environment. The physical factors of environment include air, water, soil, climate, heat, light, noise, housing, radiations, debris, etc and the biological factors are all types of plants and animals including man. Towards the end of the twentieth century, with the first stages of industrial revolution, there has been a noticeable deterioration of the natural environment. With pollution mounting at such a frightening magnitude, health problems are getting compounded[1]. Many of the diseases today are directly linked to the deteriorating environment.

It has to be realized that mostly it is not the waste that causes the problem, but the unscientific management of waste that leads to serious environmental problems[2]. Improper disposals of waste generated in health care establishments can have direct and indirect health impacts on those who work in the health care establishment, the general public and on the environment[3]. Because of the disease that it might contain

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Biomedical waste can be classified as biohazard [4]. Medical waste contains materials that have been contaminated by body fluids and may contain viruses, bacteria and even harmful drugs such as chemotherapy and radiation drugs[4]. Untreated infectious wastes dumped on the land can contaminate surface and ground water supplies, thus exposing the entire population to the risk of diseases. Biomedical waste still finds its way to road side heaps of waste, where it mixes with municipal solid waste rendering it hazardous for the environment and the public. So the waste has to be properly neutralized before it is disposed[5].

The issue of improper Hospital Waste Management in India was first highlighted in a written petition in the Honorable Supreme Court; and subsequently, pursuant to the directives of the court, the Ministry of Environment and Forests, Govt. of India notified the Bio-Medical Waste (Management and Handlings) Rules on 27th July 1998; under the provisions of Environment Act 1986.[6] These rules have been framed to regulate the disposal of various categories of Bio-Medical Waste so as to ensure the safety of the staff, patients, public and the environment. With two amendments - First in 2000 and second in 2002 .Later on in March 28, 2016 new rule has been formed , and further amended on March 28, 2018 as "Bio-Medical Waste Management (Amendment) Rules, 2018[6,7].

Majority of the problem can be avoided if the Biomedical waste management is properly managed. The activities that are commonly done in the health care waste management are segregation, storage, collection, transportation and disposal of Biomedical waste[4]. It encompasses, planning, organizational, administrative, financial, legal, engineering aspects and human resource development and their management involves inter-disciplinary relationships.[8] Biomedical waste management requires commitment from persons at all the levels in the health care facility. According to World Health Organization, the human element is more important than technology in this field[9]. Almost any system requires treatment and disposal by trained staff. A system that is managed by staff who does not understand the risks and the importance of their "contribution" is dangerous. Awareness regarding rules of disposal of biomedical waste needs to be instilled even among qualified medical personnel, including superintendents of hospitals and hospital administrators[8].

Knowledge about the importance of biomedical waste, its relationship with the environment, the environmental toxins used in health care industry and the impact of callousness on public health, remain very minimal[8]. Clearly, raising the level of awareness and training regarding biomedical waste and environment-friendly health care needs to be given utmost priority, along with legislation[8].

Discussion:-

Definition

1. Biomedical waste "Any solid, fluid or liquid waste, including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biological and the animal waste from slaughter houses or any other like establishments .(1998)[6]
2. According to WHO, **Medical Waste** is defined as "Medical waste is all waste materials generated at health care facilities, such as hospitals, clinics, physician's offices, dental practices, blood banks, and veterinary hospitals/clinics, as well as medical research facilities and laboratories."(1999)[18]

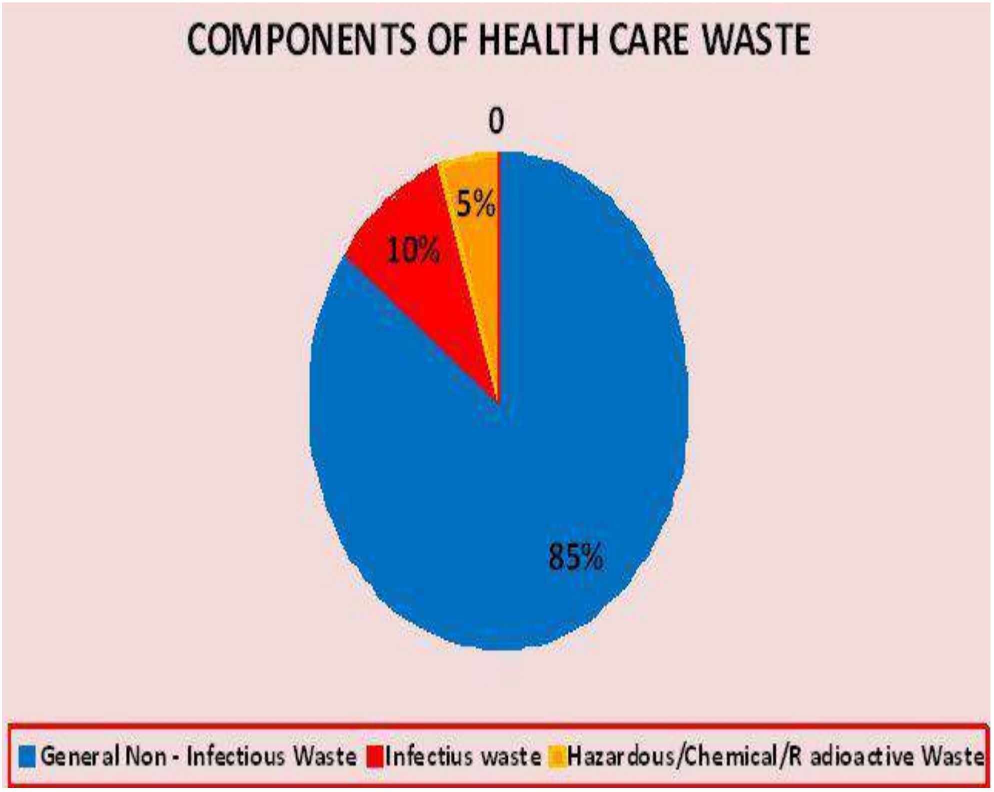

Fig 1:- Components of health care waste(WHO BLUE BOOK).

Classification

WHO classification of health care waste (1999)[19]

1. Infectious waste - Waste suspected to contain pathogens; e.g., laboratory cultures, tissues, swabs, materials or equipment that have been in contact with infected patients, excreta, etc
2. Pathological waste-Human tissues or fluids; e.g., body parts, blood and other body fluids, fetuses, etc
3. Sharps waste; e.g., needles, scalpels, blades, knives, infusion sets, broken glass
4. Pharmaceutical waste- Waste containing pharmaceuticals; e.g., pharmaceuticals that are expired or no longer needed, items contaminated by or containing pharmaceutics (bottles, boxes)
5. Genotoxic waste -Waste containing substances with genotoxic properties; e.g., cytotoxic drugs (cancer drugs), genotoxic chemicals
6. Chemical waste- Waste containing chemical substances; e.g., laboratory reagents, film developer, fixer, disinfectants that are expired or no longer needed, solvents
7. Wastes with high content of heavy metals- Batteries, broken thermometers, blood pressure gauges, etc
8. Pressurized containers- Gas cylinders, gas cartridges, aerosol cans
9. Radioactive waste-Waste containing radioactive substances; e.g., unused liquids from radiotherapy or laboratory research, contaminated glassware, packages or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclides, sealed sources

Health-Care Waste Classification (Basel Convention 2002)[21]

1. Non risk HCW
a. Recyclable waste
b. Biodegradable waste
c. Other non risk waste
2. HCW requiring special attention
a. Human anatomical waste
b. Sharps
c. Pharmaceutical waste
    - Non hazardous

- Potentially hazardous
- hazardous

d. Cytotoxic pharmaceutical waste
e. Blood and body fluids
3. Infectious and highly infectious waste
4. Radioactive waste

Sources Of Health Care Waste
Major Sources Of Health-Care Waste[21,22]
Hospitals
1. University hospital
2. General hospital
3. District hospital

Other health-care establishments
1. Emergency medical care services
2. Health-care centres and dispensaries
3. Obstetric and maternity clinics
4. Outpatient clinics
5. Dialysis centres
6. First-aid posts and sick bays
7. Long-term health-care establishments and hospices
8. Transfusion centres
9. Military medical services

Related laboratories and research centres
1. Medical and biomedical laboratories
2. Biotechnology laboratories and institutions
3. Medical research centres

Mortuary and autopsy centres
Animal research and testing
Blood banks and blood collection services
Nursing homes for the elderly

Minor Sources Of Health-Care Waste
Small health-care establishments
1. Physicians' offices
2. Dental clinics
3. Acupuncturists
4. Chiropractors

Specialized health-care establishments and institutions with low waste
1. Convalescent nursing homes
2. Psychiatric hospitals
3. Disabled persons' institutions

Non-health activities involving intravenous or subcutaneous interventions
1. Cosmetic ear-piercing and tattoo parlours
2. Illicit drug users

Funeral services
Ambulance services
Home treatment

Disposal Of Biomedical Waste

It follows the following steps:

(a) Segregation
(b) Disinfection
(c) Storage
(d) Transport
(e) Final disposal

Segregation

The key of waste management is waste segregation. And key of segregation is minimization and effective management[23]. A proper segregation system can ensure proper waste management and correct disposal route and transportation . Solid waste which are potentially infectious other than sharps should be segregated at the point of generation and collected into one or more layers of biohazard bags inside hard-sided, leak-proof secondary containers of the appropriate size with a fitted lid . A universal biohazard symbol (fig 2) must be clearly visible on the outside of the container[24]. Impression compound, agar, dental waxes, green stick compound, impression pastes, shellac base plates should be kept in a "yellow plastic bag" then sent for either incineration or deep burial[23].

Fig .2 Biohazard symbol

Culture fluids and other liquid infectious waste must be collected into autoclavable containers and treated by autoclaving prior to discard which should not be filled full to prevent spill over[25]. Sharps must be collected into commercially-available hard-sided, leak-proof sharps containers with universal biohazard symbol visible on it[6]. When containers reach the fill mark, they should be closed and replaced with a new container. Waste should be segregated into different streams at the point of generation**.** Segregation at source helps in reducing the expense of disposal and reduce chances of infection to the health worker[25]. Therefore help to prevent general waste becoming infectious.

The pictorial representation of biomedical waste segregation according to BMW rule 1998(fig 3) and 2016(fig 4)

Fig 3:- pictorial representation of segregation of waste(1998).

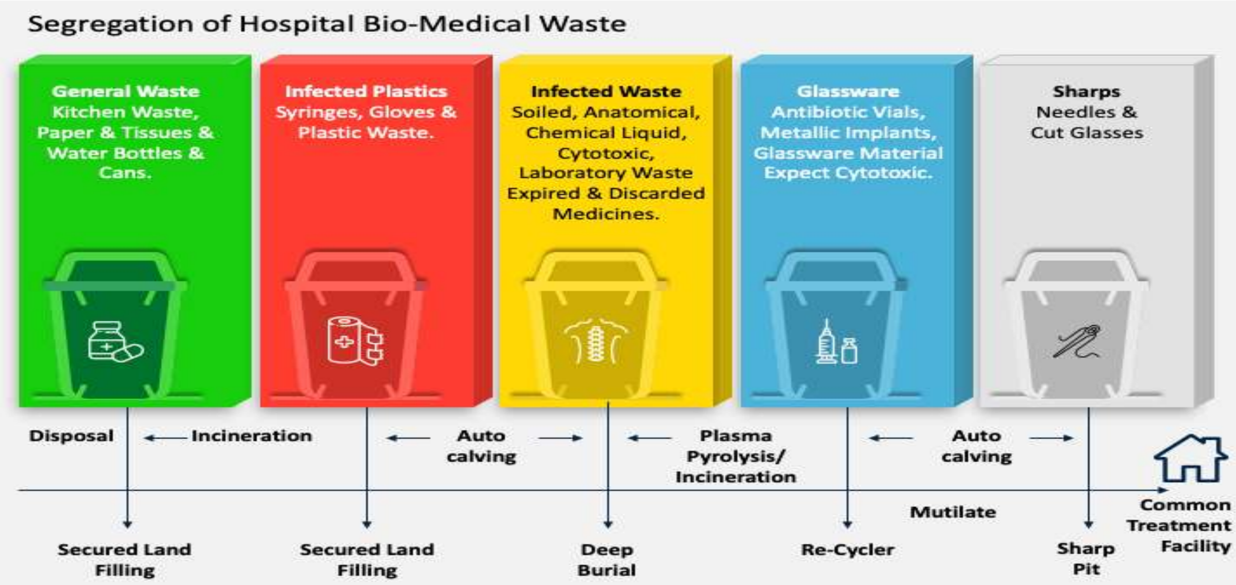

Fig 4:- pictorial representation of segregation of waste(2016).

Disinfection

It is a process of cleaning with a chemical to eliminate bacteria and other microorganism s by killing all harmful species. Disinfection of a surface does not destroy the spores of some microorganisms, and can reappear . Sterilization contrarily, kill all species, besides spores are also destroyed. Both disinfection and sterilization can be accomplished by chemical or physical processes such as radiation and heat[26]. Most microorganisms exhibit tolerance towards some types of disinfectants. Broad spectrum disinfectants are effective against many bacteria and viruses. Iodine and iodophors are narrow, or limited-spectrum disinfectants which is not effective against all. So broad spectrum disinfects like Glutaraldehyde and Quats are generally used[26].

Chemical Methods

Chemicals are added to wastes to kill or inactivate the pathogens it contains. 1 % hypochlorite solution can be used for chemical disinfection . 10,000 ppm chlorine releasing agent - for disinfection of blood stained body fluid contamination and 1,000 ppm chlorine releasing agent are used for contamination which are not stained with blood[27].

Chlorine

Chlorine-releasing agents are chemical disinfectants which at the correct concentration are effective against blood-borne viruses[27]. They are the disinfectant of choice in the event of a spillage of blood or body fluids. However, the effectiveness of all chemical disinfectants is dependent on their conditions of use. In order to be effective, they must be used in accordance to manufacturer's instructions, at the appropriate strength and for the correct contact time. Solutions made from tablets should be freshly prepared, and dilutions made with water from the cold tap[27]

Spills can be dealt with using one of two methods: -

1. hypochlorite solution 10,000 ppm available chlorine (1%)
2. chlorine releasing granules (applied directly)

Hydrogen peroxide[26]:

A 7.5% solution can produce high-level disinfection in 30 minutes at 20 °C. Alternatively, equipment exists that can generate a hydrogen peroxide plasma from a 58% hydrogen peroxide solution. The equipment has a 45-minute process time. Hydrogen peroxide can also be used in combination with peracetic acid.

Peracetic acid[26]:

Can produce sterilization in 12 minutes at 50–55 °C, with instruments ready to use in 30 minutes. Peracetic acid can also be used in combination with hydrogen peroxide.

OPA (ortho-phthaldehyde) [26]:
High-level disinfection in 12 minutes at 20 °C.

Hypochlorous acid/hypochlorite[26]:
400–450 ppm active free chlorine, contact conditions established by simulated use testing with endoscopes.

Ethylene oxide and glutaraldehyde are widely used but are being replaced in an increasing number of healthcare facilities because of their health effects. Ethylene oxide is a human carcinogen, and glutaraldehyde can cause asthma and skin irritation[26]

Storage Of Wastes
Storage of infectious wastes is not recommended . **Pathological, biological and culture/stock wastes** should be treated or disposed within 7 days of generation, or within 30 days if refrigerated or frozen. For **Sharps** it is recommended for disposal without dealy[24].

Transport Of Infectious Wastes
• Infectious waste bags or other containers must be secured (closed) in the lab or other point of generation prior to transport to the autoclave or other destination and must remain closed at all times during transport.
• Bags or other containers of infectious wastes being transported to an autoclave or other destination must be in leak-proof secondary containment at all times during transport[24].
• If transport is by vehicle, the secondary container must have a tight sealing lid that remains closed during transport, and appropriate spill remediation materials must accompany the waste[24].

Vehicle requirements for transportation of Biomedical waste[29]
A fundamental requirement is for the vehicle transporting hazardous waste to be road worthy and labeled to indicate its load, and its payload to be secured to minimize the risk of accidents and spillages.
Any vehicle used to transport health-care waste should fulfill several design criteria:
1. The body of the vehicle should be of a suitable size commensurate with the design of the vehicle.
2. There should be a bulkhead between the driver's cabin and the vehicle body, which is designed to retain the load if the vehicle is involved in a collision.
3. There should be a suitable system for securing the load during transport.
4. Empty plastic bags, suitable protective clothing, cleaning equipment, tools and disinfectant, together with special kits for dealing with liquid spills, should be carried in a separate compartment in the vehicle.
5. The internal finish of the vehicle should allow it to be steam-cleaned and internal angles should be rounded to eliminate sharp edges to permit more thorough cleaning and prevent damage to waste containers.
6. The vehicle should be marked with the name and address of the waste carrier.
7. An international hazard sign(fig 5) should be displayed on the vehicle and containers, as well as an emergency telephone number.
8. The driver should be provided with details of the waste being carried.
9. Vehicles or containers used for transporting health-care waste should not be used for transporting any other material.
10. Vehicles should be kept locked at all times, except when loading and unloading, and kept properly maintained.

Fig 5:- International hazard sign on the vehicle.

Biomedical Waste Management During Covid 19 Pandemic[30,17] (fig 6)

COVID-19 isolation wards

• Use of separate color bins/bags in wards and maintain proper segregation of waste as per the BMWM Rules 2016.
• Use of double-layer yellow color waste in the case of COVID-waste
• Storage of the collected COVID-waste in a dedicated collection bin labelled as "COVID-19" after the disinfectant spray (1% NaOCl solution) on inner and outer surface of bags.
• In addition, the COVID-waste must be labeled as "COVID-19 waste" to ensure the priority disposal at the treatment sites.
• General waste other than COVID-waste should not be mixed and their disposal should be done as common solid waste.
• Separate record for COVID-waste generation from the isolation wards
• Deputation of separate collection staffs for COVID-waste and other solid waste to ensure the timely collection disposal of waste
• Waste generation, collection, and treatment records tracking by SPCB (state pollution control board)s

Sample collection centers and testing labs

• Report opening of the collection centers and testing labs by the state pollution control boards to monitor the COVID-waste records
• All the guidelines for isolation wards should be applied to the sample collection centers and testing lab

Quarantine camps and home-care of COVID-19 patients

• Treatment of common collected waste (non-- medical) as solid waste
• Separate collection of BMW if any in the yellow color bags/bins
• As and when the BMW is generated, the quarantine camps must inform to the operator of CBWTF(Common Bio-medical Waste Treatment and Disposal Facility) for the timely collection of COVID-waste
• The waste generated by self/home-quarantine suspects/patient should be separately collected in yellow bags and handed over to the authorized collectors engaged by the local bodies

Common biomedical waste treatment facility

• Reporting to the respective SPCBs about receiving of COVID-waste from isolation wards, quarantine centers and homes, and testing centers
• Regular sanitization of waste collectors
• Providing the PPE, nitrile gloves, three-layer masks, splash proof aprons, safety boots and goggles
• Use dedicated vehicle for COVID-waste collection with marking and essential sanitization of vehicles with 1% sodium hypochlorite
• Immediate disposal of COVID-waste soon after the receiving
• Operator of the facility must maintain separate record for collection, treatment, and disposal of COVID-waste
• In case of worker showing illness symptoms, adequate leave should be provided to the worker without cutting the salary

Fig 6:- Biomedical waste management during Covid 19.

Biomedical Waste Treatment And Disposal

Health care waste is a heterogeneous mixture, which is very difficult to manage as such.

But the problem can be simplified and its dimension reduced considerably if a proper management system is planned.

Incineration Technology

It is a high temperature dry oxidation process employing combustion of the waste under controlled condition for converting them into inert material and gases[31]. Incinerators can be oil fired or electrically powered or a combination thereof[32]. Broadly, three types of incinerators are used for hospital waste: multiple hearth type, rotary kiln and controlled air types[4]. All the types can have primary and secondary combustion chambers to ensure optimal combustion[4]. These are refractory lined**.** It results in a very significant reduction of waste volume and weight[32].

During incineration and postcombustion cooling, waste components dissociate and recombine forming new particles called PIC, which are toxic[4]. Metals are not destroyed but are dispersed into the environment and these cause serious health issues. Dioxins are an unintentional by-product of waste combustion produced during incinerator operation. These are a group of 75 chemicals which coexist along with another group of toxins called furans[21]. These toxins have a tendency to accumulate in fatty tissues and travel up the food chain[4]. Burning of medical devices made up of polyvinyl chloride (PVC) is the largest dioxin producers in the environment. In addition, metals present in the medical waste act as a catalyst for dioxin formation. These are very toxic, being known carcinogenic, and cause damage with immune and endocrine system of human. In 2000, Subramanian et al. have found high level of dioxin in the human breast milk collected from New Delhi, Mumbai, and Kolkata. The incinerator ash is also hazardous and needs to be checked for the level of toxin before being sent to secured landfill. Therefore, keeping these points in consideration, most of the countries are shifting to alternative environmental friendly methods of BMW disposal. The Philippines has banned incinerator and Denmark has banned construction of incinerator[31].

Non-Incineration Technology

Non-incineration treatment includes four basic processes: thermal, chemical, irradiative, and biological. The majority of non-incineration technologies employ the thermal and chemical processes[4]. The main purpose of the treatment technology is to decontaminate waste by destroying pathogens. Facilities should make certain that the technology could meet state criteria for disinfection[32].

Microwave Irradiation

Microwave radiation is used to treat wastewater sludge and as a heat source to treat medical waste. Microwave treatment units can be either on-site installations or in mobile treatment vehicles[33]. The processing usually includes front-end shredding of the waste, both to increase the efficacy of the microwave treatment and to reduce the volume of the end waste for disposal. If the waste is dry, water is added and the wet waste is introduced to the microwave chamber.

Its basically an extensive version of kitchen's microwave oven. Typical operation is at 2450 Hz. An autoclave provides heat from outside the waste, while the microwave unit transmits energy as microwaves and that energy turns into heat inside the wet waste[33]. The microwave is based on the principle of generation of high frequency waves. These waves cause the particles within the waste material to vibrate and heat is generated from within kills all pathogens.

Microwave disinfection works only when there is water in the waste. Because the radiation directly works on the water, not the solid components of the waste. For this reason, treatment units are often supplied with a humidifier[33]. Processing time is determined by the manufacturer and experience of the operators, but somewhere about 20 minutes per batch is typical. Mechanical treatment is often positioned upstream of the microwave in order to make sure the waste pieces are small. Smaller pieces enhance the heating action as microwaves are able to penetrate to where infectious microbes are. With enough power the water is converted to steam and makes all of the waste around 100°C[33]. The entire process takes place within a single vessel. Bacteriological and virological tests are periodically conducted to ensure the process is effective. A common bacteriological test examines eradication of Bacillus subtilis. 99.99% reduction of spores is considered a benchmark[21].

Treatment of medical waste through exposure to microwaves is less expensive than incineration although it will not chemically alter hazardous materials that way incineration can. This method is not recommended for the treatment of pathological waste. Microwave treatment can also melt syringes, but it is rarely used for this purpose[33].

Irradiation

Irradiation disinfects waste by exposing it to gamma rays that are fatal to bacteria. A radioactive isotope of cobalt is employed[33]. This is basically the same radiation source used for radiation treatment of cancer. In cancer treatment, radiation is intended to kill the malignant cells. In irradiation for sterilization of equipment or treatment of waste, the radiation is intended to kill pathogens[33]. By contrast, you may hear about ultraviolet (UV) radiation treatment of wastewater. The radiation in that case is not intended to kill microbes so much as to break down chemicals[26]. UV used for wastewater is at a lower frequency and less lethal than gamma radiation. When UV is used for disinfection, the radiation in the UV-C spectrum which is germicidal is employed. Some irradiation treatment systems use electron beams. Both gamma rays and electron beams can penetrate plastic bags used for waste collection, so the waste does not need to be removed from the bag before treatment[26].

Irradiation does not change the appearance of the waste so process designers often install mechanical grinding or shredding upstream. This also makes the waste pieces smaller, which tends to enhance the efficacy of the treatment[26].

Unlike some other treatment methods, irradiation requires a dedicated place – there are no mobile treatment modules that use radiation. It is fairly expensive to build an irradiation facility and operating precautions must be taken to protect workers from radiation. These are among the reasons this method is not widely used, especially when heat treatment methods are typically just as effective[26]. The efficiency of irradiation as a sterilization process depends to a large extent on the total energy delivered, but even then waste surfaces facing the radiation source get more sterile than the waste on the shaded side[26]. Odd-shaped waste pieces may not get adequate exposure to the radiation, if contaminated surfaces face away from the cobalt source. Heat treatment, by contrast, brings every piece of waste to an adequate temperature for sterilization if done correctly[33].

Radioactive waste disposal[34]

The radioactive waste should be marked with radioactive symbol(fig7).The collected radioactive waste is disposed as per the following:
Dilute and Disperse
Delay and Decay

Concentrate & Contain (Rarely used)
Incineration (Rarely used)

Fig 7:- Radioactive symbol.

- **Dilute and Disperse:** Low activity solid article may be disposed off as ordinary hospital waste provided the activity of the article does not exceed 1.35 microcuries (50 KBq) or the overall package concentration does not exceed 135 microcuries / m3 (5MBq / m3). Such articles include vials, syringes, cotton swabs, tissue papers etc. Similarly, liquid radioactive waste with activity less than microcurie level can be disposed off into the sanitary sewerage system with adequate flushing with water following the disposal. However, the maximum limit of total discharge of liquid radioactive material into sanitary sewerage system should not exceed the prescribed limits[34]
- **Delay and Decay:** Medium activity radioactive waste and those with half-lives of less than a month may be stored. The storage room should be properly ventilated with an exhaust system conducted through a duct line to a roof top exit. The storage space should have lead shielding of appropriate thickness (10 HVL) to prevent radiation leakage. The radioactive waste should be stored for a minimum period of about 10 half lives when after decay only 0.1% of the initial activity remains. The waste is then monitored for the residual activity and if the dose limit is low it is disposed off as low activity solid or liquid waste. Most of the low and medium level radioactive hospital waste is of short half-life permitting this type of waste disposal[34].
- **Concentrate and Contain:** This technique of radioactive waste disposal is sometimes used for radioactive materials with very high activity levels and for those with long half-lives (longer than a month). Their disposal by delay and decay method is impractical because of longer storage period, particularly if space availability is limited. Radioactive waste is collected in suitably designed and labeled containers and then buried in exclusive burial sites approved by the competent authority. In day-to-day work of a hospital, we do not come across radioactive waste of this nature and as such, this method of radioactive waste disposal is rarely used[34].

Plasma Pyrolysis

Plasma pyrolysis is a state of the art technology for safe disposal of medical waste[32]. It is an environment friendly technology, which converts organic waste into commercially useful byproducts[4]. The intense heat generated by the plasma enables it to dispose all types of waste including municipal solid waste, biomedical waste and hazardous waste in a safe and reliable manner[4]. Medical waste is pyrolysed into CO, H_2, and hydrocarbons when it comes in contact with the plasma arc. These gases are burned and produce a high temperature (around 1200^{o}C)[32].

Vitrification

Although it is rarely used, vitrification can be an effective treatment for medical waste. The solid waste is mixed in when glass is formed (vitrification means production of glass). The high temperatures kill pathogens and some combustible material may burn or pyrolyze, resulting in an off-gas. Remaining material is encapsulated in glass, which has a very low diffusivity[33]. There is little danger of hazardous materials leaching out of glass in significant quantities. The vitrified waste can therefore be put in a landfill with confidence, although if there are radioactive materials in the waste, that landfill may have to be one that is certified to accept radioactive waste. Vitrification is often mentioned as a long-term solution for radioactive waste produced at nuclear reactors; this wastr is generally hairier more radioactive than any medical waste[33].

Electric Arc Plasma

Plasma treatment has been developed and proposed as an alternative to incineration. However, despite some interest in using it for medical waste, it has not found widespread[33].

Land Disposal:(Safe Burying)

In 1984, Congress created the land disposal restrictions (LDR) program as part of the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA). HSWA prohibits the land disposal of untreated hazardous wastes and requires EPA to specify either concentration levels or methods of treatment for hazardous constituents (i.e., treatment standards) to meet before land disposal[35].

1. Open Dumps : risk for public health
2. Sanitary landfills: designed and constructed to prevent contamination of soil surface, ground water and direct contact with public.

Basic rules:

1. Access to the disposal site should be restricted to authorized personnel only.
2. The burial site should be lined with a material of low permeability like clay.
3. Only hazardous health care waste should be buried so as to conserve space.
4. Large quantities of chemical waste should not be buried at one time to avoid environmental pollution
5. The burial site should be covered with a layer of earth to prevent health hazards[21]

Inertization:

Process involves mixing waste with cement and other substances before disposal in order to minimize the risk of toxic substance contained with waste migrating into surface water or ground water and to prevent scavenging. Proportion of 65% waste 15%lime 15% cement and 5% water is used. Suitable for – pharmaceuticals and for incineration ashes with a high metal content . Inexpensive method ; Not applicable for infectious waste[6]

Biomedical Waste Management Legal Aspects

In order to maintain a proper method of waste collection, processing and disposal practices in the country, the Government of India in 1998 notified rules known as the Biomedical Waste (Management and Handling) Rules, 1998 (Gazette of India, 1998)[6]. These Rules were revised from time to time. On March 28, 2016, the Government of India published the Biomedical Waste Management Rules, 2016 (Gazette of India, 2016) in supersession of the Biomedical Waste (Management and Handling) Rules, 1998. In the new BMW Rules, 2016, several changes and additions have been made to further improve the collection, segregation, processing, treatment and disposal of the biomedical wastes in an environmentally sound manner[31].

Major differences between 1998 and 2016 biomedical rule

1. According to 1998 black, red, yellow, blue, white were used now its red ,yellow, blue and white
2. According to 1998 the health care facilities with 1000 beds or more only needed authorization,but 2016 emphasis on each and every occupier generating biomedical waste including ayush, camps etc needs authorization
3. Operator duties were absent in 1998 rules in 2016 operator duties are included
4. Before it was 10 catogories and it has reduced to 4 catagories in 2016
5. According to 2016 rule treatment and disposal of all health care waste is mandatory
6. Format for annual report was introduced and schedule I-VI (1998)to I-IV(2016)
7. Standardized treatment options for each catagories were introduced in 2016

Conclusion:-

In developing countries like India, the proper disposal of infectious waste is a growing problem and if it is not managed in a sustained way, it will make the situation worse. There is considerable variation in the knowledge, facilities, handling and disposal of BMW among dental practitioners and dental office personnel and dental students .There is an urgent need to update the curriculum, regular orientation training programs and strict implementation of guidelines for BMW management & upgrade the disposal facilities at independent dental laboratories, private dental clinics & dental educational institutions to correct the deficient practices.

Medical wastes pose a significant impact on health and the environment. Management of the bio medical waste is becoming a challenging issue in India. Governmental and non governmental agencies have recognized the biomedical waste management as matter of concern. There is urgent need of extensive study on this medical waste and its management aspects. Proper waste management strategy is needed to ensure health and environmental safety.

The monitoring agencies needs to supervise the strict implementation of BMW regulations at private sector establishments. In order to accelerate the rate at which proper processing and management methods are designed, timely regulatory and legislative policies and procedures are needed. To properly separate, process and isolation of wastes, they must be well-characterized, which is challenging. Safe and effective management of bio medical waste is not only a legal necessity but also a social responsibility. Lack of concern in persons working in that area, less motivation, awareness and cost factor are some of the problems faced in the proper hospital waste management. Proper surveys of waste management procedures in various practices are needed. Clearly there is a need for education as to the hazards associated with improper waste disposal. An effective communication strategy is imperative keeping in view the low awareness level among different category of staff in the health care establishments regarding biomedical waste management.

Even after having these rules and protocols in place immense challenges are faced by Indian health care sector regarding the BMW practices. Various efforts are being made by environmental regulatory agencies for appropriate management of the waste generated from health care institution. Biomedical waste management is a social responsibility as well as legal necessity. Care should be taken during disposal of biomedical waste. This will help to protect and maintain the environment from contamination. It will also to ensure the safety of workers who will come into direct contact with it. Bio medical waste management should be included in the curriculum for health care professionals so as to emphasize on the importance of proper segregation and disposal of biomedical waste.

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