BIOMEDICAL WASTE MANAGEMENT AND ITS SUSTAINABILITY - AN OVERVIEW

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ABSTRACT

Biomedical Waste [BMW] is a concerning part which directly affects health and safety of the people. It is mandatory to maintain effective Biomedical Waste Management [BMW] to provide cleaner and healthier environment. Developed and developing countries are dealing with major problems in managing the biomedical waste due to increase in health care sectors and with the current pandemic. The major aim of the study is to figure out the sustainability of managing the biomedical waste in India. The revised BMW2016 guidelines has been framed to develop the disposal technology, treatment methodology, segregation and transportations of Biomedical waste. The authors in this research study adopted an intensive literature survey methodology to identify the various strategies and ideologies for BWM. The results highlighted that, collective team work, three dimensional supports from the Government such as infrastructure, finance, health care facilities, and dedicated workers in health care sector, proper monitoring of BMW practices will have a tendency to achieve an effective disposal of BMW. Further, the authors also highlighted the serious problem and its implication on managing the biomedical waste in India. This paper will provide unique strategies to the stakeholders and decision makers on handling the biomedical waste sustainable way.

Key words: Sustainability, Biomedical Waste, Environmental Health, 5R Technology, BMWM Rules 2016.

I. INTRODUCTION

Biomedical waste which will be usually emerged during treatment, diagnosis or immunization of living organism which is increasing drastically day to day due to precautionary methods what we are undertaking to prevent ourselves from the pandemic situation and also due to the lifestyle changes. The biggest goal of biomedical waste management is to minimize the production of waste or recovering waste by using the 5R principles [Reduce, Refuse, Reuse, Reject and Recycle].

According to Andrew Nichols et.al [2013] Globally climate change poses major environmental threats to our well-being which may leads to new challenges to the health care sectors[1]. In 2012 a survey was conducted by World Health Organization [WHO] around 24 countries on the status of Biomedical waste and the assessment was done on 5 major areas that are regulatory framework and policy, management, technologies applied, training and economic resources. In that some of the countries are well managing the biomedical waste using the BAT [Best Available Technologies] their treatment and logistics were also maintained well and tested regularly. In many countries allocation of financial resources are nil or very less for Biomedical waste management[2]. It is estimated that at least 5·2 million individuals, including 4 million infants, die each year from diseases linked to unmanaged medical waste worldwide[3]. There is no general National Waste Management Strategy at the moment and no formal guidance or regulation on the treatment of medical waste exists all over the world[4].

In India Biomedical waste is not only produced in Hospital but also from various healthcare sectors like laboratories and research centers[5]. Apart from these some biomedical waste can also generated in houses during dialysis, insulin injections and also through medicines. As per Patil [2020] et.al it is estimated 85 percent of biomedical waste is not hazardous to health, 10 percent is non-toxic infectious waste and 5 percent is toxic waste. When we compare the other developed countries, in India the generation of infectious waste is 15 percent to 35 percent whereas it is only 15 percent in other countries the waste generation is huge in India due to Health
sector development [6]. Improper segregation, poor sanitation and mixing of toxic biomedical waste with the other common waste emerged mismanagement of biomedical waste. In 1998, Ministry of Environment and Forest [MoEF] issued guidelines on how biomedical waste can be treated [7], but most hospitals in India do not use the desired criteria for biomedical waste management even after a long period of implementation [8]. As per Mishra, [2016] et al. 18 to 64 percent of health care institutions and hospital do not use the adequate biomedical waste management techniques. It was predicted that this could be due to inadequate BMW resources or lack of knowledge among health officials, or it may be due to the use of poor methods of disposal [9]. Acharya [2014] et al. in his research paper describes that a population living within 3 km of old incinerators saw a rise in the risk of cancer by 3.5 percent [10].

The Tamil Nadu Pollution Control Board [TNPCB] takes the requisite measures to ensure sustainable environmental protection of hospital waste. The Chairman of the Pollution Control Board of Tamil Nadu appointed as the designated authority for the awarding and execution of authorizations Laws for bio-medical waste [managing and supervision]. The prevailing practices are monitored and different disposal and treatment options for the safe destruction of hospital waste are evaluated, taking into account aspects of both environmental impact and cost [11]. Lack of knowledge has led hospitals to become a platform for the spread of diseases instead of working for their prevention in Tamil Nadu [12]. Owing to the lack of scientific methods of segregation, it was widely suspected that proper management of health care waste was not carried out in developed countries [13]. Even before 3800 years in Adichanallur, proper segregation and treatment of waste took place in Tamil Nadu. The community of Adichanallur used acrative manner to destroy their bodies in an urn on top of the mountain, as per the Anthropological Census of India, where the nearby river or lake could not flood them. It was the extraction method that was performed in Tamil Nadu, also in the 5th Century B.C [14]. Ineffective healthcare waste management illustrate healthcare profession, supervisors of waste and the environment to pathogens, hazardous reactions and deaths [15]. The disposal of health-care waste is an important aspect of the national health-care system. A holistic approach to health care waste management should include a clear definition of responsibilities, occupational health and safety systems, waste minimization and segregation, the development and implementation of safe and environmentally sound technologies, and capacity building [12].

II. STATEMENT OF PROBLEMS

The complete absence of training and knowledge among hospitals impacted the improper managing and sorting of HW, which really is a quite big risk for employees involved in the HWM stream. The entity does not periodically review and investigate hospitals [both public and private] in accordance with national and international BMW guidelines. The authors currently adopted an ideology to identify the sustainable way of managing the biomedical waste by using the 5R technology [Reduce, Refuse, Reuse, Reject and Recycle].

III. RESEARCH GAP

The brief Gaps associated with Hazardous Waste Management [HWM] are inadequate identification and treatment, financial and infrastructure constraints, knowledge and training, lack of responsibility, sensitivity to health and environmental problems.

IV. METHODOLOGY

The Authors adopted the methodology to execute study from various authenticated resources from Government of India Biomedical waste report [2016] further the authors explored the articles on the Google scholar, PubMed, research gate with the phrases hospital/biomedical/health care waste management/clinical which is published from 2000. This decades was chosen in order to recognize any phenomena and to provide an appropriate amount of articles, especially those pertaining to countries where access to international scientific journals is restricted [16]. In addition, in 1999/2000, the WHO published a handbook entitled 'The Blue Book,' which is quantified a pioneer in identifying the framework for waste management system for healthcare [17]. This paper is focusing comparative view of both developed and developing countries. Finally provides an overview of India how the biomedical medical waste has been managed. It was observed that these refined papers provided details about relevant findings methods of waste generation, treatment measures, collection, segregation, movement, disposal and transit. In addition to these academic research papers reported articles from WHO, records from the state government, World bank reports and NGO reports were also been referred and the study area will also explore in this review [18][Figure.1]
V. REVIEW OF LITERATURE

Current Practices in India

According to Patil et.al [2001] The biomedical waste during separating for recycling the plastic are deposited outside community by the employee which leads mixing of waste along with municipal waste [34]. In the words of Devi et.al [2019] Hospitals are not violating the BWM 2016 color coding which results in agitation of hazardous waste to the community [35]. Babu et.al [2009] described Gathered in transparent bins without proper disinfection [36]. In the phrases of Gupta et.al [2006] Transportation executed manually without any precautionary measures for safety [37]. Kannappan et.al [2016] Sharp discarded without chlorination and mutilation result spilling of infection [38]. Krishna et.al [2014] insist lack of awareness on separation among employee and inadequate training [7]. Shalini et.al [2012] in his study elaborates BMW is stored in open dump sites nearby incinerator area before it was brought for incinerators after the ashes are stored in blackbags in the hospitals site itself and the black bags was managed as a general waste which poses major danger to the society [39].

Current Practices in Tamil Nadu

In the words of Dutta et.al [2017] 56.7% of practitioners classify biomedical waste into various groups at source by using separate color-coded containers for disposal. [40]. According to Jacob et.al [2017] Due to lack of knowledge and training the sharpers were not dispose properly leads to needle sticks injuries [41]. Selvaraj [2013] described 58% of the hospital are not using the needle destroyer frequently to dispose the needles [42]. Angelinal [2020] in his words described Incinerations method is used to treat hazardous healthcare waste it is the easiest method followed by the management which reduce 90% waste but this methods emits toxic ash and smoke while processing [43]. Kannappan et.al [2009] BMW is stored in open dump sites nearby incinerator area before it was brought for incinerators after the ashes are stored in blackbags in the hospitals site itself and the black bags was managed as a general waste which poses major danger to the society [38].

VI. RESULTS AND DISCUSSION

Hazardous waste production in developing countries averages 0.5 kg per bed per day, while it is 0.2 kg per bed per day in developed countries [19]. As per World Health Organization the biomedical waste can be classified into to below [20] [Figure : 2]
6.1 Source of Biomedical Waste

The biomedical waste can be differentiating into primary and secondary sources [21][22][23]

<table>
<thead>
<tr>
<th>Primary Sources</th>
<th>Secondary Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitals and other premises for wellbeing</td>
<td>Clinics for Physicians/dentist</td>
</tr>
<tr>
<td>Laboratories and centers for study</td>
<td>Slaughter houses/Animal House</td>
</tr>
<tr>
<td>Mortuary centers and autopsy centers</td>
<td>Camp for organ donor</td>
</tr>
<tr>
<td>Animal research and lab for study</td>
<td>Center for Vaccinations</td>
</tr>
<tr>
<td>Blood banks and facilities for collection</td>
<td>Acupuncturists/Clincs of Psychiatry/Cosmetic Piercing</td>
</tr>
<tr>
<td>Elderly Nursing homes</td>
<td>Services for Funerals</td>
</tr>
<tr>
<td></td>
<td>Institutions for differently abled persons</td>
</tr>
</tbody>
</table>

6.2 Categories, Treatment and Disposal Options of Biomedical Waste: Table: 1

According to Biomedical Waste Management rule 2016 the biomedical waste generated in Healthcare sector need to be classified into four classifications depending on the pathways for separation and the color code [24][25]

<table>
<thead>
<tr>
<th>Categories</th>
<th>Types of waste</th>
<th>Types of Bags/Container use</th>
<th>Treatment/Disposal options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow</td>
<td>Anatomical waste from humans</td>
<td>Non-chlorinated plastic bags with a yellow color</td>
<td>Incineration, plasma pyrolysis, or burial in the ground</td>
</tr>
<tr>
<td></td>
<td>Anatomical waste from animals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>soiled garbage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medicine that has been discarded or has passed its expiration date</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waste from microbiology, biotechnology, and other clinical labs</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liquid waste containing chemicals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.3 Segregation
The process of segregating waste inside the color containers covered with non-chlorinated plastic bags such as yellow, red, white and blue will be an appropriate process to handle the waste effectively [26].

6.4 Storage Process
The storage period is 72 hours [winter], 48 hours [Autum] and 24 hours [summer] as per International Committee of the Red Cross [ICRC][27].Storing in separate zone or room will prevent unauthorized access of outsiders [2]

6.5 Transport
off-site transport- safe packaging with proper marking shift to authorized destination along with competent authorities which supports emergency service to take remedial measures [27].

6.6 Treatment Methods
The various phases of treatment methods involved in the process of BMW are as follows

6.6.1 Incineration :The process of incinerating the waste in 980 to 2000 ° C is the most prominent feature to decrease the amount of solid waste [6] [28] [29]

6.6.2 Autoclaving :It is thermal process horizontal method system is suggested for safe and easy treatment[9].

6.6.3 Microwaving: Microwave is an evolving method for handling biohazardous waste which helps to reduce lengthy heating times, thermal gradients and energy loss to atmosphere [30]

6.6.4 Shredding: BMW dispersed or cut into nano pieces to make the waste unrecognized. This methods is used to reclaimed or recycle[31].
6.6.5 Deep burial and Inertization: Duging waste about 2 meters depth covering within a surface of 50 cm finally galvanized Iron/wire meshes. In Inertization mixing BMW with cement and other materials before disposal both methods will minimize the toxic substances mixing with land and water[32].

6.6.6 Landfilling: Oldest method where remaining BMW disposed in landfills low cost and easiest method which need to handle properly and carefully [33]

6.7 Highlights of 2016 Biomedical Waste Management Regulations

Different health camps, such as vaccination camps, blood donation camps, and surgical camps, are also covered by the regulations.[24]. Occupier responsibilities have been updated. He is the person in charge of administration. Pretreatment of the laboratory, blood bags and microbiology waste disposal need to be done on site or either at CBMWTF. The NACO [National AIDS Control Organization method] or WHO Guideline need to followed for sterilization/disinfection Training need to be given for all Health Care workers and immunization must be provided to them inorder to protect them from Hepatitis B diseases Pretreatment need to be done for liquid waste before mixing with other waste BMW barcode system must be set up before it can be shipped out for diagnosis and disposal. Reports need to be maintained for major accidents The Existing Incinerator need to upgraded as per new notification Register need to be maintained daily and update month wise in website based on its disposal The process of segregation, transportation, packaging and storage of BWM have been improved Healthcare waste can be divided into four groups depending on the color codings with treatment options Treatment facilities like autoclave, incinerator, shredder and microwave before treatments need to taken prior approval from the concern authority.

6.8 New Biomedical Rules Benefits

Extensive and strict requirements Expand its coverage to include numerous health-related camps such as blood donation, vaccine, and surgical camps. The phased out option of gloves, plastic bags and blood bags which usually emits dioxins and furans while burning has been controls due to these implemented rules which can make our environment green. Recycling process need to be given only to the authorized recyclers. The treatment site and disposal facilities should available within 75 Km. According to new rules of BMWM2016 framing an advisory committee meeting every six month is a mandatory.

6.9 Challenges to Follow New Biomedical Waste 2016 Rules

Biggest challenges to implement BMW 2016 rules in Government hospitals and small HCFs are due to lacks of financial situations. Phasing out gloves, blood bags, chlorinated plastic bags and establishing bar code patterns for the bags will acquire more cost. There are currently 198 CBMWTFs in service in India and there is a great need for more CBMWTFs to meet the need for treatment and disposal of all BMWs produced in India.

VII. IMPROVISATION ON CURRENT PRACTICES

1. The authors suggested to frame a biomedical waste management committee to track the segregation process

2. Further the study emphasized to providing adequate training for the Health care workers working in organizations – Top Management. Also the management can display sign boards for the good practices of Biomedical waste management
The biomedical waste whenever it is generated needs to be handled in a safe and reliable method and which is essential. Even though several authors insisted various methods and technology to manage the biomedical waste in this paper the authors identify the sustainable way to manage the biomedical waste. Most of the researchers have highlighted that 5R’s is a sustainable way the authors also suggest these common scenarios need to be followed to maintain ecological stability. Using the 5R activity results in saving our natural resources, money, pollution, emission and help to generate revenue. In some of the recent study the authors also emphasize that treating biomedical waste management through incineration process can attain efficient strategy but still less problems exist in this methods. The authors suggest implementing sustainability and financially to enhance biomedical waste management sustainability.

REFERENCES