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IMPACT OF IMPROPER BIOMEDICAL WASTE DISPOSAL ON HUMAN HEALTH AND ENVIRONMENT DURING COVID- 19 PANDEMIC

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Abstract

The COVID-19 pandemic is reported to have reduced air pollution and environmental-related noise and improved biodiversity and tourist sites, however, the impact of stay-at-home and preventive measures on waste management is alarming. The present review article highlighted the impact of improper biomedical waste disposal on human health and environment during COVID- 19 pandemic.

Key words: Bio-Medical Waste, COVID-19, Gloves

Introduction

The term "Health Care Waste" or "Bio-Medical Waste" includes all the wastes from any medical procedure in healthcare facilities, research centres and laboratories. The activities generating Bio-Medical Waste (BMW) may be in healthcare, research or diagnostic facilities with one or more of the activities such as diagnosis, treatment, immunization of human beings and animals and production or testing of biological materials. Biomedical waste also includes waste produced during any healthcare activities taken place at home. The types and characteristics of the contents determine how hazardous is the waste.[1]

Though the COVID-19 pandemic is reported to have reduced air pollution and environmental-related noise and improved biodiversity and tourist sites, however, the impact of stay-at-home and preventive measures on waste management is alarming. Due to the stockpiling of gloves, gowns, masks and other protective clothing and equipment, there appears to be a waste emergency due to the unusual production of waste from both households and health facilities. Failure to properly manage the waste generated from health facilities and households may escalate the spread of COVID-19 via secondary transmission.[2]

The COVID-19 pandemic has created a global health crisis along with diverse impacts on environment, economy and society. It has posed various challenges to the existing regulations

and management practices regarding BMW worldwide. Wuhan in China witnessed a rise of healthcare waste generation by 600% in the middle of COVID-19 outbreak. Restriction in recycling to prevent the spread of the virus, increase in generation and improper treatment have posed alarming situation. The management of BMW during this pandemic has been highlighted as major concern by several researchers which can increase the risk of further contagion through different pathways. As the increased generation of BMW is inevitable during COVID-19 outbreak, safe handling, treatment and disposal of waste must be prioritized for minimizing contamination of land, water and air. This paper has attempted to examine the existing situation of BMW in terms of its generation, handling and treatment during this current pandemic situation in India. It has also looked into the regulatory changes formulated at various levels to deal with adverse consequence of COVID-19 related BMW (BMW-COVID).[3]

Biomedical waste

"The Associated Chambers of Commerce and Industry of India (ASSOCHAM)" stated that India can generate 550.9 tons of medical waste per day of 2020 from hospitals and research laboratories. Improper management of biomedical wastes is taken into account and concern all over the world as it may lead to serious harmful effects on human health, aquatic systems and environment. The exposure to untreated biomedical wastes can cause serious health risks and can induce infectious diseases including tuberculosis, typhoid, cholera, hepatitis, AIDS, respiratory and abdominal infections. Additionally, the hazardous biomedical waste can also affect the natural water reservoirs and aquatic life when it is directly discharged into the streams without prior treatment with reduced toxic effects. Generally, the biomedical wastes are classified into three major categories such as chemical/radioactive (5%), infectious (10%) and general municipal (85%) wastes respectively.[4]

Classification of Biomedical waste

Bio-medical Waste (Management & Handling) Rules, 1998 [1], wastes were classified into ten categories as Human Anatomical Waste, Microbiology & Biotechnology Waste, Animal Waste, Waste Sharps, Liquid Waste, Soiled Waste, Unwanted Medicines & Cytotoxic drugs, Incineration Ash, Solid Waste, and Chemical Waste. Bio Medical Waste Management Rules, 2016 categorizes the biomedical wastes into four categories and the medical wastes are segregated based on four colour code as yellow, blue, red and white category.[5]

Development of Biomedical Waste Management System (BWMS)

The first BMW rules were introduced by the government of India (G.S.R. 343(E), S.O. 630 (E)) dated 20 July 1998. This act describes the segregations of wastes into 10 categories which are found to be a difficult task for the scavengers/housekeeper staff to sort out different kinds of biomedical wastes without having prior knowledge about its infectious risks. The major drawback of this act was, the scavengers were found to get exposed to infectious waste with no gloves, masks and used syringes without sterilization. Before this act, there was only general environmental act (The Environment (Protection) Act, 1986).[6]

Risk of Biomedical Waste

With the increase in population, the number of hospitals, clinics and nursing homes increases drastically leading to increase in the generation of biomedical waste. More than 30 tons of biomedical is generated by hospitals in metropolitan cities each day. Bio-medical waste is hazardous to the open population and causes great risk to patients, healthcare workers,

scavengers and the community at large, if the disposal is not methodically managed properly.[7]

Biomedical effects of COVID-19

According to the World Health Organisation report, the non-communicable disease (Cardiovascular disease, Cancer, Chronic respiratory disease, and Diabetes) and other health services are highly influenced by COVID-19.[8] Almost majority of countries (53%) are partially or completely interrupted by COVID-19. The medical emergency was highly concerned for patients with diabetes (49%), cancer (42%) and cardiovascular (31%). Significantly, COVID-19 infection rate is increasing day by day, this imposes pressure on the demand of hospitals and medicines to tackle the challenges. Specifically, the requirement for medical resources (ventilators, masks, gloves, face shields, gowns and hand sanitizer) is in greater demand. In addition, the mental and physical pressure of healthcare workers on hospitals is becoming very high.[9] The inadequate providence or inappropriate usage of Personal Protective Equipment (PPE) has highly affected many healthcare workers and general public. Especially, psychological context of humans has been profoundly affected by this pandemic. Notably, many adolescents have committed suicide by stress, anxiety, fears and loneliness. The over reactions of the body immune system (cytokine storm) also have induced in COVID-19 cases, because their infection did not only affect the lungs, but some of them have reported with gut issues, kidney failure and multi organ failure.[10]

Medical waste assessment

Sustainable management of medical waste is problematic and amplified, especially in emergencies like the COVID-19 pandemic. Due to the novelty of the global pandemic, modification to existing waste facilities to control the unusual medical waste and its associated viral spread effect requires adequate information on the amount of medical waste generated, hot spots for waste generation and available treatment facilities. On account of potential rapid expansion volumes of medical waste, several technical know how on sorting, segregation, transport, storage and sustainable waste management technologies are required to maximize existing infrastructures to accommodate the emergency.[11] Improper management of medical waste has the potential to expose patients, health workers and waste managers to injuries, infections, toxic consequences and air pollution. The different forms of medical waste and its derivatives include non-hazardous waste, pathological waste, radioactive waste, infectious waste, chemical waste, cytotoxic waste, sharps waste and pharmaceutical waste (WHO 2018). The global pandemic has led to an unusual amount of reported medical waste. For example, the COVID-19 pandemic in China is reported to have increased medical waste from personal protective equipment like gloves, face masks and eye protection due to a surge in personal protective equipment and immediate disposal after use.[12]

Inappropriate biomedical waste disposal

Medical waste can be infectious to both people and the environment causing high contamination and cross contamination risks. Based on the references of World Health Organization (WHO) and other guidelines medical waste must be treated near to its source of its generation. This needs responsibility from every employee working in the hospital who is involved in the segregation process. Suitable location and equipped waste disposal facilities can reduce the necessary transportation of hazardous materials. There is high risk considering the transportation of biomedical waste such as illegal or inappropriate disposal (dumping and obsolete treatment technologies) by haulage personnel and accidents. In addition, transportation of hazardous waste to the treatment centres is prohibited in some urban areas.[13]

Exposure and emission of toxic gases during incineration

As per the regulations all biomedical waste should be treated within 48 hours and hence every hospital and other HCFs generating bio-medical waste is required to set up proper BMW treatment facilities to ensure proper treatment of waste. Incineration in a widely used and the most popular method of disposing majority of hazardous medical waste. However open burning or burning of medical waste in incinerator emits harmful and toxic gases such as black smoke, toxic flue gas, fly ash, and odors which lead to atmospheric pollution causing respiratory and skin disease or even cancer. US Environmental agency has found that medical waste was the third main source of dioxin emission and 10% of mercury emission. Burning of medical waste such as plastic materials which are generated from polyvinyl chloride (PVC) products is the major producer of dioxin.[14]

Impact of biomedical waste on water

The improper disposal of biomedical waste may cause negative impact on the water quality as different pollutants may leach out from the waste dumping sites into the ground water. Al Raisi et al[15] assessed and found that heavy metals in leachate were exceeding the drinking water standards. The concentrations of Al, V, Cr, Mn, Co, Ni, Ba, Pb, and Fe 2.050, 0.9775, 2.800, 0.503,0.128, 0.773, 0.8575, 0.130, and 39.25 mg/L, respectively. The effect of these contaminants was considered as a surface and ground water contamination.

Biomedical waste impact on soil quality

Improper and unscientific disposal of biomedical waste may change the quality of soil near waste dumping sites. Different pollutants may get mixed with the soil and may change the chemistry and biology of the soil ecosystem. Abidemi and Theresa[16]analyzed five heavy metals (chromium, nickel, zinc, lead, and copper) for their levels in soil. The concentration of heavy metals in soil were zinc (1133 ± 897 mg/kg), nickel (26.3 ± 51.1 mg/ kg), copper (110 ± 90 mg/kg), lead (137 ± 64 mg/kg), and chromium (3.63 ± 2.46 mg/kg). The level of heavy metals at different sampling site were higher than soils from background with factors of 67 (zinc), 18 (copper), and 20 (lead).

Biomedical waste and its impact on air quality

Burning of biomedical waste may pollute the environment and will mix different pollutants to a level that may be dangerous to human health. Karthikeyan, Balasubramanian, and Iouri[17] argued that greenhouse gas and particulate emissions are considered as a challenging issue from municipal solid waste dumping sites. The burning of hospital waste at these sites is a serious threat for the environment and human health. It releases harmful pollutants that cause various types of respiratory problems among the residents. Their study revealed that dust, black carbon, ammonia, sulfate, and nitrate are the major species of PM10 and PM2.5. The particulates were found to be high during the summer than the monsoon. The significant variation among the samples were observed and ranged from 211 to 900 lg/m3, and exceeded the upper limits of 150 lg/m3 standards prescribed by Central Pollution Control Board (CPCB). The ambient air samples were further contaminated by hazardous organic compounds like diethyl phthalate, decane, dodecane, octane, nonane, methenamine, cyclobutane, carbon disulfide, and acetone diperoxide.[18]

Controlling of infectious COVID-19

Healthcare Facilities or hospitals having quarantine wards for COVID-19 patients should mandatorily follow these paces to guarantee safe management and discarding of biomedical waste generated in treatment process. As per BMWM Rules, 2016 and CPCB guidelines, the

segregation of waste should be performed in a separate colour-coded bags/bins/containers in order to reduce the effects due to improper management of bio-medical wastes.

1. Usage of two-layered bags for collection of discarded things from quarantine wards, to guarantee more protection.

2. Separately collect the biomedical waste from CBWTF and stored in collection bin (bags/containers) and labelled as "COVID-19 Waste" for the easy identification of CBWTF authorities. The resultant wastes from bin should be handed over to authorized staff and then it can be shifted to CBWTF collection van for disposal.

3. To collect the used PPEs in isolation wards such as goggles, face-shield, Hazmat suit and gloves and wastes like eppendorf tubes, plastic vials, vacutainers and plastic cryovials into red colour bags.

4. Yellow colour bag should be used to collect N95 mask, head and shoe covers, non-plastic or semi-plastic coverall and linen Gown.

5. Usage of black colour Polypropylene bags for general waste.

6. Maintain separate records of waste generation and management in different quarantine centres.

7. Labelling of "COVID-19 Waste" on trolleys, vehicles and collection bins.

8. To use 1% sodium hypochlorite disinfectant solution for cleaning of inner/outer surface of storage containers.[19]

Challenges of BMWM during COVID-19

(a) Adequate training in the context of collection of waste, segregation of waste, barcoding of different kinds of wastes in appropriate containers, necessity for social distancing has to be given to all the Maintenance staff Team in small batches and the person involved in the collection, segregation, transportation, treatment and disposal of BMW.

(b) (b) Necessity of maintaining Hand hygiene, usage of proper Personal Protective Equipment (PPE) and disinfectants in infectious quarantine site/home quarantine unit. The responsibility etiquette of maintenance staff, doctors, nurses and general public in suitable disposal of PPE products through proper channels as per CPCB rules and BMWM rules.

(c) (c) Regular Health checkup/screening of public and patients in quarantine centres, Immunization, disposal of BMW through appropriate treatment process with minimized wastes and reduced transmission of infectious disease. Introduction of CPCB Mobile App for COVID-19 waste management.[20]

Conclusion

With the increasing spread and impact of the COVID-19 pandemic on economic development and health outcomes, there is an urgent global call for waste management from households, medical facilities and toxic waste to be treated as essential public service. This will in effect mitigate the potential threats of COVID-19 pandemic on environmental sustainability and health outcomes. In line with the United Nations Environment Program of ensuring sustainable waste management, guidelines for containing the spread of COVID-19 through waste management include treatment of residual waste.

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