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OCCUPATIONAL HEALTH OF BIOMEDICAL WASTE TRANSPORTATION WORKERS IN CHANDRAPUR CITY, CENTRAL INDIA

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Abstract
The occupational health assessment of biomedical waste transportation workers was carried out in Chandrapur city, Central India. Hundred male workers were identified for the study who is engaged in this activity along with twelve individuals as a control population. Occupational health was assessed on the basis of specially designed interview schedule, microbial exposure along with lung capacity analysis by Peak Expiratory Flow Rate (PEFR). Results revealed needles, contaminated cotton, blood and urine samples are the most common objects in the biomedical waste. Injuries during work include, cut & prick due to glasses and metal objects, needles and intravenous-sets are common. Occupational health issues identified by these workers include redness and watering of eyes, skin itching, breathlessness, nausea, general body and back pain. PEFR analysis revealed observed values are less than expected values. No personal protective equipments are used by these workers. The indoor air quality of biomedical waste transportation vehicle pertaining to microbial analysis revealed presence of Staphylococcus aureus and Escherichia coli. It is recommended to bring these workers under existing Biomedical Waste (Management) Rule 2018 and ensure safe working conductions so to reduce occupational health disease burden on them. To reduce the occupational health hazards of these workers use of personal protective equipments should be encouraged, regular health check-up, medical insurance and training for effective handling of the biomedical waste needs to be provided.

Key Words: *Biomedical waste transportation worker, Chandrapur, Medical waste, Occupational health*

Introduction

Biomedical waste is usually infectious waste that includes waste like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc., usually in the form of disposable syringes, swabs, bandages, body fluids, human excreta, etc. These can be a serious threat to human health if not managed in a scientific and discriminate manner.

Sources of biomedical waste include hospitals, research institutions, clinical laboratories, veterinary institutions, etc. The waste is generated after the treatment of the patient, results of diagnosis and research. The biomedical waste is classified as hazardous and non-hazardous

waste. Approximately 10-25% of biomedical waste is harmful or hazardous and 75-90% is a non-hazardous. The non-hazardous waste becomes harmful if hazardous waste is mixed with it (Pasupathi *et al*., 2011). Mishra *et al.* (2016) reported 18-20% of the health care institution and hospitals do not follow the standard method for the biomedical waste management, and reasons predicted for this was lack of awareness in healthcare officials or poor disposal facilities or insufficient amount of resources for biomedical waste management.

Biomedical waste handling workers come across different types of medical waste, this causes various health problems. Blood borne diseases include HIV and Hepatitis B/C viruses (HB/CV) are common in developing countries. Health care workers are reported to get injuries by needles and sharp metal due to improper disposal of medical waste and this causes blood borne disease in them. Lack of comprehensive vaccination coverage against HB/CV and lack of standard safety infection control measures such as gloves, washing hands, and usage of disinfectant increases the risk of transmission of blood borne diseases (Owie and Apanga, 2016).

Occupational hazards occur in waste transportation case are accidental cut and prick, dress material and bedding of the patients, contact with stool, urine, pus, blood, etc. of the patients and contact with infectious material like pathological waste, used gloves, tubingen, etc. (Pasupathi *et al.,* 2011, Shivalli and Sowmyashree, 2015). Ananthachari and Divya (2016) found HIV, hepatitis B and C can be transmitted to the health care workers (HCWs) during segregation, collection and transportation. Major occupational health hazard among HCWs is Tuberculosis, Latent Tuberculosis Infection (LTBI) (Owie and Apanga, 2016). According to Radha *et al.,* (2009) health care workers are at potential risk of infection from sharps like needle. Waste sharp injuries from hospital waste or through other transmission channels can cause respiratory infections, skin infections, hepatitis A and B, communicable diseases like gastro-enteritis, enterococci, non-haemolytic streptococci, anaerobic cocci, clostridium tetani, klebsiella, HIV and HBV are responsible for infection.

It is anticipated that India will generate 775.5 tonnes of biomedical waste per day by 2020 from the existing 550.9 tonnes with a combined annual growth rate of about 7% (Economic Times, 2018). It is reported that the Maharashtra state generates 71,511 kg per day (2016) biomedical waste (BMW) which makes it in the top position. According to Maharashtra Pollution Control Board report, Mumbai (erstwhile Bombay) generates 14,000 kg of BMW per day, Pune 12,000 kg per day, Nagpur 1,000 kg per day and Nashik with 8,000 kg per day (Hindustan Times, 2018).

Print and online literature review pertaining to this topic revealed that studies on the composition of biomedical waste generated in hospitals are being attempted. However, no particular study on workers who are engaged in collecting this BMW from hospitals and transporting them to disposal site is being carried out. Thus, this is the identified gap in the subject domain. The objective of the study is to assess the occupational health of biomedical waste transportation workers, microbial exposure during transportation of the waste along with Peak Expiratory Flow Rate (PEFR) analysis with suitable recommendations so as to control these

occupational health hazards. The study outcomes will add new understanding of the occupational health issues of these workers. Furthermore, the initiatives to be taken at national/state-level policy formulation and mechanism for the implementation of the same can be taken to reduce their occupational health exposure and provide them a dignified life.

Study Area

Chandrapur city (19.57° N latitude and 78.18°E longitude) (Figure 1) is a municipal corporation in the Chandrapur district of Central India. The city has an area of 70.02 sq km. According to the Census of India 2011, the city has a population of 302,379. Being the district headquarter the city caters to the medical needs of inhabitants from the nearby administrative blocks. The city has about 40 hospitals and nursing homes where inpatient facilities are available. The BMW generated from these hospitals are collected and transported by a single handling and treatment facility centre situated at Maharashtra Industrial Development Corporation (MIDC) area. This centre has a number of small biomedical waste collecting vehicles that collect the waste from hospitals and transport them to treatment facility centre for incineration of the same.

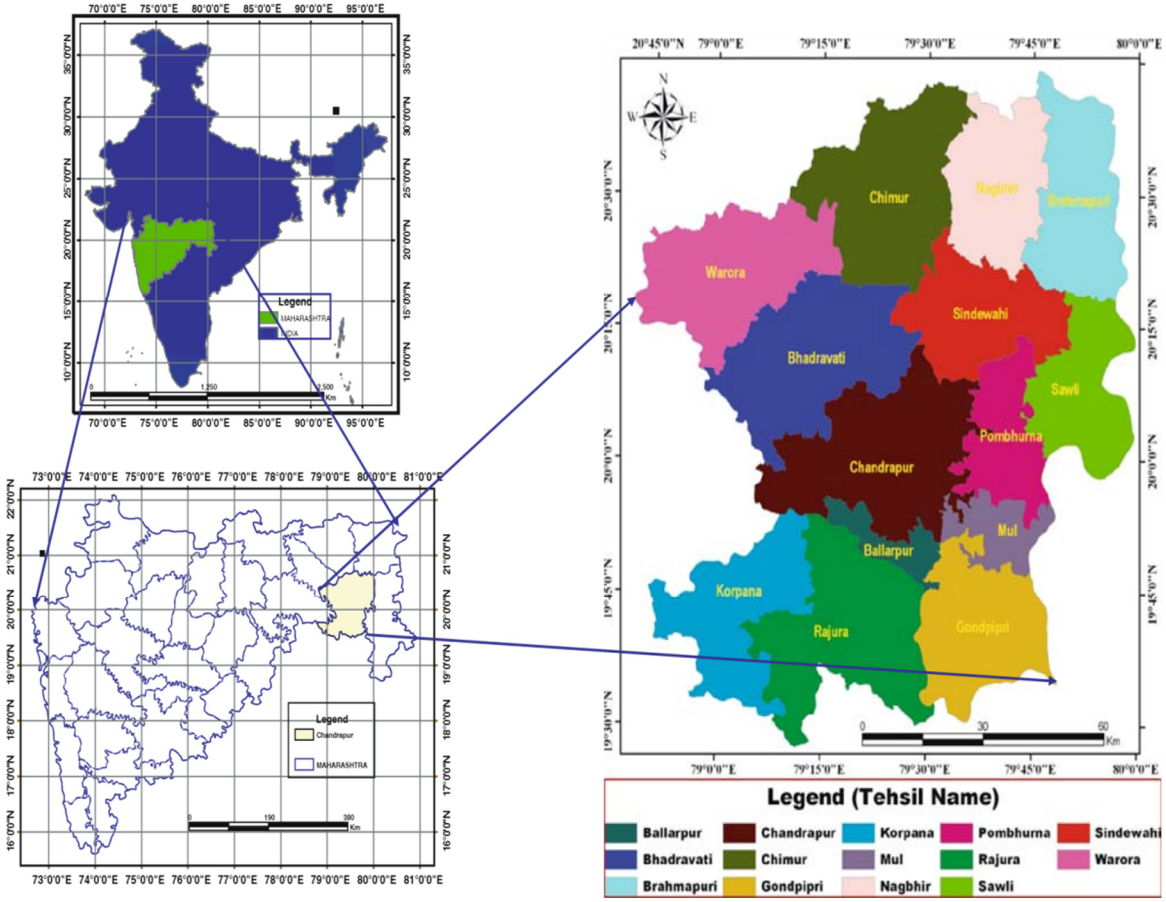

Fig. 1: Chandrapur district with differnet administrtive block in central India (Satapathy, 2009)

These BMW handling worker works for six days a week and visits the assigned hospitals in the allotted area daily. No official training was given to them for the collection of this waste. The waste collected is transported to 6-7 km away from the city in MIDC area.

Materials and Methods

A cross-sectional study was carried out from July 2018 to March 2019 on biomedical waste transportation workers of Chandrapur city, central India. To carry out this study 100 biomedical waste transportation workers from the study area were selected. In this occupation only male workers are involved. The identified workers are in the age group of 25-45 years with 50% in 25-35 years. The workers are educated up to secondary and higher secondary level. These workers abuse substances such as tobacco and alcohol consumption. These workers' job profile includes the collection of BMW stored in different plastic bags from the hospitals into the waste collection vehicle and then transportation of the same to treatment facility centre for its treatment and disposal.

To assess the occupational health of these workers a specially designed questionnaire was developed so as to draw the information pertaining to occupational health issues associated with this work. The questionnaire for assessing the occupational health assessment of identified workers comprises of their work profile, occupational health-related problems, abuse substances, coverage of health insurance, mortality and disease calendar. These aspects are measured on a 3-point and 5-point Likert scale. Furthermore, the indoor microbial environment of the transportation vehicle and Peak Expiratory Flow Rate analysis (PEFR) was also carried out. To compare the results obtained in this study 12 individuals are selected as a control population. These individuals are not engaged in BMW collection work and do not abuse the substance.

To assess the indoor microbial environment of BMW transportation vehicles Nutrient agar, MacConkey agar, and Potato dextrose agar were prepared according to standard methods. Petri plates with these agars were exposed to the indoor environment of the BMW transportation vehicles and microbial growth was allowed to grow in an incubator at 27ºC for 24 hours. After the incubation period got over, the microbial growth was identified.

The Peak Expiratory Flow Rate (PEFR) is a measure of how well air is able to move out of the lungs. To assess the PEFR breathe-o-meter instrument was used. The peak expiratory flow meter is a simple and easy way to use the device to assess the health of individual's airway. When an individual blows into the mouthpiece of the instrument the pointer moves forward and reading will be taken to check the lung power. It measures the airflow through the bronchi and the degree of obstruction in airways. In people with asthma, the PEFR reading is reduced as their airways are narrowed. Biomedical waste transportation workers were asked to use a breathe-o-meter (Cipla, India, as per EU scale) to measure their lung capacity by comparing it with standard chart prepare by Chest Research Foundation (CRF), Pune, India according to age and height of an individual.

The qualitative data generated in the study is converted to the quantitative aspect which is used to assess occupational health related issues. For

statistical analysis, results are presented in percentages.

Results and Discussion

Occupational health assessment of the identified BMW transportation workers revealed 70% (n=70) have work exposure <5 years; whereas, 30% (n=30) with 6-10 years. These workers work for 9-12 hours per day and travel an area of about 30 km each day by using the biomedical waste transportation vehicle. Biomedical waste collection activities are carried out in all season and these workers work from morning till evening. Regular site visit to an assigned hospital once a day is carried out for the collection of biomedical waste.

Biomedical Waste Exposure

The BMW transportation workers' exposure to different waste is presented in Table 1. From the table BMW generated from the study area can be arranged in the order of needles = contaminated cotton = blood and urine > sharp items > amputed organs.

Table 1: Biomedical waste exposure

Biomedical waste	Respondent (%)
Needles	100
Contaminated cotton	100
Blood and urine samples	100
Sharp items	90
Amputed organs	30

Occupational Health Problems

Biomedical waste transportation workers play an important role in biomedical waste collection and its treatment. While carrying out these activities this waste results in a number of occupational health related issues in these workers. Occupational health issues associated with BMW handling and transportation workers is presented in Table 2. From the table, it can be seen that injuries during work and cut & pricks are common identified problems. Glasses and metal, needles and intravenous sets are the substances causing injuries during work. Long term exposure to waste can lead to serious health issues.

Table 2: Occupational issues

Occupational issue	**Respondent (%)**
Injuries during work	100
Cut and prick	100
Substance causing injuries	
Glasses and metal	100
Needles	100
Intravenous-sets	100

Occupational health issues related to BMW is presented in Table 3. From the table, it can be seen that nausea resulting from odour of BMW is reported by all respondents. Furthermore, vomiting due to this nausea is reported by 40% workers. Redness and watering of eyes are reported by all sample population. Skin itching has emerged as a dermatological problem. Breathlessness has been reported as a respiratory problem by 80% workers. High blood pressure has been reported by 50% sample population. Gastrointestinal problems are in the order of nausea > heartburn > diarrhoea > vomiting. General body pain and back pain is reported by all sampled individuals. Of the identified workers, 50% reported irritation due to unknown chemicals in BMW. The results reported by Owie and Apanga (2016) concurs with the observation recorded in the study for workers getting injuries by needles and sharp metal due to improper disposal of this waste.

Table 3: Occupational health issues

Occupational health issue	Respondent (%)
General illness (Cold, fever, malaise, mild diarrhoea)	
No	70%
Yes	30%
Bio-medical waste odour	
Nausea	100%
Vomiting	40%
Headache due to BMW odour	
Yes	50%
No	50%
Eyes problem	
Redness	100%
Watering	100%
Soreness	40%
Swelling	30%
Dermatological problem	
Itching	90%
Rashes	10%
Respiratory problem	
Breathlessness	80%
Cough with expectoration	40%
Cough	20%
Hyperventilation	10%
Cardiovascular problem	
Hypertension	50%
Hypotension	10%
Gastrointestinal problem	
Nausea	90%
Heartburn	50%
Diarrhoea	20%
Vomiting	10%
Musculoskeletal problem	
General body pain	10%
Back pain	10%
Irritation due to an unknown chemical	50%
Joint pain	30%

Precautionary Behaviour and Personal Hygiene

Biomedical waste transportation workers have not received any formal training for handling of this type of waste. Furthermore, they are not provided with any personnel protective clothing, mask, gloves, shoes, etc. during the work. These workers follow some personal hygiene practice which includes bathing after completion of the work (100%), hand hygiene before drinking water and eating.

Microbial Exposure

Biomedical waste transportation workers spend a considerable period of time (9-12 hours per day) inside the vehicle which is used for collection and transportation of this waste. Owing to this aspect, indoor air quality with respect to the microbial analysis of the vehicle revealed the presence of Staphylococcus aureus and Escherichia coli. These results are in agreement with the Osagie *et al*. (2016) and Alwabr *et al*. (2016). Staphylococcus aureus can become opportunistic pathogen and can be common cause of skin and respiratory infection. It can also cause life threatening diseases such as pneumonia, meningitis, sepsis etc.

Peak Expiratory Flow Rate

The Peak Expiratory Flow Rate (PEFR) analysis was carried out to assess the lung capacity of the BMW workers and control population. It is observed that there is difference between the expected value and the observed value. Observed PEFR values are less than the expected values. These observations indicate that the lung capacity of the BMW transportation workers is below normal and may suffer from asthma, bronchitis or other lung diseases. The exposure to pathogenic harmful microorganisms present in BMW and in the vehicle may have reduced the lung capacity of these workers. Statistical summary of PEFR values for exposure period of <5 years and >5 years is presented in Table 4. From the table it can be seen that exposure duration has pronounced effect on minimum PEFR

value. As exposure duration increases average PEFR value increases (476.66 L/min).

Table 4: Statistical summary of PEFR for the different exposure period

Statistical parameter	**Exposure duration**	
	<5 years	**>5 years**
Minimum	400	470
Maximum	490	480
Average	451.42	476.66
Standard deviation (±)	33.38	5.77
Variance	1114.28	33.33

PEFR values in L/min.

According to Patil and Kamble (2017b), occupational health issues in sanitary workers include musculoskeletal problems, exposure to harmful gases, headache, gastrointestinal, respiratory and dermatological while working; whereas, dermatological problems, allergies, cough and cold, bronchitis lungs, asthma and hearing disorder after completion of work. Reduced PEFR values were directly proportional to exposure duration (in years).

Occupational health problems in solid waste collecting workers include musculoskeletal, respiratory, dermatological, headache and gastrointestinal during work; whereas, stomach pain, allergies, asthma, bronchitis lungs, cough and cold, hearing disorder, fever etc. after completion of work. As exposure duration increases PEFR values decreases and minimum values were observed in the exposure period of >25 years (Patil and Kamble, 2016-17).

Street sweepers occupational health issues include musculoskeletal, respiratory, dermatological, headache and gastrointestinal problems during work, and after completion of work includes allergies, cough and cold, asthma and bronchitis lungs, fever and vomiting (Patil and Kamble, 2017a).

Occupational health issues in flour mill workers include extensive cough, skin burning, itching and watery eyes and allergic problems. Workers in mix flour mills have reported additional health problems than only wheat flour mills. Increase in asthma problem is directly proportional to exposure duration (in years). Reduction in PEFR showed the reduction of lung capacity with increased exposure period (Nimgade and Kamble, 2016).

Conclusion

Biomedical waste has emerged as an important hazardous waste. Biomedical waste transportation workers work in a hazardous environment for a prolonged period of time during collection and transportation. These workers are exposed to a number of biomedical waste objects and microorganisms owing to which they suffer from a number of occupational health diseases. No formal training and absence of personnel protective equipment make these workers more vulnerable to this hazardous waste. Furthermore, they are not covered under any insurance scheme which makes their families more susceptible in case of their death as they are the sole bread earner in the family. It is recommended a formal training to be given to these workers in addition, personal protective equipment to be provided so as to reduce their exposure and thus chances of occupational diseases associated with it. Hospitals should also ensure the BMW to be separated according to their categories. The study has limitation as it covered only Chandrapur city, an extended study in other parts of India needs to be carried out along with assessment of other health

related aspects for comprehensive understanding of the issue. The government while amending the concerned law in future take cognizance of these occupational health aspects associated with this waste and bring these workers under its ambient.

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