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Knowledge, attitude, and practices of Bio-medical Waste Management (principle) rules, 2016; Bio-medical Waste Management (amendment) rules, 2018; and Solid Waste Rules, 2016, among health-care workers in a tertiary care setup

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Abstract:

INTRODUCTION: Biomedical waste poses physical, chemical, radiological, and microbiological risks to the public and health-care workers (HCWs) for current and future generations.

AIM: The aim was to gauge the depth of understanding amongst HCWs on biomedical waste management (BMWM).

MATERIALS AND METHODS: A predesigned questionnaire on knowledge, attitude, and practices on BMWM Rules, 2016 (Principle), and 2018 (Amendment), Solid Waste Rules, 2016, and health hazards in HCW was distributed to all participants.

RESULTS: Only 68% of the participants knew that the most important step in waste management is waste segregation. Eighty-two percent of the HCWs working in this setup knew of the different color-coded bins used for segregation. However, awareness was lacking with respect to health hazards associated with improperly segregated and disposed off biomedical waste as only 49% answered the questions on the hazards of waste correctly. Laboratory waste handling was found to be the least understood area of the newer guidelines.

CONCLUSIONS: Training aspects of health-care waste management should be strengthened so that the current, existing, and future regulations are practiced diligently and uniformly. Periodic evaluation and assessment should become routine to enforce adherence to waste management.

Key words:

Biomedical waste management, Bio-medical Waste Management Rules 2016 and 2018, health-care workers, India

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Introduction

Biomedical waste is any waste, which is generated during the diagnosis, treatment, or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals or in health camps: categories in Schedule I appended to Bio-medical

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Waste Management (BMWM) Rules, 2016.[1,2] Improper management of medical waste has posed a grave threat not only to human health and safety but also to the environment for the current and future generations.[3]

Hospital waste is 85% noninfectious and only 15% infectious.[3] However, poor segregation can cause the mixing of noninfectious with infectious waste and increase the total hazardous waste volume. In 2015, the Central Pollution Control Board, India, has estimated that 169,913 health-care facilities (HCFs) of India have generated approximately 495.30 tons/day biomedical waste, which roughly translates into 0.5–2 kg/bed/day.[4,5] With newer complicated diagnostic and treatment modalities getting introduced every day, this volume has shown only an increasing trend. Previous methods of waste management such as the landfill and incineration are now ineffective in tackling this huge volume. Sometimes, incineration and landfill themselves pose a threat to the environment and population. This forced developers and regulators to change their focus from incineration and landfill to segregation, recycling, and waste minimization.[2,6]

The first regulation for efficient management of biomedical waste in India came in 1998. However, medical sciences transform faster than the methods of waste management methods. The most comprehensive and effective guidelines of waste management were introduced by the Government of India as BMWM (Principle) rules, 2016, and BMWM (amendment) rules, 2018.[3,7] These guidelines included a severe penalty as a deterrent to defaulters. Waste management guidelines now follow the cradle-to-grave approach and include all steps of waste generation, collection, storage, transportation, treatment, and ultimate destination (incineration, recycle).[8]

The International Clinical Epidemiology Network performed a nationwide survey in 25 districts across twenty states. Improper pretreatment of BMW at source and improper terminal disposal and lack of proper dedicated infrastructure were observed as the major challenges.[9] Although numerous studies on the knowledge, attitude, and practices (KAP) of BMW rules, 1998, exist, studies on BMWM Rules, 2016, and BMWM (Amendment) Rules, 2018, are scarce.[10-20] Just teaching about the rules without assessing the depth of understanding has led to a lot of mishaps related to biomedical waste. This study was done to test the KAP of BMWM (Principle) Rule, 2016, and BMWM (Amendment) Rule, 2018, and Solid Waste (SW) rules, 2016, among health-care workers (HCWs) in a tertiary care setup.

Materials and Methods

This study was undertaken in a 2873-bedded largest public sector hospital in New Delhi from April 2018 to September 2018. We have an established system of the mandatory teaching program of BMWM and SW Management for new HCWs, be it a doctor or housekeeping staff at the time of induction and once every year thereafter. The training program was conducted for 2 h for each session. It included lectures, open discussions, and demonstrations on all aspects of BMWM.

An in-house survey pertaining to health-care waste (BMW and SW) was planned to assess the existing knowledge and practices of the HCWs taking part in these training sessions.[10,11] A self-designed pretested questionnaire [Annexure 1] as in all other studies done in this contemporary time, was used.[5,12-14] We critically felt that a universal tool should be developed for assessment to establish uniformity. Participation in the survey was purely voluntary and anonymous. Questions were close ended (multiple-choice based) and based on the KAP of BMWM. Responses were checked by one of the study conductors and discussed at the end of each session. To ensure the understandability of the questionnaire, a trial test comprising of five participants from each study population group was done before the actual study.[12] The language of the questionnaire was adjusted for clear-cut understanding, following discussion with the trial groups (English mainly for all except sanitation staff [n = 109]).

Analysis of the responses was done under groups as follows: (1) knowledge and attitude (12 questions) and (2) practice (8 questions). Groups under which knowledge and attitude were analyzed were (a) Legal aspect and administration, (b) SW disposal, (c) color coding of disposal bins, (d) methods of sterilization and disinfection, and (e) health hazards, prevention, and management.

Results

A total of 1668 personnel attended the training program during the study period. As participation was voluntary, many choose not to take part, and only 1212 completed forms could be collected at the end. The collected responses were evaluated by the study supervisor while the training session was being conducted. At the end of each session, the checked responses were recirculated and discussed among the participants to increase comprehension. Out of the 1212 participants, 66% (n = 799) were doctors of different specialties, 19% (n = 230) were nurses, 6% (n = 72) were laboratory

technicians, and the rest 9% ($n = 109$) were housekeeping staff [Figure 1].

Analysis of the compiled results showed that doctors and nurses were aware of the waste management rules and guidelines [Table 1]. Even though our hospital has a well-developed BMWM system in place, the knowledge among housekeeping staff was found to be lacking [Table 2]. Cronbach's alpha for the result was calculated to be ≥9.

It was found that 68% of the participants knew it was necessary to segregate infectious from noninfectious waste. This leaves a staggering 32% of health-care personnel unaware of the problem. Knowledge of color-coded bins used in our facility was good among all groups except the housekeeping staff, of whom only 56% answered this question correctly [Table 1].

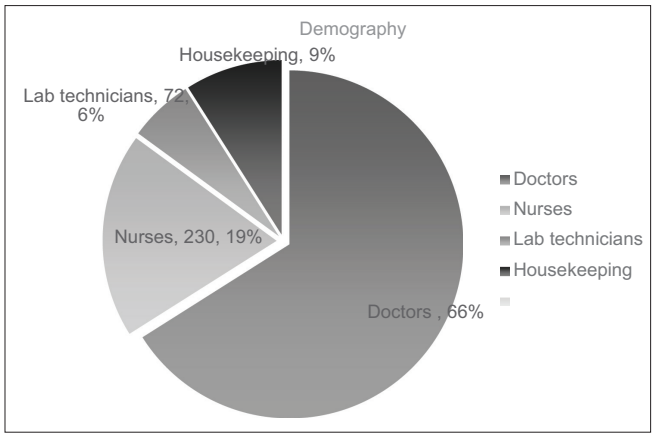

Figure 1: Demography of study population

Discussion

At present times, focus has shifted to the reduction of infectious waste volume. This reduction can be achieved by first separating infectious waste from noninfectious waste. Similar to the study by Bhagawati *et al.*, 2015, in this study, 68% of the participants knew that the key step is segregation, but 32% of all HCWs did not know how to differentiate infectious from noninfectious waste.[15] On simplification, only 41% of the housekeeping staff could tell the proper color coding of waste, as was the case with Mathur *et al.*, 2011 (27%), and Soyam *et al.*, 2017 (25%), and Bansal *et al.*, 2011 (43%).[5,16,17] The most worrying point was nearly half of the HCW population is unaware of the prerequisite of treatment of laboratory waste before sending out of the facility. Even in the case of laboratory technicians, 70% answered this question correctly.

Doctors, nurses, and laboratory technicians were well versed with waste segregation, color coding, and the important health hazards of biomedical waste. Our finding agrees with that of Mathur *et al.*, 2011, that the lack of formal education among the house-keeping staff might play a factor in low awareness among them.[5] Another problem in the color coding system arises for

Table 1: Knowledge and attitude among health-care workers about Bio-Medical Waste Management rules, 2016 and 2018, and Solid Waste rules, 2016

Knowledge and attitude	Doctors (*n*=799)	Nurses (*n*=230)	Laboratory technician (*n*=72)	Housekeeping staff (*n*=109)	Total (*n*=1212)
Legal aspect and administration (%)	73	67	61	63	70
Solid waste disposal (%)	76	89	74	44	74
Color coding of disposal bins (%)	84	88	78	56	82
Methods of sterilization and disinfection (%)	79	73	77	70	77
Health hazards, prevention, and management (%)	49	58	57	24	49

Cronbach's α – 0.9375

Table 2: Practices among health-care workers about Bio Medical Waste Management rules, 2016 and 2018, and Solid Waste rules, 2016

Practices	Doctors (*n*=799)	Nurses (*n*=230)	Laboratory technician (*n*=72)	Housekeeping staff (*n*=109)	Total (*n*=1212)
Differentiating infectious from noninfectious waste (%)	73	65	63	41	68
Treatment of laboratory waste before discarding (%)	45	52	70	0.1	45
Reporting of sharp-related injury (%)	77	67	27	36	69
Hepatitis B vaccination (%)	66	75	69	12	63
Hand hygiene (%)	73	77	40	31	68

Cronbach's α – 0.9375

the general waste (SW), where blue bags are used. In this study, 89% of the nurses answered correctly, whereas only 44% of the housekeeping staff were able to answer correctly. No previous study was found regarding SW disposal and compliance in HCWs. The authors strongly feel that every biomedical waste training curriculum should include SW/general waste management.

Only 36% of the housekeeping staff knew what to do after needlestick injury. Other studies which were conducted earlier have also shown a similar finding. Laboratory technicians were poorly aware of how to manage sharp injury (27%) and adhering to the principles of hygiene (40%), which was abysmal compared to the study by Dudi *et al*., 2016, but somewhat agrees with the finding of Ismail *et al*., 2013.[14,18] Anyone working in the health sector, that comes in contact with infectious material daily, must have adequate knowledge of health-care waste management. Anything less than absolute perfect knowledge is a disaster waiting to happen.

Numerous studies on the KAPs of BMW rules, 1998,[10-19] were done, but studies on KAP for BMWM Rules, 2016, and BMWM (Amendment) Rules, 2018, compliance, are scarce.[20] In this study, even though doctors knew the importance of health-care waste management, when it comes to guidelines, their knowledge is not complete [Table 1]. Other HCWs were better in working knowledge as on an average, ≥70% could answer the methods of disinfection and sterilization. The gravity of this issue just cannot be ignored. To increase awareness, the curriculum of medical, postgraduate, nursing, laboratory technology, and other paramedical courses should give higher importance on biomedical waste, its hazards, and its impact on the society.

The limitation of our study was that the study population was positively skewed in favor of doctors followed by nurses. Although a large population of housekeeping staff took part in the training for BMWM, only ≤30% took part in the study. Housekeeping staff who handle and transport waste should undergo repeated training and evaluation, as their attrition rate is high in HCFs.

Conclusions

It is concluded that repeated and comprehensive training (starting with induction of all new appointees to once a year thereafter) by vertical and horizontal modes on BMWM is the only way forward. Mandatory attendance in regular training programs and periodic assessments should be included in yearly performance assessment of all HCWs to increase compliance. The spirit of BMWM rules is dynamic, and it is reinforced by the fact that by the time we penned down our study, BMWM rules, 2019, have been already rolled out twice in 2019.[21]

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Conflicts of interest

There are no conflicts of interest.

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Annexure 1: Questionnaire

Q.1. If a health-care facility does not comply with the waste management rules of the Central Pollution Control Board, it is liable to the following punishment:

a. Warning is issued
b. Fine of Rs. 10,000/-
c. Imprisonment of 6 months
d. Fine and imprisonment up to 1 year and up to Rs. 1 lakh.

Q.2. Infectious waste can be stored in the health-care unit:

a. Up to 12 h.
b. Up to 24 h.
c. Up to 48 h.
d. Up to 72 h.

Q.3. What percentage of waste generated in the hospital is infectious/hazardous?

a. 80%–90%
b. 15%–20%
c. 60%–70%
d. 30%–40%

Q.4. Blue solid waste bags should be used to put

a. Cardboard boxes, wrappers
b. Plastic infected waste
c. Infectious dressing or swab (soiled waste), i.e., material contaminated with blood or body fluid
d. Syringes and needle

Q.5. As per the Safdarjung Hospital policy of health-care waste management, the following color-coded bins with liners are used:

a. Yellow, blue, red, and puncture-proof container
b. Blue, red, green, yellow
c. Yellow, blue, black, and puncture-proof container
d. Yellow, red, and puncture-proof container

Q.6. The following method involves the destruction of all microorganism including the resistant spore forms:

a. Disinfection
b. Antisepsis
c. Germicidal
d. Sterilization

Q.7. All of the following can be incinerated except:

a. Placenta, tissue
b. Soiled gauze, dressing
c. Tissues culture, waste from microbiology
d. Halogenated plastic

Q.8. How are antibiotic-resistant pathogens most commonly spread from one patient to another in hospital:

a. Airborne spread from patients' cough and sneeze
b. Patient coming into contact with contaminated equipment

c. From one patient to another via hands of contaminated hands of health-care workers
d. Poor environmental/sanitation/cleaning

Q.9. Risk of transmission of HIV following sharps injury from infected needle

a. 30%
b. 20%
c. 10%
d. 0.3%

Q.10. Rollback of 10% to 1%–2% sodium hypochlorite was advocated in:

a. BMWM amendment rules, 2018
b. BMWM rules, 2016
c. BMWM rules, 1998
d. BMWM draft rules, 2011

Q.11. Efficacy of hepatitis B vaccine in preventing hepatitis B infection is:

a. 70%–75%
b. 90%–95%
c. 40%–50%
d. 30%–40%

Q.12. Which is the most common means of spread of nosocomial pathogens?

a. Central intravenous catheter (Central venous catheter [CUP] lines)
b. Foley's catheter
c. Peripheral intravenous lines
d. Hands of health-care workers

Q.13. The "keys step" to "waste minimization" and management of waste is

a. Incineration of waste which is infectious
b. Autoclaving/microwaving infectious waste
c. Recycling of plastic
d. Segregation at the point of generation.

Q.14. When a health-care worker experiences a needlestick injury, he/she should do all the following except:

a. Immediately suck his/her bleeding finger
b. Wash with the soap under running water and seek further medical advice
c. Report to chief medical officer (CMO)/nodal officer casualty
d. Apply antiseptic dressing immediately.

Q.15. Pre-treatment/disinfection of laboratory waste is done with the aim of:

a. To reduce the bulk and to disinfect the waste
b. Safety of waste handlers
c. To reuse the item
d. To store for a long period

Q.16. How will you sterilize endoscopes?

a. 1% hypochlorite solution
b. Autoclaving
c. Boiling for 30 min

d. 2% glutaraldehyde (Cidex)

Q.17. Concentration of sodium hypochlorite used for routine disinfection of used disposable item is:

a. 0.1% for 1 h
b. 1.0% for 30 min
c. 5% for 20 min
d. 10% for 30 min

Q.18. The first step in the processing of surgical reusable instrument is

a. Cleaning under running water
b. Washing using soap and water
c. Scrubbing with brush and water
d. Decontamination

Q.19. What is the single-most effective way to prevent the transmission of diseases in the hospital?

a. Prophylactic antibiotics.
b. Hand washing for 20–30 s following six steps
c. Using disinfectants in hospital
d. All of the above

Q.20. Schedule of hepatitis B virus vaccination?

a. 0, 1, 6
b. 0, 1, 3
c. 0 and 6
d. 0 and 1