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Review Article

Knowledge, Attitude, And Practices of Biomedical Waste Management(Principle) Rules 2016; Biomedical Waste Management (Amendment) Rules 2018 Among Health Care Workers in A Teaching Hospital: A Critical Appraisal On the Current State and Way Ahead

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Abstract: Hospital-generated waste materials commonly labeled as 'Biomedical waste (BMW) is a kind of remnant that includes infectious and non-infectious materials, and their appropriate disposals are controlled per the guidelines of Biomedical waste management (BMWM) Amendment Rules, 2018, Government of India. Periodic assessment on BMWM among health care workers (HCW) is mandated to ensure quality assurance which may be helpful during pandemic times. The study was conducted with ethical clearance using a validated questionnaire (using Cronbach's α) covering Knowledge, Attitude, and Practices (KAP) derived based on recent Biomedical waste management 2018 guidelines. The study conductors checked the responses in context to KAP; appropriate statistical analysis was done and discussed at the end of each session. Nearly 279 HCWs participated in the study and cast their responses. Knowledge and attitude domain on BMWM showed statistical significance, and varied responses were observed with practices among the participants. The present study proves novelty by extensively analyzing KAP among healthcare workers on biomedical waste management in general, with particular emphasis on laboratory biosafety norms. The study emphasizes that BMWM should be a continuous process, and all HCWs handling BMW must undergo regular training and assessment with questionnaire surveys. Multi-tasking and cumulative efforts must be formulated to attain translational synergy in the stream of KAP of BMWM, which could be attained by incorporating BMWM in the health science curriculum.

Keywords: Waste Management, Biomedical Waste, Disposal, Environmental Impact, Health Care Workers, Knowledge, Attitude, And Practice.

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1. INTRODUCTION

A hospital is a healthcare institution catering to the medical needs of society. People from all domains and sectors visit it, irrespective of sociodemographic profile, to get treated for their medical illnesses. [1,2] A health care body comprises doctors, medical staff, and other health care workers broadly termed as 'health care providers. Any human activity generates waste in several forms, which may pose potential hazards to mankind and the environment for the present and future generations, thereby warranting appropriate disposal methods. [2] Hospital-generated waste materials, commonly labeled as 'Biomedical waste,' is a kind of remnant disposal in either human tissue or medical utilities that is potentially harmful with infectious nature.[2-4] Biomedical waste(BMW) is any form of waste materials, which is generated during the process of diagnosis, especially laboratory procedures, treatment process, and sometimes even immunization of human beings or animals in research activities about it or which includes production or testing of biologicals and health camp activities.[1,4]From the administrative perspective, activities involved in handling biomedical waste management are labeled under the category in Schedule I appended to the recent Biomedical Waste Management (BMWM) Rules, 2016 which includes (me). Waste generation, (ii). Segregation and collection of disposals, (iii). Reception and transportation, (iv). Storage and treatment as per guidelines. [1-4] In general, it has been estimated that nearly 85% of biomedical waste generated in hospital are non-infectious, while the rest 15 % are hazardous and infectious. [4,5] Another potential risk is mixing up this non-infectious waste with infectious contents owing to improper segregation, thereby increasing the volume of total hazardous contents. Hence an effective task is warranted in managing the 15% volume and solving all the related problems. A nationwide census study by the Central Pollution Control Board of India has shown that nearly 17,000 healthcare facilities(HCF) in India seemed to have generated around 500 tons/day of biomedical waste, which translates to a figure of 05-2kg/bed per day. [2,5,6] In the modern era, many new innovative laboratory testing facilities and treatment modalities have been introduced now and then contributed to an increasing trend in the gross volume of biomedical waste management.[6,7] Earlier waste management methods, like landfilling, incinerations, burial, etc., have become ineffective in managing the huge volume and pose a threat to the environment in many instances.[7] The "waste management hierarchy" concept is solely based on the principle of '3R'- Reduce, Reuse & Recycle, which is further categorized with the inclusion of 'recover and treat'[7,8] Despite many regulatory frameworks worldwide, the ground realities remain grim, thereby warranting enriching the health care providers, including housekeeping sectors, with knowledge and practice on BWM.[9] Apart from environmental hazards, the health care workers (HCWs) dealing with BMW are frequently subjected to infectious hazards such as HIV, Hepatitis, and Tetanus. To curb such adverse health effects on personnel dealing with BMW and give general hygiene, the first regulation for proper management of BMW came into existence in 1998 in India, as notified by the Ministry of Environment and Forest, issuing guidelines to all hospitals and laboratories. However, the government of India commissioned the most efficient and comprehensive waste management guidelines under the BMWM (Principle) rules. 2016 and BMWM (amendment) rules, 2018. [2,6,8] These guidelines are enforced with laying penalties as a deterrent to defaulters. BMW guidelines follow the cradle-to-grave approach till the ultimate destination is attained. The International Clinical Epidemiology Network surveyed the country covering 25 districts, including 20 states. [2,9] The results revealed that the major challenges were improper pre-treatment of BMW at the source point and inadequate infrastructure. This puts physicians and HCWs at exposure risk for acquiring infectious conditions. Several studies have been conducted on analyzing the Knowledge, Attitude, and Practices (KAP) of BMW rules, 1998, study analysis on BMWM Rules, 2016 and BMWM (Amendment) Rules, 2018 are very minimal, especially in private sector laboratories covering ground-level sewage workers. [2,6-9] Several research studies and publications in the laboratory sector include clinical trials and drug research followed by translational research, whereas studies on biomedical waste management often go unprecedented.[10] While the recent 2018 BMWM amendment includes many newer entities incorporating different contents under the BMW category, proper protocol and policy on BMWM are essential for every hospital operating their functionaries and mandatory for accreditation inspections such as NABH and NABL.[11] Hence keeping the purview of these regulations, the present study was conducted as a part of quality assurance with a novel aim to assess the KAP of the BMWM (Principle) Rule, 2016, and BMWM (Amendment) Rule, 2018 among laboratory technicians, health care professional including housekeeping staff at our tertiary care teaching hospital located in a semi-urban area of South East Coastal region of India.[2,12]

2. MATERIALS AND METHODOLOGY

The present study was conducted for six months, from November 2019 to April 2020, in a tertiary care hospital at Puducherry equipped with 3600 patient beds. Proper Institute Ethical committee clearance was obtained for conducting the study. We have a hospital protocol as an established system of an induction training program on BMWM and Solid waste disposal for all the health care workers, including laboratory technicians, physicians, and housekeeping staff who are involved in handling Biomedical waste and Sewage Waste Management. The training program is scheduled to be conducted at the time of induction and then onwards for 2 hours every week once in six months. The mode of training delivery included didactic lectures, group tasks, open discussions, and demonstrations on all aspects of Biomedical waste management in English and local languages (Tamil mainly for housekeeping and sanitation staff [n=45]). In addition, an in-house survey pertaining to healthcare waste BMWM (Biomedical Waste and Sewage Waste management in context to the latest Government guidelines) was proposed to assess the existing knowledge, Attitude, and practices of the healthcare workers mentioned above.

2.1 Questionnaire validation

A self-administered, pre-tested, and structured questionnaire with options(close ended-multiple choice questions) covering three domains -Knowledge (11 questions), Attitude (10 questions), and Practices(6 questions) of BMWM was prepared and circulated to the health care workers [Annexure-1] The questionnaires were framed with novelty adapted from literature and with assistance from peer experts and validated

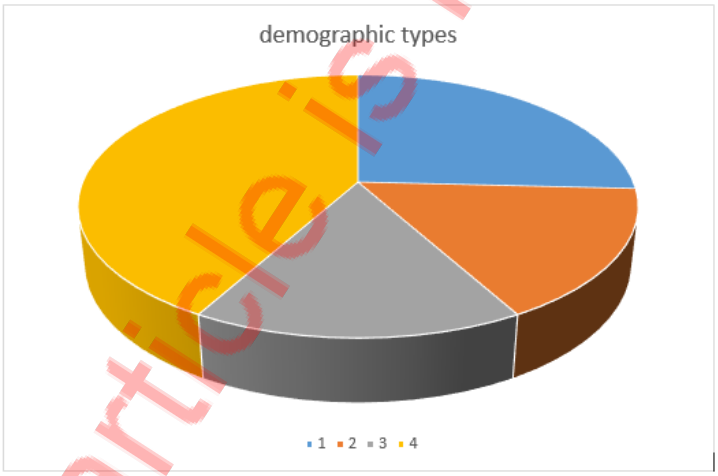
using a pilot study.[13-15] To ensure a better perception of the questions, a mock trial test comprising five participants from each group of HCWs (health care workers) was conducted before commencing the actual primary study to avoid 'sampling bias .'The questions were kept simple, clear, and straightforward without any leading questions to avoid bias (response bias). The aims and objectives were explained to the participants before handing out the questionnaires in the language they understood. It was ensured that the language of the questionnaire was modified for distinct understandings following post-discussion with the trial groups. The participants were ensured that enrolling in the study was voluntary and the participant's details would be anonymized (to avoid voluntary bias). The study results would not be used as the employee's Appraisal of the work. One of the study conductors checked responses and discussed them at the end of each session. Responses of the groups under which knowledge and attitudes were evaluated include (i). Legal aspects and administrative perspectives (ii). Color coding and appropriate usage of disposal bins (iii). Solid waste disposal management (iv). Sterilization procedures, including disinfection (v). Infectious and potential health hazards and their preventive measures. [16-18]

3. STATISTICAL ANALYSIS

The observations and Data parameters were tabulated and then entered in a Microsoft excel sheet and statistical analysis was done to calculate the p-value [chi-square test] using Socscistatistics.com & p-value <0.005 is taken as a significant value. The self-administered questionnaire was validated by a short pilot study using the appropriate statistical tool, Cronbach's α, which showed a value (Cronbach's α≥ 9 is considered as significant)

4. RESULTS & OBSERVATIONS

450 personnel attended the training and orientation program during the study period fulfilling the eligibility criteria. Among those, 279 personnel volunteered to enroll as participants in the study and actively cast their responses. Since participation in the study was voluntary, many HCWs chose not to take part at their liberty. At the end of the survey, the study supervisors collected and evaluated the responses. The observations showed interesting responses which differed amongst participant groups in varying proportions. Among the 279 participants, 25% (n=72) were laboratory technical staff, 16.2% (n=45) were housekeeping and sanitization personnel, 16.2 %(n=45) were doctors, and 42.6 %(n=117) were nurses. Fig 2 shows demographic variables.



4 = nurses, 2= laboratory technical staff, 2= housekeeping 1= doctors

Fig 1: Demographic types

Table-1: Knowledge and Attitude among HCW on Bio- Medical Waste Management Rules, 2016 and 2018, and Solid Waste rules, 2016

Knowledge and Attitude	Laboratory technicians (n=72)	Housekeeping staff and sanitization personnel (n=45)	Laboratory Physicians & Doctors (n=45)	Nurses handling laboratory samples (n=117)	Chi-square	P-VALUE
Legal aspect and administration (%)	27 (38%)	18 (40%)	36(80%)	56 (47%)	22.6	0.001
Solid waste disposal (%)	45 (63%)	27 (60%)	38(84%)	45(39%)	30.8	0.001
Color coding of disposal bins (%)	63 (87%)	27 (60%)	43(95%)	99(84%)	23.3	0.003
Methods of sterilization and disinfection (%)	65 (90%)	36 (81%)	32(72%)	72(63%)	26.8	0.001

Health hazards, prevention & management (%)	48 (66%)	18(40%)	38(84%)	52(44%)	29.1	0.001

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

Practices	Laboratory technician (n=72)	Housekeeping &sanitization personnel (n=45)	Laboratory Physicians (n=45)	Nurses handling laboratory samples (n=117)	Chi-square test	P value
Differentiating infectious from Non-infectious waste (%)	54(74.2%)	32 (72.25%)	32 (72%)	77 (65%)	3.8	0.001
Treatment of laboratory waste before discarding (%)	65(90%)	28 (63.4%)	38 (84.%)	74 (63%)	13.3	0.004
Reporting of sharp/needle-related injury(%)	54 (74%)	23 (51.5%)	40(88.8%)	86 (72%)	20.1	0.001
Hepatitis B vaccination (%)	63(87.4%)	32 (71.2%)	41(91.1%)	72 (61%)	23.5	0.003
Hand hygiene (%)	65 (90%)	34 (75.5%)	42 (93%)	90 (77%)	10.8	0.001

ANNEXURE-I

1. Does the laboratory generates and handles biomedical waste?
a. Yes b. No
2. If a laboratory or hospital does not comply with the waste management rules proposed by the Central Pollution Control Board, it is liable to the following penalty:
a. Warning and show cause notice is issued
b. Fine of Rs. 10,000/- (In Indian Rupees)
c. Imprisonment to the concerned for up to 6 months
d. Both fines up to Rs. 1 lakh. And Imprisonment up to 1 year period
3. Maximum time duration that an infectious biomedical waste could be stored in the Healthcare unit:
a. Up to 12 hours.
b. Up to 24 hours
c. Up to 2 days
d. Up to 3 days
4. In the color coding system of disposal, Blue solid waste bags should be used to put
a. Cardboard boxes, wrappers
b. Plastic-infected waste
c. Infectious dressing or swab (soiled waste)
d. Syringes and needle
5. What percentage of waste generated in the hospital is infectious/hazardous according to BMW Rules 2016?
a. 80%–90%
b. 15%–20%
c. 60%–70%
d. 30%–40%
6. What is the percentage of infectious and non-infectious BMW generated in your hospital?
a. 80%–20%
b. 85%–15%
c. 75%–25%
d. 50%–50%
7. As per your working hospital policy on biomedical 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
8. Are you aware of the incident of getting infected by biting nails or having food in laboratories

a. Yes
b. No

9. The following solid waste can be incinerated except:
a. Placenta, tissue
b. Soiled gauze, dressing
c. Tissues culture, waste from microbiology
d. Halogenated Plastic
10. The following is the ideal method of destructing all microorganisms, including resistant microbial agents:
a. disinfection
b. Antisepsis
c. Germicidal
d. Sterilization
11. COVID-19 suspected/positive laboratory samples should be discarded in
a. Double yellow autoclavable bag
b. Blue bag
c. Red bag
d. None
12. Sample with suspicion or positive for COVID-19
a. can be centrifuged
b. centrifugation should be avoided
c. can be centrifuged with an N95 mask
d. None of the above
13. BMW disposal for COVID-19 suspected/positive samples should contain the following
a. Danger symbol
b. "COVID-19 waste."
c. No labeling
d. None of the above
14. Disinfection of laboratory BMW in COVID-19-related samples should be done by
a. 0.1% surface disinfection
b. 1% sodium hypochlorite
c. Both
d. None of the above
15. Personal protective equipment must be collected in the following bag for disposal
a. Red bag
b. Blue bag
c. Yellow bag
d. None
16. The concept of Rollback of 10% to 1%–2% sodium hypochlorite was proposed in the following:
a. BMWM amendment rules, 2018
b. BMWM rules, 2016
c. BMWM rules, 1998
d. BMWM draft rules, 2011
17. How much is the Efficacy of hepatitis B vaccination in preventing hepatitis B infection:
a. 70%–75%
b. 90%–95%
c. 40%–50%
d. 30%–40%
18. Which of the following is the most common means of the spread of nosocomial pathogens?
a. Central intravenous catheter
b. Foley's catheter
c. Peripheral intravenous lines
d. Hands of healthcare workers
19. The "major key step" to "waste minimization" and appropriate management of biomedical waste is
a. Incineration of waste, which is infectious
b. Autoclaving/microwaving infectious waste disposal
c. Recycling of plastic disposals
d. Proper Segregation at the point of generation.
20. If a healthcare worker encounters a needle stick injury, the following are supposed to be followed:
a. Immediately suck their bleeding finger
b. Wash with the soap under running water and seek further medical advice
c. Report to the chief medical officer (CMO)/nodal officer casualty

d. Apply antiseptic dressing immediately
21. Appropriate Pre‐treatment as disinfection of laboratory waste is done with the purpose of:
a. Reducing the bulk and disinfecting the waste
b. Safety of waste handlers
c. To reuse the item
d. To store for a long duration
22. Concentration of sodium hypochlorite used for routine disinfection of used disposable items is:
a. 0.1% for 1 hour
b. 1.0% for 30 minutes
c. 5% for 20 minutes
d. 10% for 30 minutes
23. The first step in the processing of reusable instruments is
a. Cleaning under running water
b. Washing using soap and water
c. Scrubbing with brush and water
d. Decontamination
24. Masks and gloves for suspected cases of COVID-19 /quarantine cases must be kept in a paper box for a minimum of the following duration before disposal
a. 72 hours
b. 48 hours
c. 24 hours
d. one week
25. Which of the following 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
26. Schedule of hepatitis B virus vaccination?
a. 0, 1, 6 months
b. 0, 1, 3 months
c. 0 and 6 months
d. 0 and 1 months
27. During the COVID-19 pandemic, utilization of treated wastewater in HCF should be
a.Continued
b.Avoided
c.To be stored separately
d.None

The results observed from the participant's responses in the context of Knowledge and Attitude toward BMWM were tabulated in Table-1. The analysis of the compiled results as a quantum revealed that doctors and nurses were well aware of waste management rules and norms about legal aspects, solid waste disposal color coding, sterilization procedures, and preventive and management aspects. Adequate awareness about knowledge and Attitude domain of BMWM among HCWs was reflected in statistical significance with p value <0.005 in all the categories. Though the results of BMWM among HCWs as a quantum are reassuring, the knowledge aspects of BMWM among the sanitization and housekeeping personnel could have been more efficient. In contrast, responses among laboratory technicians were unprejudiced, with some scope for improvement. Even though our hospital has an appropriate and well-developed biomedical waste management system set in place, responses towards the practice of BMWM among HCWs were concerning, especially in emphasizing segregation of infectious from non-infectious wastes, leaving a staggering around 38% of HCWs (especially housekeeping staff followed by laboratory technicians) unaware of the prevailing problem. The results from the participant's responses on the practices of BMWM are shown in Table-2. Surprisingly results obtained from doctors also showed variations at a modest level, especially in the first two domains of practice of BMWM.

5. DISCUSSION

Appropriate and sustainable management of the disposal of biomedical waste materials has turned out to be a social and legal responsibility of all the personnel supporting and financing the healthcare profession. Effective Biomedical waste management is now mandatory for healthy humans and an eco-friendly environment. [1,3,5] In 2012, World Health Organisation surveyed the biomedical waste management status of around 24 countries of various geographical regions in Asian countries and West Pacific countries.[1,3,7] The survey analysis included an extensive literature search, a review of published articles in reputed journals, news, magazine articles, and a few other social media sources.[1-3,16] The survey mainly focused on assessing five major streams of Biomedical waste: management and legal aspects, policy guidelines and regulatory authority framework, segregation, training sessions, orientation classes, technical tools implemented, and utilization of financial resources. Fairly satisfactory results were obtained in knowledge aspects whereas training sessions, technical and logistical aspects showed a dip in the assessment results,

especially in Indian Sub-continent. [2,17] Majority of the countries had no or very minimal allocation of financial resources for BMWM. [2,3,17] Health care working management system remains far from ideal in the majority of Tropical and a few West Pacific countries.[18,19] Thus, enhanced backing for expanding BMWM systems in the nations is vital to affirm that safe 'biosafety systems 'are set in place by the next decade. In terms of simplified expression, nearly 81% of respondents knew about the color coding system of disposal, leaving behind a staggering 19% majority being sanitation and housekeeping staff again. In context to knowledge on the color coding of disposal bins, our observations studies done by Parida et [al. 13] varied significantly with study observations from Bhagawathi *et* [al. 20] and Soyam *et* [al. 21], which showed positive responses of only 27% and 25% respectively. Similar observations were noted in the aspects of legal administration and hazard management. The present study postulates that concerning knowledge and Attitude. However, satisfactory responses were obtained; the domain is still lacking among housekeeping and effluent scavengers because they confine themselves to handling at ground levels of the hospital campus, thereby possessing a tendency to neglect to learn the aspects of knowledge and Attitude. Hence regular training sessions and hands-on orientation demonstrations should be mandated at frequent intervals. [21] Based on the WHO survey report, in recent times, more focus has been directed to retard the volume of infectious and contagious biomedical disposals. This could be achieved by segregating BMW from the primary source level onwards. [2,3] Practically, in many instances, segregation occurs at the biomedical waste disposal ground off the hospital vicinity, which should be stringently discouraged. In the present study, nearly 72% of participants are aware that the key step in differentiating infectious from non-infectious waste is appropriate segregation of disposals which is supposed to be done at the point of origin, concurring with the study observations by Bhagawatie*tal.,*[20] As a point of worrying concern, only 70% of HCWs are aware of the practice of the pre-requisite of treating laboratory waste disposal before passing it out of the facility. Surprisingly laboratory technical staff (90%) gave more correct responses than physicians. Though the physicians had an upper hold in the knowledge domain, interestingly, the score in the practice domain is almost similar in groups (except housekeeping workers) due to the unforeseen casual approach to BMWM in some instances among the physicians. Among doctors, the correct responses were obtained from laboratory physicians with experience than five years of experience. In contrast, doctors with undergraduate qualifications (especially those with less than five years of experience) scored low. Higher scores were obtained regarding vaccination due to the mandatory vaccination schedule being practiced in our hospital at the time of the appointment. Another major observation in the study is solid waste (SW) disposal, where even the nurses and laboratory technical staff scored low. The reason identified is that the blue bag bin disposes of general waste. Concerning SW disposal, no prior studies had been carried out as well on compliance among HCWs. Thus we strongly propose incorporating solid/general waste disposal management in the curriculum of BMWM, concurring with the studies of Parida et al. [20.] Around 52% of housekeeping staff and 72% of laboratory technical staff are aware of the practice of needle stick injury concurring with an observation of Dudi *et al.*[19] whereas abysmal with the study done by Ismail *et al.* [22]. Thus, when contacting infectious material or needle stick injury, all HCWs must possess adequate management knowledge and any aspect below par with the expected knowledge and practice. It is an instant disaster awaiting to occur at any level. [23-26] Several studies have been conducted to assess the KAP of BMW rules proposed in 1998[2,3,13]. In contrast, studies about the assessment of KAP on BMWM Rules,2016, as well as recent BMWM (Amendment) Rules 2018 and its compliance, are very sparse, especially among the country's Southern states.[2,27] From the present study, it is evident that though the doctors, including laboratory physicians, were aware of the importance of the management of healthcare disposals when it comes to the aspects of guidelines and practice, their knowledge is found to be not competent and complete as expected to be.[2,13,27] The other HCWs, like laboratory technicians and sanitation workers, owned better practices in disinfection and sterilization. Thus the gravity of the prevalent issue cannot be sided away. The study reveals that the challenges of diverse and varied awareness, administrative issues, casual approach and Attitude among staff members, poor accountability, logistics, and fund allotments had many impacts on BMWM with evidently visible critical gaps.

5.1 Critical Appraisal of the study analysis:

The concept of 'quality assurance' being the backbone of an efficient hospital system must be adhered to invariably by all HCWs. Regular questionnaire surveys on BMWM must be conducted for HCWs as a part of quality assessment at regular intervals. Employees should be reassured that it is fact-finding rather than fault-finding. One of the significant aspects of the survey must be framing appropriate questionnaires for a better understanding of the study of the quality system. To enhance the awareness and KAP, the curriculum of all medical, nursing, paramedical, and allied health courses should incorporate BMWM in the syllabus. If BMWM is routinely followed, all HCWs could be prepared to manage sudden pandemic situations such as COVID-19.

5.2 Limitation & Scope for future work

The study was confined only to the study hospital. However, the topic could be extended to more expansive to other relevant regional domiciles for further exploration assessment and implementation of biomedical waste guidelines and in pandemic scenarios. Furthermore, although the study was mildly skewed towards favoring doctors followed by laboratory technicians, a large number of housekeeping, and effluent scavengers who took part in training and orientation programs on BMWM, only 65% of them had participated in the study. Thus the Scope for future tasks includes extensive surveys and frequent visits to hospitals to evaluate and determine the process of collection, segregation, logistics, and appropriate disposal of BMW. In addition, the statistical analysis must be carried out on the questionnaire data and parameters for a better understanding of the responses.

6. CONCLUSION

The present study proves novelty by extensively analyzing knowledge, Attitude, and practice among laboratory personnel and other healthcare workers on biomedical waste

management about recent guidelines on laboratory biosafety norms. The study emphasizes that BMWM should be a continuous process rather than accreditation-oriented inspections, which will aid laboratory staff in handling BMW's disposal during the pandemic. Housekeeping and staff handling BMW must undergo regular training and assessment since their attribution rate is much higher in a healthcare facility. Multi-tasking and cumulative efforts must be formulated to attain translational synergy in the stream of KAP of BMWM**.** We suggest incorporating BMWM in the medical and health science curriculum with added weightage. Regular questionnaire surveys must be commissioned, which could provide a wider platform to accommodate additional concerns.

7. ACKNOWLEDGEMENT

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8. ETHICAL STATEMENT

An ethical committee waiver statement is a document that indicates that an individual or organization has waived their right to a review by an ethical committee for a specific research project or study. This waiver acknowledges that the project does not pose any significant ethical concerns and can proceed without formal ethical review. The statement may include information about the nature of the project, the methods used, and how participants will be protected. The purpose of the waiver is to streamline the research approval process and reduce the administrative burden while maintaining ethical standards.

9. AUTHOR CONTRIBUTION STATEMENT

Dr.E.S.Keerthika Sri's concept and manuscript, Dr. Anandraj Vaithy. K design, Dr. Shanmugasamy. K data collection and design, Dr. Sowmya.S supervision

10. CONFLICT OF INTEREST

Conflict of interest declared none.

11. REFERENCES

1. Patnaik S, Sharma N. Assessment of cognizance and execution of biomedical waste management among health care personnel of a dental institution in Bhubaneswar. J Indian Assoc Public Health Dent. 2018;16:213-9.
2. The gazette of India biomedical wastes (management and handling) rules, India: Ministry of Environment and Forests. Government of India; Jul 20, 1998.
3. World Health Organization. Safe management of health care waste. 2nd ed. Geneva: World Health Organization; 2014.
4. Capoor MR, Bhowmik KT. Implementation challenges in Bio-medical Waste Management rules, 2016. Indian J Med Microbiol. 2017;35(4):623-5. doi: 10.4103/ijmm.IJMM_17_416, PMID 29405164.
5. Gupta NK, Shukla M, Tyagi S. Knowledge, Attitude and Practices of biomedical waste management among health care personnel in selected primary health care centers in Lucknow. Int J Community Med Public Health. 2016;3:309-13. doi: 10.18203/2394-6040.ijcmph20151582.
6. Central Pollution Control Board. Waste management division- bio-medical waste. Status on Bio-medical Waste Management scenario and recommendations for ensuring compliance to the Bio-Medical Waste Management Rules; 2016. p. 3.
7. Abhishek KN, Suryavanshi HN, Sam G, Chaithanya KH, Punde P, Singh SS. Management of biomedical waste: an exploratory study. J Int Oral Health. 2015;7(9):70-4. PMID 26435621.
8. Biomedical waste (management and handling) Rules. Clim Change. 2015.
9. Solid waste management rules 2015. Ministry of the Environment, Forest, climate change. New Delhi: Government of India; 2015. Available from: http://www.moef [cited Jun 30, 2015]. Available from: http://nic.in/sites/default/files/Solid%20Waste%20Management%20rule.pdf.
10. Chartier Y, Emmanuel J, Pieper U, Prüss A, Rushbrook P, Stringer R. Safe management of wastes from healthcare activities. 2nd ed. Geneva, Switzerland: WHO Blue Book; 2014.
11. Mathur V, Dwivedi S, Hassan M, Misra R. Knowledge, Attitude, and practices about biomedical waste management among healthcare personnel: A cross-sectional study. Indian J Community Med. 2011;36(2):143-5. doi: 10.4103/0970-0218.84135, PMID 21976801.
12. Ministry of the Environment. Biomedical W a s t e management (amendment). Rules. 2018. Forest and Climate Change Notification New Delhi;2018.
13. Parida A, Capoor MR, Bhowmik KT. Knowledge, Attitude, and practices of Bio-medical Waste Management (principle) rules. J Lab Phys 2019;11. 2016; Bio-medical Waste Management (amendment) rules, 2018; and Solid Waste Rules;2016, among health-care workers in a tertiary care setup:292-9.
14. INCLEN Program Evaluation Network (IPEN) study group, New Delhi, India. INCLEN Program Evaluation Network (IPEN) study group, New Delhi, India. Bio-medical waste management: situational analysis and predictors of performances in 25 districts across 20 Indian states. Indian J Med Res. 2014;139(1):141-53. PMID 24604049.
15. Anand P, Jain R, Dhyani A. Knowledge, attitude and practice of biomedical waste management among health care personnel in a teaching institution in Haryana, India. Int J Res Med Sci. 2016;4:4246-50. doi: 10.18203/2320-6012.ijrms20163115.
16. Ministry of the Environment. Bio-medical waste management (amendment). Rules. 2019. Forest And Climate Change Notification New Delhi;2019.
17. Central Pollution Control Board. Guideline for Handling, Treating, Disposal of Waste Generated during treatment/Quarantine of COVID-19 Patients. New Delhi: Ministry of the Environment, Forest & Climate

Change [Updated March 2020]. Available from: http://www.tnpcb.gov.in.
18. Guidelines for Biomedical Waste Management-Quarantine Facilities COVID-19-NCDC. Available from: http://www.ncdc.gov.in.
19. Dudi M, Sharma R, Sharma S, Jain M. Assessment of the knowledge, Attitude, and practices regarding biomedical waste management amongst paramedical staff in a tertiary level health care facility. Int J Med Sci Public Health. 2016;5(4):615-9. doi: 10.5455/ijmsph.2016.1107201594.
20. Bhagawati G, Nandwani S, Singhal S. Awareness and practices regarding bio-medical waste management among health care workers in a tertiary care hospital in Delhi. Indian J Med Microbiol. 2015;33(4):580-2. doi: 10.4103/0255-0857.167323, PMID 26470969.
21. Soyam GC, Hiwarkar PA, Kawalkar UG, Soyam VC, Gupta VK. KAP study of bio-medical waste management among health care workers in Delhi. Int J Community Med Public Health. 2017;4(9):3332-7. doi: 10.18203/2394-6040.ijcmph20173840.
22. Ismail IM, Kulkarni AG, Kamble SV, Borker SA, Rekha R, Amruth M. Knowledge, Attitude and practice about bio-medical waste management among personnel of a tertiary health care institute in Dakshina Kannada, Karnataka. Al Ameen J Med Sci. 2013;6:376-80.
23. Joseph S. Why India doesn't need the sanitary napkin revolution; Jul 19, 2015. Available from: http://www.swarajyamag.com/culture/why-India-doesn't-need-the- sanitary-napkin-revolution/. [last accessed on Oct 06, 2015].
24. Bhattar S, Qureshi S, Seth RK, Butola R, Shingare P. Awareness and practices of biomedical waste management guidelines 2016 in an upcoming super specialty hospital of east Delhi, India. Int J Community Med Public Health. 2018;5(8):3289-92. doi: 10.18203/2394-6040.ijcmph20182979.
25. Joseph L, Paul H, Premkumar J, Rabindranath, Paul R, Michael JS. Biomedical waste management: a study on the awareness and practice among healthcare workers in a tertiary teaching hospital. Indian J Med Microbiol. 2015;33(1):129-31. doi: 10.4103/0255-0857.148411, PMID 25560016.
26. Saini SG, Kahlon SS, Parvinder Singh G, Navneet GS A. To study biomedical waste (BMW) awareness among private practitioners in the Amritsar region. Indian J Compr Dent Care. 2015;5:542-5.
27. A M, Eshwar B. Knowledge, Attitude and Practice of Biomedical waste management among health care personnel in a tertiary care hospital in Puducherry. Int J Biol Med Res. 2015;6(3):172-6. doi: 10.7439/ijbr.v6i3.1665.