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Original Article

Microbiology Section

Awareness and Practice Concerning Biomedical Waste Management with Special Reference to COVID-19 among Healthcare Providers at a Tertiary Care Centre in Karnataka, India

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ABSTRACT

Introduction: Growing healthcare facilities to provide better health for patients have contributed in increased generation of Biomedical Waste (BMW). Emergence of Coronavirus Disease-2019 (COVID-19) has added to this burden. BMW carries a higher risk of infections, injuries and also environmental hazards. Effective management of BMW is a fundamental practice of healthcare providers in averting health and environmental hazards.

Aim: To know about the awareness and practice concerning BMW management among healthcare provider at tertiary care hospital.

Materials and Methods: The present cross-sectional study was conducted at district hospital attached to Kodagu Institute of Medical Sciences, Madikeri, Karnataka, India, for seven months during July 2021 to January 2022. A total of 232 Healthcare Workers (HCWs) who were involved in patient caring participated in this study. Study included Questionnaires (30 questions) regarding awareness and practice of BMW management. The data was procured by structured self-administered questionnaire through Google forms.

Results: The study showed that majority of participants had good awareness and modest numbers of participants were practicing proper method of waste management. About 93.5% were aware of BMW management categories, 98.7% of participants knew regarding which coloured bags are used for collection. Study identified some gaps in awareness and practices. About 49.1% participants dispose used Personal Protective Equipment (PPE) during COVID-19 into proper bag, only 27.6% participants knew correctly regarding maximum time limit to store BMW.

Conclusion: Every healthcare provider must have proper knowledge and awareness of BMW management. It is necessary to contain transmission of infection and prevention of environmental hazards caused due to BMW. The study emphasises the need for regular monitoring and training requirement at all level to bridge the awareness gap. Proper BMW handling and disposal are components of infection control measures.

Keywords: Coronavirus disease 2019, Pandemic, Questionnaire, Waste handling

INTRODUCTION

Biomedical Waste (BMW) is defined as the waste generated during any research activities concerning humans and animals, also in the manufacture or analysis of biologicals [1]. According to World Health Organisation (WHO), about 85% of the hospital waste is non hazardous and the remaining hazardous, of the hazardous category, 10% are infective whereas 5% are non infective [2]. BMW carries higher risk of infections, injuries and causes environmental hazards [3,4]. It is very essential to practice proper BMW management techniques in healthcare facility and also wherever it is generated [5].

BMW management and handling rules came into effect since 1998 [6,7]. These rules are essential for healthcare centres during segregation, disinfection, transient storage and waste disposal in an environmentally favourable manner. The waste should be meticulously managed at all step from generation to disposal [5]. Every healthcare worker is required to have a proper working knowledge and must possess the capacity to direct others during waste collection and management [8]. The world has woken to the truth of new pandemic; COVID-19 in December 2019. Since then the world is still fighting against COVID-19. During this pandemic, BMW generated from facilities treating COVID-19 demands greater emphasise as they can be potential bearers of COVID-19. Disposal of this recent category of BMW (COVID-19 waste) is of eminent public health relevance, if handled improperly [9]. Recently, India produces an estimated daily 600 metric tons of BMW, as a consequence of COVID-19 this has increased by 10% [10]. Increased quantity of BMW during COVID-19 outbreak, needs safe handling, treatment and disposal to stop unintentional spread of the virus in the community [9]. Proper disinfection and disposal of COVID-19 waste is required in control of the infection and environmental hazards [11,12].

COVID-19 pandemic has called into question the existing regulations and management practices of BMW management worldwide [9]. BMW management rules have been amended timely, regularly with new guidelines for COVID-19 waste which was put forth by the Central Pollution Control Board (CPCB), New Delhi, Government of India on March 18, 2020 and further revised on April 19, 2020 [13]. These specific guidelines apply to all personnel, who are involved in handling BMW during the diagnosis and treatment of COVID-19 suspected/confirmed patients and are compulsory to be followed in all the healthcare centres including laboratories, sample collection centres, quarantine centres, isolation wards and common BMW treatment and disposal facilities, on top of existing practices under BMW management rules 2016 [9,11].

Hence, the present study was conducted to know about awareness and practice concerning BMW management, among healthcare provider at tertiary care centre with special reference to waste generated during diagnosis and treatment of suspected and positive COVID-19 patients.

MATERIALS AND METHODS

The present cross-sectional study was conducted at district hospital attached to Kodagu Institute of Medical Sciences, Madikeri, Karnataka, India, for seven months duration from July 2021 to January 2022 after obtaining Institutional Ethics Committee (IEC)

clearance (Ref: KOIMS/IEC/05/2021-22). A total of 232 HCWs participated in this study.

Inclusion criteria: HCWs who volunteered and gave consent to participate in the study including Doctors, Medical students, Interns, Nurses and Paramedical staff of the hospital who were involved in caring patients during COVID-19 pandemic.

Exclusion criteria: HCWs who were not involved in COVID-19 patient care or those who were not willing to participate in the study.

A total of 232 voluntary participants were included, study included closed ended Questionnaires (30 questions) regarding awareness and practice of BMW management. The questionnaire were prepared in English from standard guidelines of BMW management and also from guidelines for handling, treatment and disposal of waste generated during treatment/diagnosis/quarantine of COVID-19 patients by CPCB [2,13] after which it were reviewed and approved by the head of the department. The objectives of the study were explained clearly to the participants before data collection. The data were collected using a structured self-administered questionnaire through Google Forms. For every correct/yes answer, the score was taken one and for every incorrect/no, the score was taken as zero. Details of various socio-demographic variables of study participants like age, sex, type of work, etc were collected.

STATISTICAL ANALYSIS

The data collected was tabulated, coded and analysed using Microsoft excel and Statistical Package for the Social Sciences (SPSS) Version 20 for windows. Descriptive statistics used.

RESULTS

Among 232 participants, 106 (45.7%) were males 126 (54.3%) were females. The age, gender and occupation distribution is shown in [Table/Fig-1].

Parameters	N	%
Age (years)		
18-28	182	78.5
29-38	29	12.5
39-48	10	4.3
Above 48	11	4.7
Gender		
Male	106	45.7
Female	126	54.3
Occupation		
Doctor	42	18.1
Nurse	89	38.3
Paramedical staff	19	8.2
Attender	5	2.2
Medical students and Interns	77	33.2

[Table/Fig-1]: Profile of respondents (n=232).

All participants had heard about biomedical waste. 184 (79.3%) participants had heard about BMW Rule/act 1998, 229 (98.7%) participants knew about which coloured bags are used for collection, 217 (93.5%) were aware of BMW categories and 194 (83.6%) were aware about health hazards associated with BMW, 203 (87.5%) respondents agreed that BMW transmits disease. About 213 (91.8%) respondents felt that regular educational program is needed for BMW waste management, 223 (96.1%) participants felt that BMW management should be compulsorily made a part of undergraduate curriculum, 189 (81.5%) participants knew that our institution has tie up with common biomedical waste management facility. Only 126 (54.3%) participants had training in BMW management. About 225 (97%) participants were aware about the need of double layered bags for collecting waste from COVID-19 isolation wards, 221 (95.3%) respondents were aware that it was mandatory to label bags/containers for collecting BMW from COVID-19 wards as 'COVID-19 waste' [Table/Fig-2].

S. No.	Question	Response (n)		Percentage (%)
1.	Have you heard about BMW?	Yes	232	100
		No	0	0
2.	Have you heard about BMW Rule/ Act, 1998?	Yes	184	79.3
		No	48	20.7
3.	Have you had any training for BMW management?	Yes	126	54.3
		No	106	45.7
4.	Can any plastic bag be used for waste disposal?	Yes	114`	49.1
		No	118	50.9
5.	Do you know what coloured bags used for BMW collection?	Yes	229	98.7
		No	3	1.3
6.	Is present hospital generating BMW?	Yes	214	92.2
		No	18	7.8
7.	Are you aware of BMW management categories?	Yes	217	93.5
		No	15	6.5
8.	Is any BMW management disposal policy there in present hospital?	Yes	228	98.3
		No	4	1.7
9.	Are any health hazard associated with BMW?	Yes	194	83.6
		No	38	16.4
10.	Is BMW transmits any disease?	Yes	203	87.5
		No	29	12.5
11.	Do you feel that regular educational program/training needed for BMW?	Yes	213	91.8
		No	19	8.2
12.	Do you believe that as part of undergraduate curriculum BMW management should be made compulsory?	Yes	223	96.1
		No	9	3.9
13.	Any guideline provided for colour coding at work area?	Yes	222	95.7
		No	10	4.3
14.	Does your institute have a link up with Common Biomedical Waste Treatment Facility (CBMWTF)?	Yes	189	81.5
		No	43	18.5
15.	Are double layered bags required for collecting COVID-19 waste to ensure adequate strength and no leaks	Yes	225	97
		No	7	3
16.	Is labelling 'COVID-19 waste' on bags/containers used for collecting biomedical waste from COVID-19 wards mandatory?	Yes	221	95.3
		No	11	4.7

[Table/Fig-2]: Response to awareness based question on biomedical waste management (n=232).

Among the participants 205 (88.4%) had been maintaining BMW records, 207 (89.2%) respondents were segregating BMW according to different categories at work place, 223 (96.1%) respondents use personal protective measures while handling BMW, 218 (94%) respondents agreed that they have proper storage facility for collecting BMW at work place. About 171 (73.7%) respondents were maintaining records of injuries related to BMW, 206 (88.8%) respondents dispose waste sharps in white container, 186 (80.2%) respondents dispose general waste in black plastic bag, 216 (93.1%) of respondents daily disinfect the surface of containers/trolleys/bins used in storage of COVID-19 waste using 1% sodium hypochlorite solution. About 114 (49.1%) respondents disposed used PPEs such as Nitrile gloves, face shield, HazMat suit, plastic coverall, splash proof aprons, goggles used during COVID-19 pandemic into red bag, 136 (58.6%) respondents dispose masks (including three ply mask, N-95 mask etc), non plastic coverall, shoe cover, disposable lining gown, head cover/cap used during treatment of COVID-19 patient into yellow bag. About 168 (72.4%) of respondents disposed faecal matter from COVID-19 confirmed patients, who were unable to use toilets, the diapers were treated as biomedical waste and

was disposed in yellow bags, 166 (71.6%) respondents dispose BMW generated from COVID-19 quarantine centres/camps in yellow colour bag. Only 64 (27.6 %) of participants had correctly responded that 48 hours is the maximum time limit that BMW could be stored. 148 (63.8%) respondents had been disposing gauze, cotton pads and other items contaminated with blood into yellow plastic bag [Table/Fig-3].

S. No.	Question	Response (n)		Percentage (%)
17.	Are you maintaining BMW records at work place?	Yes	205	88.4
		No	27	11.6
18.	Do you segregate BMW according to different categories at work place?	Yes	207	89.2
		No	25	10.8
19.	Do you use personal protective measures while handling BMW?	Yes	223	96.1
		No	9	3.9
20.	Do you have proper storage facility for collecting BMW at work place?	Yes	218	94
		No	14	6
21.	Are you maintaining record for injuries related to BMW?	Yes	171	73.7
		No	61	26.3
22.	Where do you dispose waste sharps?			
	a. Black plastic bag		9	3.9
	b. Red plastic bag		14	6
	c. White container		206	88.8
	d. Yellow plastic bag		3	1.3
23.	Which bag to be used for disposal of general waste?			
	a. Black plastic bag		186	80.2
	b. Red plastic bag		25	10.8
	c. White container		4	1.7
	d. Yellow plastic bag		17	7.3
24.	Do you disinfect surface of containers/trolleys bins used in storage of COVID-19 waste, daily using 1% sodium hypochlorite solution	Yes	216	93.1
		No	16	6.9
25.	Where do you dispose used PPEs such as splash-proof aprons, face shield, goggles, plastic coverall, nitrile gloves, HazMat suit used during COVID-19 pandemic into			
	a. Red bag		114	49.1
	b. Yellow bag		98	42.2
	c. White bag		5	2.2
	d. Blue bag		15	16.5
26.	Where do you dispose masks (including triple layer mask, N-95 mask etc), shoe cover, headcover/cap, non-plastic coverall, disposable lining gown used during treatment of COVID-19 patient, into			
	a. Red bag		74	31.9
	b. Yellow bag		136	58.6
	c. White bag		7	3.0
	d. Blue bag		15	6.5
27.	COVID-19 confirmed patient, who are unable to use toilets whose excreta is collected in diaper and treated as biomedical waste and should be disposed in			
	a. Red bag		47	20.3
	b. Yellow bag		168	72.4
	c. White bag		6	2.6
	d. Blue bag		11	4.7
28.	BMW generated from COVID-19 quarantine centers/camps should collect in what colour bag			
	a. Red bag		43	18.5
	b. Yellow bag		166	71.6
	c. White bag		9	3.9
	d. Blue bag		14	6.0
29.	What is the maximum time limit for storage of biomedical waste according to the National guidelines?			
	a. 24 hours		137	59.1
	b. 48 hours		64	27.6
	c. 72 hours		31	13.3
30.	Where do you dispose cotton, guaze and other items contaminated by blood?			
	a. Red		60	25.9
	b. Yellow plastic bag		148	63.8
	c. General waste		19	8.2
	d. White container		5	2.1

[Table/Fig-3]: Response to practice based question on biomedical waste management (n=232).

DISCUSSION

The WHO declared that COVID-19 is the sixth public health emergency of international concern [11]. The COVID-19 pandemic is a global health crisis and it has various impacts on environment, economy and society [9]. An increase of BMW generation during the emergence of COVID-19 through used PPE such as gloves, air-purifying respirators, N-95 masks, goggles, face shield, surgical mask, safety gowns or suits and shoe covers, high-flow nasal cannulas and plastic syringes with needles [11]. In the beginning of the pandemic, PPE was used primarily by HCW only, but as this pandemic continued, PPE is being frequently used by general population [14]. This large quantity of wastes must be managed by a safe and proper method [15].

Exposure to emissions of highly toxic gases during incineration of BMW also can cause adverse impacts on human health and environment [9]. If improperly managed, BMW has the capability to be hazardous, toxic and possibly even lethal because of its high potential for diseases transmission, injury and environmental degradation [16]. Appropriate waste management techniques must be understood, implemented by each Healthcare Professional (HCP) [15].

In present study all participants had heard about BMW, 92.2% of respondents were aware that the present hospital generates BMW and 79.3% respondents heard about BMW Rule/act 1998. Study done by Haque S et al., reported that 82% of the study participants heard about BMW and only one fourth of the participants knew about BMW rules 1998 formulated by govt of India [15,17]. Study by Alshahrani NZ et al., found that 56.9% heard about the rules/act for biomedical waste management in Kingdom of Saudi Arabia (KSA) [18]. The fundamental purpose BMW management guidelines are to improve the overall BMW management of healthcare facilities [19].

In present study 54.3% respondents had training in BMW management, 49.1% of the respondents opined that any plastic bag can be used for BMW disposal, 98.7% knew about which coloured bags are used for BMW collection, 93.5% of respondents were aware of BMW management categories, 98.3% respondents were aware about BMW management disposal policy there in present hospital and 95.7% were aware about guidelines provided for colour coding at work area. Study conducted by Abrol A et al., reported 80% of study participants had training in BMW management and 83.3 % had opined that any plastic bag can be used for BMW disposal [5]. However, study by Haque S et al., reported only 60.8% participants were able to correctly answer the questions on colour coding [15], whereas study by Jalal SM et al., reported 69.1% participants always follow colour coding of containers [11]. Colour coding is to identify different types of waste easily [20]. Study conducted by Madhukumar S and Ramesh G reported 47.5% study subjects had adequate knowledge about categories and the treatment of BMW correctly [21]. Study by Narang RS et al., reported 82.5% of dentists, 12.5% of auxiliary staff knew that there was a waste management policy in the hospital [4].

In present study, 87.5% respondents were aware that BMW transmits diseases and 83.6% of them were aware about health hazards associated with BMW. Study conducted by Bhagawati G et al., reported awareness regarding health hazards due to improper BMW management was 60.10% [22]. Study conducted by Narang RS et al., reported that all the dentists were well informed regarding the various health hazards brought about by improper BMW management and 45% auxiliary staff had knowledge about this subject [4]. Inappropriate segregation and disposal of BMW and combining it with municipal waste can cause unwanted risk to waste handlers and general public to infectious and fatal diseases [4].

In present study 81.5% knew that our institution has tie up with common BMW management facility, 91.8% respondents felt that regular educational programs are needed for BMW waste management. About 96.1% felt that BMW management should compulsory be made part of undergraduate curriculum. Study done by Abrol A et al., reported 91.7% responded that institute have tie up with Common Biomedical Waste Treatment Facility (CBMWTF) [5]. Study by Jalal SM et al., reported 70.8% of participants agreed that an upgrade in knowledge on BMW management is mandatory [11]. Study by Haque S et al., reported 95.8% of participants agreed regular training should be given to upgrade existing knowledge [15]. Study by Abrol A et al., reported 58.3% participants felt that BMW management should be a compulsory part of under graduate curriculum [5].

In present study 73.7% respondents had been maintaining record of injuries related to BMW and 88.4% of them had been maintaining BMW records at work place. Study conducted by Jalal SM et al., reported 70.7% participants maintain BMW records, which was similar to present study findings [11]. Mandatory reporting of injuries involving BMW to concerned authorities will help in taking appropriate measures [15].

In present study 96.1% respondents use personal protective measures while handling BMW, 89.2% respondents segregate BMW according to different categories at work place, 80.2% respondents dispose general waste into black plastic bag, 63.8% respondents dispose gauze, cotton and other articles contaminated with blood into yellow plastic bag and 88.8% respondents dispose waste sharps in white container. Study done by Jalal SM et al., found that 43.8% healthcare professionals strongly believed that PPE must be used during handling of BMW [11]. Study by Abrol A et al., reported 91.7% respondents segregate BMW according to different categories and 75% respondents dispose waste sharps in white container [5]. Study by Bhagawati G et al., overall response regarding the practice of disposal of non-sharp waste was 68.27% and that of sharps was 86% [22]. The mixing of infectious and non infectious waste is caused due to improper handling or segregation at the site of origin [23]. All HCWs should have proper knowledge, positive attitude towards waste management and practice the same.

In present study 94% respondents answered that they had proper storage facility for collecting BMW at work place. Only 27.6% respondents were aware of the fact that 48 hours is maximum time limit for which BMW can be stored. Study conducted by Haque S et al., 31.7% participants had complete knowledge about storage of BMW prior to disposal [15]. There must be appropriate facilities for short-term storage of the waste on site using sealed containers, located in secured areas allowing only authorised personnel to enter. Waste generated by COVID-19 patients is disposed on a daily basis as per guidelines [20].

In present study 97% were aware about the need of double layered bags for collecting waste from COVID-19 isolation wards. To prevent leakage from primary containers, a secondary container is mandatory while handling waste and such practices are essential during the pandemic [20]. About 95.3% respondents were aware that it was mandatory to label bags/containers of BMW during COVID-19 pandemic as 'COVID-19 waste'. 93.1% of participants disinfect the surface of containers/trolleys/bins used in storage of COVID-19 waste, daily using 1% sodium hypochlorite solution. To avoid possible transmission of the SARS CoV-2 virus disinfectants should be used on outer and inner surfaces of containers/bins/trolleys used for storage [20].

49.1% participants disposed used PPEs such as HazMat suit, splash proof aprons, goggles, nitrile gloves, face shield, plastic coverall used during COVID-19 pandemic into red bag, 58.6% participants disposed masks (three ply mask or N-95 mask), disposable lining gown, shoe cover, head cover/cap, non-plastic coverall used during treatment of COVID-19 patient into yellow bag. 72.4% participants disposed faecal matter from COVID-19 confirmed patient, who were unable to use toilets into yellow bags. 71.6% respondents disposed BMW generated from COVID-19 quarantine centres/camps in yellow colour bag. Extra care during segregation must be taken as errors made here can put waste handlers at risk.

In light of the COVID-19 pandemic in India, the CPCB, Ministry of Environment, Forest and Climate had released a set of guidelines regarding management of waste generated during treatment/diagnosis/quarantine of COVID-19 patients [13]. These guidelines has suggested the use of double layered bags, labelling of containers as "COVID-19 waste," timely disinfection of containers, in addition to the existing practices of BMW Management Rules, 2016 [23]. Effective knowledge and practice regarding management of COVID-19 waste is necessary to curb the pandemic spread [12].

Limitation(s)

Since present study was based on structured self-administered questionnaire every aspects of awareness and practice of BMW management could not be evaluated Also as it was an online platform and questionnaires were self-administered which lead to lack of accountability of the response due to absence of an interviewer.

CONCLUSION(S)

The magnitude of BMW generation has escalated due to COVID-19 pandemic. Effective management of BMW is necessary to control the pandemic spread, insufficient awareness about BMW management amid healthcare workers poses deleterious impact on waste handling and disposal. The present study provides valuable information about awareness and practice concerning BMW management during a critical period of the pandemic. The study's findings highlight the necessity of training programs such as small group discussions, workshops and symposia to be conducted regularly and it must be made mandatory for all HCWs to attend at all levels.

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