



COMMUNITY AWARENESS AND PRACTICES IN HOSPITAL WASTE MANAGEMENT AMONG HEALTHCARE PRACTITIONERS IN RURAL GHAZIABAD

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ABSTRACT

Effective communication and community engagement are crucial for the safe disposal of waste and protection against the harmful impacts of hazardous waste. This study aims to assess the knowledge and practices regarding handling rules and biohazard management of biomedical waste among healthcare workers in government health facilities in rural Ghaziabad. Emphasizing community awareness and proper communication strategies, the study seeks to enhance the implementation of safety precautions and appropriate methods in biomedical waste management. A cross-sectional study was conducted to assess the knowledge and practices regarding biomedical waste management at Community Health Centers (C.H.C.), Primary Health Centers (P.H.C.), and sub-centers in rural blocks of Ghaziabad district in Uttar Pradesh, India. The study involved a total of 122 healthcare workers, including 27 doctors, 75 nursing staff, 6 laboratory technicians, and 14 sanitary staff. Participants were selected using a proportional allocation scheme to ensure representation from each group. The Knowledge regarding Handling rules of BMWM was 68.3% and practice was 58.1% among the HCW. Multinomial regression between socio-demographic features of HCWs and their practice regarding Handling rule, revealed that the practice regarding handling rule was six time better 6.045 (1.883-19.411) in graduate and 6.33 (1.308-30.661) in post graduate than diploma holders. Doctors had thirteen times better 13.542 (2.992- 61.289) practice of handling rule in biomedical waste management than nurses. Practice was eight times better 8.974 (2.679-30.056) among the CHC staff and three times higher 3.059 (1.330-7.038) among PHC staff than sub-center staff. The outcome of the current study showed that the levels of knowledge and practice scores were unsatisfactory among healthcare workers. Therefore, it is recommended that healthcare facilities engage in effective community communication strategies and provide periodic training. Ensuring proper communication of guidelines and adequate supplies for waste handlers will improve biomedical waste management practices and enhance community safety.

Key Words- Community, Awareness, Health Care workers, Handling Rules.

Introduction

Biomedical waste management are not regularized in many nations. India was among

the first nation to adopt and implement waste handling rules (Gupta S et al, 2009). Hospitals in India have not met the expected criteria for

BMWM practices despite a decade of implementation (Dixit A et al, 2021). These potentially dangerous wastes have a high pathogenicity, or capacity to spread illness, and they may not respond to therapy. (Jahnavi G et al, 2006). Safe waste disposal and community protection from various harmful impacts of hazardous waste can be achieved with the help of sufficient information, appropriate methods, and safety precautions. (Padmaja K et al, 2017) (Rashidian et al 2015) Health care providers may also be a possible source of infection. Medical waste handlers frequently experience occupational health risks as a result of poor waste management practices and working in a highly risky environment (Alemayehu T et al, 2016) (Padmanabhan K et al, 2018). The key to protecting people from potentially hazardous substances is adequate information, a positive attitude, and good waste disposal methods. (Adogu P et al, 2014) (Ferronato N et al, 2019). Safe waste disposal and community protection from various harmful impacts of hazardous waste can be achieved with the help of sufficient information, appropriate methods, and safety precautions. (Padmaja K et al 2017). People frequently experience occupational health risks as a result of poor waste management practices and working in a highly risky environment (Alemayehu Tet al 2016). The key to protecting people from potentially hazardous substances is adequate information, a positive attitude, and good waste disposal methods. (Hanumantha Rao, P. et al, 2009) Moreover, it has been noted that improper segregation at the point of origin results in the mixing of infectious and non-infectious waste (Shaheen, Tet.al 2020).

Therefore, the purpose of this study was to assess the knowledge and practices regarding handling rules and biohazard management in biomedical waste among healthcare workers in health facilities in rural Ghaziabad, with an emphasis on community awareness and effective communication strategies.

Materials and method

A health care facilities based cross-sectional study was conducted from 27th July 2022 to 23rd Sept. 2022. The sampling frame was government health facilities of district Ghaziabad i.e. Community health center (C.H.C), Primary health center (P.H.C) and Sub-center. Doctors, nursing staff, laboratory

technician and sanitary staff working in the health care facilities were involved in this study. The sample size was calculated by using the estimated proportion of knowledge (79%) on BMW among healthcare workers, reported by Pavan P. Amin et al, in the year 2018. (Amin PP et al, 2018)⁶ Using the probability proportional sampling with the estimated population of health care worker i.e., 232 (which is the finite population) we have calculated the sample size using formula

$$n = \frac{m}{1 + \frac{m-1}{n}} \quad \text{where } m = \frac{z_{1-\alpha/2}^2 pq}{d^2}$$

n= sample size, m= Adjustment factor with respect to FPC (finite population correction), $z_{1-\alpha/2}$ = Critical value of z for 95% confidence interval, p= Estimated proportion, q= 1-p, d= Desired absolute precision. The required sample size came out to be 122. Proportional allocation scheme was used to select the required number of health care workers from each facility. Stratified sampling technique was used with proportional allocation scheme. The total sample size was first stratified on the basis of educational qualification of the respondents and then on the basis of health care facilities where the respondents were posted. There are four blocks in district Ghaziabad, in each block there is one CHC, under each CHC there are four PHC contains a total of 145 sub-centres. However, data was collected randomly from 4 CHC, 12 PHC and 50 Sub-centres. A predesigned Semi-structured questionnaire was used a study tool to collect data. Consents & Approvals: Informed written consents have been taken from Health Care worker and Ethical approval (F.No: SU/ 2021/1830[13]) has been taken from the intuitional ethical committee of the Santosh Deemed to be University (SDTU), Ghaziabad. The data was collected and entered in MS excel 2016. Analysis was done using chi square and logistic regression method in SPSS software version 20.0 If p value <0.05, considered as statistically significant and if p-value>0.05, then it is statistically insignificant.

Results

1) Demographic characteristics

In this study we have collected data from 122 health care workers working in different health facilities in the district. Out of total

health care workers, 26 (21.3%) were from CHC, 46 (37.7%) were from PHC and 50 (41%) were from sub-centre. Majority of the study participants 96 (78.6) were female. Maximum number of the study participants 61 (50.0%) were in the age group of 31-40 years. Most of the health care workers were 71 (58.2%) diploma holders followed by 25 (20.5%) being graduate and 13 (10.7%) were post graduate. The complete socio-demographic characteristics are depicted in **table 1** below:

Table 1: Showing socio-demographic characteristics of the Health Care Workers.

Socio-demographic characteristics	Health Care workers (n=122)	Percentage (%)
Health Facilities		
C.H.C (n=4)	26	21.3
P.H.C (n=12)	46	37.7
Sub Center (n=50)	50	41.0
Gender of Health Care workers		
Male	26	21.3
Female	96	78.6
Age of the Health Care workers		
21-30	17	13.9
31-40	61	50.0
41-50	37	30.3
51 and above	07	5.70
Education of the Health Care workers		
Post Graduate	13	10.7
Graduate	25	20.5
Diploma	71	58.2
12 th Pass	03	2.50
10 th pass	10	5.40

We observed that, Of the total 27 (22.1%) doctors 18 (69.2%) were from CHC and 9

(19.6%) were from PHC. The 75 nurses selected were 50 (100%) from sub centre, 21 (45.7%) from PHC and 4 (15.4%) from CHC. One lab technician (3.8%) was from CHC and the remaining 5 (10.9%) from PHC. Regarding the 14 (11.5%) sanitary staff 11 (23.9) were from PHC and 3(11.5%) from CHC. The complete distribution of study participants according to occupation are depicted in **Fig 1** below:

2) Knowledge regarding Handling rules and Bio-Hazard in Biomedical Waste Management

The appropriate Knowledge regarding Handling rules in Biomedical Waste Management was found in 68.3% of the health care workers. We found that 109 (89.3%) of the health care workers were aware of Biomedical waste management & handling rule and 13 (10.7%) were unaware of handling rule. Half of the doctors 14 (51.9%), two third of the lab technicians 4 (66.7%), about one fourth of the nurses 22 (29.3%) and only 2 (14.3%) of the sanitary staff knew correctly that the bio medical waste management and handling rules was first proposed in 1998. We observed 47 (38.5%) HCW (Health care workers) correctly knew that the Bio medical waste management and handling rules were revised in 2016. In addition, 73 (59.8%) of the HCW knew that BMW (Biomedical waste management) regulated by state government. The knowledge on both the hepatitis and HIV/AIDS can be caused by Bio medical waste if not disposed safely was noted from 6 (100%) of the lab technician, 26 (96.3%) of the doctors, 64 (85.3%) of nurses and 6 (42.9%) of the sanitary staff. Any hazardous event occurred while handling biomedical waste

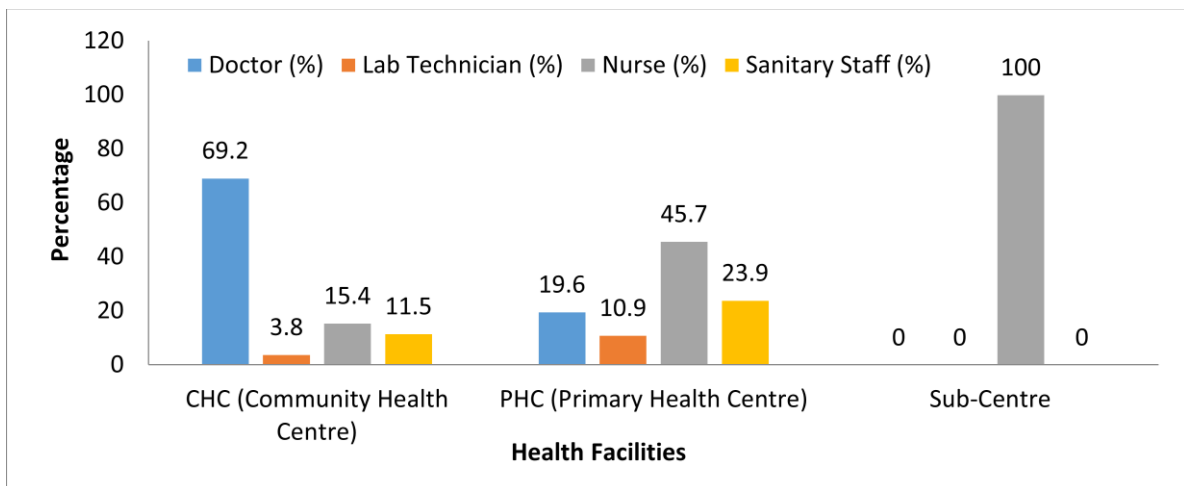


Fig 1: Distribution of study participants according to occupation.

should be reported in 24 hours was known by 40 (32.8%) of the HCW. In the present study, only 7 (5.7%) of the study participants correctly knew that the biomedical waste should not be stored beyond 48 hours. Correct symbol for Biohazard waste was identified by 59.8% of the total health care workers. About half 66 (54.1%) of the health care workers knew how to correctly prepare 1L of 1% Sodium hypochlorite from available 5% strength. We observed that 8(26.9%) doctors, 12 (16%) nurses and only 1(7.1%) sanitary staff

worker knew the correct color coding as per the BMW. None of the lab technician knew the correct colour coding as per the revised 2016 biomedical waste management and handling rule. We observed that the 44 (36.1%) of the health care workers knew that pollution control board of India is responsible for the safe transportation of the biomedical waste. The complete knowledge regarding Handling rules and Bio-Hazard in Biomedical Waste Management are depicted in table 3 below.

Table 3: Showing knowledge regarding Handling rules and Bio-Hazard in Biomedical Waste Management.

Knowledge regarding Handling rules and Bio-Hazard in Biomedical Waste Management						
Parameters	Doctor (%)	Lab Technician (%)	Nurse (%)	Sanitary Staff (%)	Total	Percentage
Are you aware of Hospital Waste Management & Handling Rule?						
Yes	27 (100)	6 (100)	69 (92.0)	7 (50)	109	89.3
No	0(0)	0(0)	6 (8.0)	7 (50)	13	10.7
Do you know when Biomedical waste (Management & Handling) Rules were first proposed?						
1997	4 (14.8)	0 (0)	15 (20.0)	3 (21.4)	22	18
1998	14 (51.9)	4 (66.7)	22 (29.3)	2 (14.3)	42	34.4
1999	3 (11.1)	1 (16.7)	3 (4.0)	0 (0)	7	5.7
2000	6 (22.2)	1 (16.7)	35 (46.7)	9 (64.3)	51	41.8
New classification of Bio-medical waste as per the revised Biomedical Waste Management rule came in which year?						
2015	5 (18.5)	0 (0)	27 (36.0)	3 (21.4)	35	28.7
2016	16 (59.3)	3 (50)	24 (19.7)	4 (28.6)	47	38.5
2017	3 (11.1)	0 (0)	12 (16.0)	1 (7.1)	16	13.1
2018	3 (11.1)	3 (50)	12 (16.0)	6 (42.9)	24	19.7
Do you know about the agency that regulate Biomedical waste at your health care facilities?						
State	18 (66.7)	6 (100)	46 (61.3)	3 (21.4)	73	59.8
Private	7 (25.9)	0(0)	17 (22.7)	4 (28.6)	28	23
No regulation	0 (0)	0(0)	4 (5.3)	1 (7.1)	5	4.1
Don't know	2 (7.4)	0(0)	8 (10.7)	6 (42.9)	16	13.1
Are you aware of biomedical waste hazards?						
Yes	27 (100)	6 (100)	71 (94.7)	11 (78.6)	115	94.3
No	0 (0)	0 (0)	4 (5.3)	3 (21.4)	7	5.7
If yes, What are the diseases that can be cause by biomedical waste if not disposed safely?						
Hepatitis-B (%)	0 (0)	0 (0)	2 (2.7)	2 (14.3)	4	3.3
HIV/ AIDS (%)	1 (3.7)	0 (0)	6 (8.0)	4 (28.6)	11	9
Both (%)	26 (96.3)	6 (100)	64 (85.3)	6 (42.9)	102	83.6
None of above (%)	0 (0)	0 (0)	3 (4.0)	2 (14.3)	5	4.1
As per the Bio Medical Waste Management Rules, 2016, any hazardous event should be reported/forwarded within?						
12 hour	11 (40.7)	4 (66.7)	48 (64.0)	9 (64.3)	72	59

Knowledge regarding Handling rules and Bio-Hazard in Biomedical Waste Management						
24 hour	13 (48.1)	2 (33.3)	22 (29.3)	3 (21.4)	40	32.8
48hour	1 (3.7)	0 (0)	3 (4.0)	0 (0)	4	3.3
72hour	2 (7.4)	0 (0)	2 (2.7)	2 (14.3)	6	4.9
According to biomedical waste (Management & Handling) Rule, waste should not be stored beyond?						
12 hour	8 (29.6)	1 (16.7)	29 (38.7)	4 (28.6)	42	34.4
24 hour	15 (55.6)	3 (50.3)	40 (53.3)	9 (64.3)	67	54.9
48hour	3 (11.1)	2 (33.3)	2 (2.7)	0 (0)	7	5.7
72hour	1(3.7)	0 (0)	4 (5.3)	1 (7.1)	6	4.9
Do you know how to prepare 1L of 1% Sodium hypochlorite from available 5% strength?						
Yes	21 (77.8)	4 (66.7)	38 (50.7)	3 (21.4)	66	54.1
No	6 (22.2)	2 (33.3)	37 (49.3)	11 (78.6)	56	45.9
Who regulates the safe transport of Biomedical Waste?						
Pollution Control Board of India	11 (40.7)	3 (50.0)	28 (37.3)	2 (14.3)	44	36.1
Transport Corporation of India	2 (7.4)	2 (33.3)	26 (34.7)	1 (7.1)	31	25.4
Private Corporation	4 (14.8)	0 (0)	10 (13.3)	7 (50)	21	17.2
Don't know	10 (37.0)	1 (16.7)	11 (14.7)	4 (28.6)	26	21.3

3) Practice regarding Handling rules & Bio-Hazard in Biomedical Waste Management

The appropriate practice regarding handling rules in Biomedical Waste Management was found in 58.1. % of the health care workers. We found that, 23 (18.9%) of the health care worker said that the revised biomedical waste management rules were not followed in their setup. All of the doctors 27 (100%) and lab technicians 6 (100%), while 62 (82.7%) nurses and 8 (57.1%) sanitary workers, were following the colour coding of the waste. We observed that 11 (9%) of the health care workers were still not following and 44 (36.1%) were not aware of the new colour coding rules.

In this study, 25 (92.6%) doctors 5 (83.3%) lab technicians, 47 (62.7%) nurses and 7 (50%)

sanitary staff workers were labelling the hazardous waste separately. Worryingly 34 (27.9%) of the health care workers were putting the infectious waste in black container. Nearly one fourth 35 (28.7%) of the health care workers knew the correct preparation for 1% for Sodium hypochlorite for biomedical waste management. This included 13 (48.1%) doctors, 1 (16.7%) lab technician, 20 (26.7%) nurses and 1 (7.1%) sanitary staff workers. Nearly one third 39 (32%) of health care workers said that a private agency while almost half of them 58 (47.5%) said that a state agency, is assigned for safe transport for biomedical waste management. The complete Practice regarding Handling rules and Bio-Hazard in Biomedical Waste Management are depicted in **table 4** below.

Table 4: Showing practice regarding Handling rules and Bio-Hazard in Biomedical Waste Management.

Practice regarding Handling rules and Bio-Hazard in Biomedical Waste Management						
Parameters	Doctor (%)	Lab Technician (%)	Nurse (%)	Sanitary Staff (%)	Total	Percentage
Are you following the revised biomedical waste management rule in your setup?						
Yes	27 (100)	6 (100)	58 (77.3)	8 (57.1)	99	81.1
No	0 (0)	0 (0)	17 (22.7)	6 (42.9)	23	18.9
Do you follow the color coding of the biomedical waste management rule in your setup?						
Yes	27 (100)	6 (100)	58 (77.3)	8 (57.1)	99	81.1
No	0 (0)	0 (0)	17 (22.7)	6 (42.9)	23	18.9

Since when the new colour coding of the biomedical waste management rule is being followed in your setup?						
2015	4 (14.8)	0 (0)	10 (13.3)	0 (0)	14	11.5
2016	10 (37.0)	4 (66.7)	36 (48.0)	3 (21.4)	53	43.4
Not followed	0 (0)	0 (0)	8 (10.7)	3 (21.4)	11	9
Don't know	13 (48.1)	2 (33.3)	21 (28.0)	8 (57.1)	44	36.1
Do you label hazardous waste separately, present in your health facilities?						
Yes	25 (92.6)	5 (83.3)	47 (62.7)	7 (50.0)	84	68.9
No	2 (7.4)	1 (16.7)	28 (37.3)	7 (50)	38	31.1
Do you put infectious waste in black container?						
Yes	7 (25.9)	5 (83.3)	20 (26.7)	2 (14.3)	34	27.9
No	20 (74.1)	1 (16.7)	55 (73.3)	12 (85.7)	88	72.1
How do you prepare 1L of 1% Sodium hypochlorite from available 5% strength?						
1000ml of water + 500ml of Sodium hypochlorite	5 (18.5)	1 (16.7)	30 (40.0)	7 (50.0)	43	35.2
250ml of water + 500ml of Sodium hypochlorite	2 (7.4)	0 (0)	10 (13.3)	2 (14.3)	14	11.5
500ml of water + 200ml of Sodium hypochlorite	7 (25.9)	4 (66.7)	15 (20.0)	4 (28.6)	30	24.6
800ml of water + 200ml of Sodium hypochlorite	13 (48.1)	1 (16.7)	20 (26.7)	1 (7.1)	35	28.7
In your health facility which agency is assigned for safe transport of Bio Medical Waste management?						
State	16 (59.3)	5 (83.3)	36 (48.0)	1 (7.1)	58	47.5
Private	7 (25.9)	1 (16.7)	25 (33.3)	6 (42.9)	39	32
No regulation	0 (0)	0 (0)	8 (10.7)	1 (7.1)	9	7.4
Don't Know	4 (14.8)	0 (0)	6 (8.0)	6 (42.9)	16	13.1

We observed that 16 (61.5%) male and 67 (69.8%) female had good knowledge regarding handling rule of Biomedical waste management and maximum of them were doctors 19 (70.4%) followed by nurse 51 (68%), lab technician 4 (66.7%) and sanitary staff workers 9 (64.3%)

Among the 10th pass of the study subject 7 (70%), 12th pass subjects only 1 (33.3%), diploma holder 47 (66.2%), graduate 18 (72%) and post graduate 10 (76.9%) had good

knowledge regarding handling biomedical waste. In CHCs and PHCs, health care workers 8 (30.8), 19 (41.3) had poor knowledge regarding hazards of Biomedical waste, while 25 (50%) in case of Sub-centers had bad knowledge regarding hazardous of Biomedical waste respectively. The complete relationship of Knowledge regarding Handling rule and Hazard of BMWM with socio-demographic variable are depicted in **table 5** below.

Table 5 Relationship of Knowledge regarding Handling rule and Hazard of BMWM with socio-demographic variable

Variable	Category	Knowledge Regarding Handling rule of BMWM		Total (100%)	p value	Knowledge Regarding Hazard of BMWM		Total (100%)	p value
		Good (%)	Bad (%)			Good (%)	Bad (%)		
Gender	Male	16 (61.5)	10 (38.5)	26	0.425	16 (68.5)	10 (38.5)	26	0.629
	Female	67 (69.8)	29 (30.2)	96	Reference	54 (56.30)	42 (43.8)	96	Reference
Education	10th Pass	7 (70)	3 (30)	10	0.811	4 (40)	6 (60)	10	0.381
	12th Pass	1 (33.3)	2 (66.7)	3	0.275	1 (33.3)	2 (66.7)	3	0.475
	Diploma	47 (66.2)	24 (33.8)	71	Reference	39 (54.9)	32 (45.1)	71	Reference
	Graduate	18 (72)	7 (28)	25	0.594	17 (68)	8 (32)	25	0.257

	Post Graduate	10 (76.9)	3 (23.1)	13	0.45	9 (69.2)	4 (30.8)	13	0.343
Occupation	Doctor	19 (70.4)	8 (29.6)	27	0.82	20 (74.1)	7 (25.9)	27	0.082
	Lab Technician	4 (66.7)	2 (33.3)	6	0.946	4 (66.7)	2 (33.3)	6	0.573
	Nurse	51 (68)	24 (32)	75	Reference	41 (54.7)	34 (45.3)	75	Reference
	Sanitary Staff	9 (64.3)	5 (35.7)	14	0.786	5 (35.7)	9 (64.3)	14	0.2
Health Facilities	C.H.C (Community health center)	20 (76.9)	6 (23.1)	26	0.107	18 (69.2)	8 (30.8)	26	0.112
	P.H.C (Primary Health Center)	34 (73.9)	12 (26.1)	46	0.103	27 (58.7)	19 (41.3)	46	0.394
	Sub- Center	29 (58)	21 (42)	50	Reference	25 (50)	25 (50)	50	Reference

A significant association was found between education level and practice regarding handling rule of biomedical waste management. Practice regarding handling rule was six time better 6.045 (1.883-19.411) in graduate and 6.33 (1.308-30.661) in post graduate than diploma holders.

Doctors had thirteen time better 13.542 (2.992-61.289) practice of handling rule in biomedical waste management than nurses. Practice was eight times better 8.974 (2.679-30.056) among the CHC staff and three times higher 3.059 (1.330-7.038) among PHC staff than sub-centre staff.

Practice regarding hazard was five times better 5.023 (1.410-17.90) in males than

females. A significant association was found between education level and practice regarding hazard of biomedical waste management. Practice regarding hazard was four time better 4.308 (1.34-13.837) in graduate than diploma holders. Doctors had twenty time 20.42 (2.633-158.477) better practice regarding hazard in biomedical waste management than nurses. Practice regarding hazard was thirteen times better 13.0 (2.772-60.975) among the CHC staff and almost three times higher 2.750 (1.177-6.423) among PHC staff than sub-centre staff. The complete relationship of Practice regarding Handling rule and Hazard of BMWM with socio-demographic variable are depicted in **table 6** below.

Table 6 Relationship of Practice regarding Handling rule and Hazard of BMWM with socio-demographic variable

Variable	Category	Practice Regarding Handling Rule BMWM		p value	OR (CI)	Practice regarding Hazard of BMWM		Total (100%)	p value	OR (CI)
		Good (%)	Bad (%)			Good (%)	Bad (%)			
Gender	Male	19 (73.1)	7 (26.9)	0.088		23 (88.5)	03 (11.5)	26	0.013*	5.023 (1.410-17.90)
	Female	52 (54.2)	44 (45.8)		Reference	58 (60.4)	38 (36.6)	96		Reference
Education	10th Pass	5 (50)	5 (50)	0.835		6 (60)	4 (40)	10	0.763	
	12th Pass	1 (33.3)	2 (66.7)	0.658		2 (66.7)	1 (33.3)	3	0.691	
	Diploma	33 (46.5)	38 (58.5)		Reference	39 (54.9)	32 (45.1)	71		Reference
	Graduate	21 (84)	4 (16)	0.003*	6.045 (1.883-19.411)	21 (84)	4 (16)	25	0.014*	4.308 (1.34-13.837)
	Post Graduate	11 (84.6)	2 (15.4)	0.022*	6.33 (1.308-30.661)	13 (100)	0(0)	13	0.998	
Occupation	Doctor	25 (92.6)	2 (7.4)	0.001*	13.542 (2.992-61.289)	26 (96.3)	1 (3.7)	27	0.004*	20.429 (2.633-158.477)
	Lab Technician	3 (50)	3 (50)	0.925		4 (66.7)	2 (33.3)	6	0.614	
	Nurse	36 (48)	39 (52)		Reference	42 (56)	33 (44)	75		Reference
	Sanitary Staff	7 (50)	7 (50)	0.891		9 (64.3)	5 (35.7)	14	0.566	
Health Facilities	C.H.C (Community health center)	22 (84.6)	4 (15.4)	0.05*	8.974 (2.679-30.056)	24 (92.3)	2 (7.7)	26	0.001*	13.0 (2.772-60.975)
	P.H.C (Primary Health Center)	30 (65.2)	16 (34.8)	0.009*	3.059 (1.330-7.038)	33 (71.7)	13 (28.3)	46	0.019*	2.750 (1.177-6.423)
	Sub- Center	19 (38)	31 (62)		Reference	24 (48)	26 (52)	50		Reference

Discussion

Demography of the current study shows that majority of the study participants in the present study were female 96 (78.6), which is

similar to a recent cross-sectional study where majority of the study participants (65.4%) were females. (Saha A et al, 2019) It was observed that a maximum number of study participants

61 (50.0%) were in the age group of 31-40, followed by 17 (13.9%) in the age group of 21-30 years. In a study conducted in 2016 by a Kamakar N et al in Agartala, where maximum number (74.2%) of health care worker were from 20-30-year age group. In this study most (58.2%) of the health care workers were diploma holders. Similar result was found in a cross-sectional study in Haryana conducted by Singh S et al in 2020, where maximum number of health care workers were diploma holders (47.6%). A recent study conducted in a tertiary care hospital at Bihar, reported that 22 (18%) of the health care workers were unaware regarding biomedical waste and handling rules. (Ranjan R et al, 2016) (Md. Sariful Haque et al, 2021) However, in the current study only 10.7% of the health care workers were unaware of "Biomedical waste management & handling rule" and 109 (89.3%) were aware of handling rule. Though the outcome of the current study shows a greater number of the study participants are aware of the biomedical waste management & handling rules, still more effort on creating awareness need to emphasized. Regarding the revised rules and regulations of the biomedical waste management, it was found that 47 (38.5%) of HCW knew correctly that the rules have been revised in the year 2016. Our results are in correlation with a recent study of 2021 reported by Haque et al., where the authors have reported in one fourth 31 (25.8%) of the study participants.

In the present study total of 73 (59.8%) health care workers knew about the correct agency that regulate biomedical waste. The knowledge regarding the correct agency was known by 80 (66.7%) of the study subjects as quoted by Haque et al., 2021. Diseases like Hepatitis and HIV/AIDS may be caused by improper disposal of bio-medical waste, participants having this knowledge were all of the lab technicians, 26 (96.3%) doctors, 64 (85.3%) nurses and 6 (42.9%) sanitary staff. (Gpta P et al, 2023) Ananthachari KR et al. found that a total of 89.6% of health care workers were aware that the infections like HIV, hepatitis B and hepatitis C could be transmitted during collection, segregation, transportation and treatment of biomedical waste management. (Ibrahim M et al, 2023) (Mitiku G et al, 2022) (Ananthachari KR et al, 2016) Knowledge regarding reporting of any hazardous event within 24 hours while

handling BWM was found in 40 (32.8%) of the HCW. Amin PP et al. found that most of the health care workers (91.7%) were reporting hazardous event like needle stick injury was immediately. (Amin PP et al,2018). In the current observational study, only a meagre 7 (5.7%) study participants were correctly aware that BMW should not be kept for more than 48 hours. Similarly, Deress T et al., found that only 12.7% of the health care workers correctly identified that maximum time period for keeping the BMW was 48 hours. (Deress T et al, 2019) In the current study, about half of the health care workers 21 (77.8%) correctly knew how to prepare 1L of "1% Sodium hypochlorite from available 5% strength." As such Basavaraj TJ et al in Bangalore, found that 86.7% of the doctors knew how to correctly prepare the disinfectant. The present study revealed that only 36.1% of the health care workers knew that pollution control board of India regulates the waste generation and safe transportation of the biomedical waste. Ananthachari KR et al found that 73.8% knew that pollution control board regulate biomedical waste management and handling practices.

In this study, 84 (68.9%) of the HCW were labelling the hazardous waste separately. Similar practice was seen by Amin PP et al, where the author found that all doctors and most of the paramedical staff (87%) were labelling the hazardous bin before filling. In the current study 88 (72.1%) of the health care workers were in a good habit of putting non-infectious waste in black container. Basavaraj TJ et al in., found that all of doctors, sanitary staff and 87.5% of the nurses were in a good habit of putting non-infectious waste in black container (Basavaraj TJ et al, 2021)

In the present study, 35 (28.7%) of the health care workers knew the correct preparation of 1% of Sodium hypochlorite. Similar practice was seen among 42.46% doctors and 40.6% of the nurses in a study conducted Mehta TK et al.in the western India in the year 2018.

To conclude, the levels of knowledge and practice scores among healthcare workers were unsatisfactory. Technical qualifications of the healthcare workers were identified as an important determinant of their waste management practices. This emphasizes the need for healthcare facilities to engage in effective communication and community

outreach, as well as to provide periodic training for waste handlers.

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