# Health-Care Waste Management in Public Sector of Tripura, North-East India: An Observational Study

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## Abstract

**Background:** Hospitals generate variety of waste which is hazardous to patients, health workers, community, and environment. Proper health-care waste management (HCWM) requires infrastructure, trained workforce, law and supervision. More than 80% of the population of Tripura depends on the public health-care system but the knowledge and practice of health-care workers regarding HCWM in the public sector of Tripura is not clear. **Objectives:** The objective was to assess the knowledge and practice of health-care workers regarding HCWM and to take an account of the existing HCWM facilities in the public sector of Tripura. **Study Design:** This was a facility-based, cross-sectional study. **Materials and Methods:** This study was conducted during 1st November 2015 to 16th October 2017 among 544 health-care workers working in thirty health institutions chosen by stratified random sampling. Data entry and analysis was performed using SPSS software version 15.0. **Results:** Overall, 37.68% of the respondents had fair knowledge regarding HCWM, 8.27% received in-service training on HCWM, 66.17% were immunized against hepatitis B and > 90% of the respondents knew about segregation of waste at source but knowledge regarding the use of colored bins for this purpose varied widely across different categories of participants. Housekeeping staff were ignorant about most of these issues. The importance of disinfecting the waste before disposal was known to 83.63% of the workers. Proper HCWM was practiced by 39.15% and segregation of waste at source into colored bins was followed by 23.3% of the respondents. The study revealed both waste management facilities and display of waste management policy as poor. Technical qualification and in-service training were identified as the statistically significant determinants of knowledge and practice of HCWM ($P < 0.05$). **Conclusion:** HCWM scenario including knowledge of health-care workers in Tripura is lacking. Installing proper waste management facilities, raising technical qualification at recruitment and in-service training may improve the situation.

**Keywords:** Health-care provider, health-care waste, Tripura, waste management practice

## Introduction

Generation of waste is inevitable everywhere and health sector is not an exception. Proper waste management is not only a legal but also a social responsibility of hospitals as it is hazardous to patients, caregivers, community and environment as well.[1] The World Health Organization (WHO) reported hazardous waste generation rate per hospital bed per day in high and low-income countries as 0.5 and 0.2 kg respectively.[2] The waste generation rate in India ranges from 0.5 to 2.0 kg/bed/,[3] with an expected annual increment of 8%.[4] According to WHO, around 10% of hospital wastes are infectious; 5% are toxic chemicals, pharmaceutical and radioactive wastes; and remaining 85% are nonhazardous. Health-care waste (HCW) is of great concern due to its nature, which results in increased incidence of water, air and soil pollution along with dreaded nosocomial infections. Needlestick injury poses a considerable risk for transmission of more than twenty kinds of blood-borne pathogens including hepatitis B virus (HBV) and hepatitis C virus (HCV) and HIV.[5] Epidemiological studies have found the risk of getting transmitted HBV, HCV and HIV as 30%, 1.8%, and 0.3%, respectively.[6] WHO has also reported that exposure to sharps in workplace accounts for 40% of HBV or HCV and 2%–3% of HIV infections among health-care workers.[7] Hence, proper disposal of HCW is essential to combat the health and ecological hazards.

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As per Bio Medical Waste (BMW) rule 2016, India has legal provisions to mitigate the impact of HCW[8] but it is remaining in its infancy throughout the globe. HCW management (HCWM) scenario in India is far below the acceptable level and its determinants include poor health infrastructure, lack of trained staff and poor knowledge and practice of HCWM by health-care workers.[9-11] Studies conducted among health-care professionals in India have found that gap in knowledge and lacunae in attitudes and practices are still prevalent to a worrying extent.[12]

The state of Tripura differs from rest of the nation regarding health infrastructure as well as HCWM. Knowledge and practice regarding HCWM among the health-care workers engaged in the public sector of Tripura remains under the shade. Hence, the present study was designed to throw light upon the knowledge and practice of these health-care providers regarding HCWM and also to take an account of the standard waste management facilities available in the public sector of Tripura.

## MATERIALS AND METHODS

This cross-sectional study was conducted among 544 health-care providers including doctors, nurses, housekeeping staff and laboratory technicians working in thirty different public health-care (PHC) setups of Tripura during November 1, 2015–October 16, 2017, chosen by stratified random sampling ensuring proportional representation. Minimum sample size requirement for this study was calculated separately for the strata of doctors, nurses, and housekeeping staff by using the following formula for calculating sample size in observational studies measuring proportions $n = \dfrac{(Z^2 PQ)}{L^2} \times DEEF$ [13] considering the fact that 68.3% of doctors, 60.9% of nurses, and 40.4% of housekeeping staff had adequate knowledge regarding HCWM at 95% confidence interval.[2] A relative error of 15% and a design effect of 1.1 were also considered. Thus, 93 doctors, 132 nursing personnel and 293 housekeeping staff were required for this study. In the first stage of sampling, two districts (25%) namely West Tripura district and Gomati district were chosen from total eight districts of Tripura by Simple random sampling (SRS). These two districts had thirty institutions in total ranging from PHC to state hospital. Health-care providers working in these two districts were stratified into doctors, nurses, housekeepers and laboratory technicians. SRS was followed again to choose the calculated number of participants from each stratum ensuring proportionate representation from each category of the health institution. Staff attendance registers were used to construct sampling frames for this purpose. In the study sample, only 26 laboratory technicians could be recruited (four institutions did not have any laboratory technician). Thus the final sample size was 544. Written informed consent for participation in this study was obtained from the selected health-care workers. The health centers were visited and the selected participants were interviewed confidentially by using a pretested interview schedule. Infrastructure for waste management was assessed using a checklist. The study tools were developed by consulting book,[14] published journals,[4] and BMW management rule, Government of India gazette[8] and validated by pilot testing. The interview schedule contained 15 knowledge and 10 practice-related questions. Each correct and incorrect response to these questions carried a score of 1 and 0 respectively. For assessing knowledge and practice, the obtained scores above the median were labeled as "fair" and the rest as "poor." HCW was defined as any waste generated during the diagnosis, treatment or immunization of human beings or in research activities pertaining there to or in health camps and including categories mentioned in Schedule I of BMW Rules of 1998. In this study, participants who could neither read nor write with understanding in any language were considered as illiterate. Participants with primary education were those who studied any level up to Standard V. Participants with secondary education were those who had schooling of any level up to Standard XII. Technical diploma holders were those who had diploma in technical stream after Standard XII and technical graduates were those who had graduations in technical streams. Participants working for 5 years or more were considered as permanent and the rest as temporary employees. Correct segregation of waste was defined as depositing particular type of waste in a particular colored bin out of four different colored bins namely, green, red, blue, or white transparent and yellow at the point of generation. Data were entered in the interview schedule and the checklist on spot and later on entered and analyzed with a computer using SPSS software version 15.0 (SPSS Inc, Chicago)[15] and Epi-info-7 (Atlanta, GA).[16] The data were summarized using frequencies and percentages. Mean and standard deviation were calculated for presenting the quantitative data. The inferential statistical tests such as Chi-square test and Fisher's exact test were applied to study the association between different independent variables. $P < 0.05$ was considered statistically significant. The Institutional Ethics Committee of Agartala Government Medical College has approved the study.

## RESULTS

Majority of the study participants were aged between 20 and 30 years and there was a female predominance in all the categories except doctors. Majority of the respondents (59.40%) had service experience of 5 years or more, 66.17% received immunization against HBV and 8.27% of them received in-service training on HCWM. Majority (30.76%) of the housekeeping staff knew the regulatory authority of HCWM, whereas only 9.89% of the laboratory technicians knew the same. Majority (96.15%) of the laboratory technicians have heard about BMW Management Rule 2016 but only 8.87% of the housekeeping staff have heard about it. Most of the doctors were familiar with the biohazard symbol but only 6.14% of the housekeeping staffs were familiar with the same. All the doctors and technicians knew the use of colored bins for waste segregation and the technicians also knew that it is to be segregated at

source. Knowledge regarding the use of specified colored bins and disinfection of waste before disposal was satisfactory among all categories of the health-care providers. The median knowledge and practice score was 9.0 (interquartile range [IQR] = 7.0–11.0) and 2.0 (IQR = 4.0–6.0) respectively. Overall, 37.68% of the health-care providers were found to have fair knowledge regarding the different aspects of HCWM. Significantly higher proportions of the health workers with technical diploma or degree, laboratory technicians, temporary employees, employees having in-service training, and the younger employees had fair knowledge of HCWM (P < 0.05) [Table 1].

Out of total, 76.5% of the HCWs used to segregate waste at source, 79.6% were using needle destroyers and 50.0% of them used to disinfect waste prior to disposal. Nearly 39.7% of the HCWs were not accustomed to the regular use of personal protective devices (PPDs) and only 23.3% of them used to segregate HCW into specified colored bins at source. Among the study participants, 26.93% of laboratory technicians, 27.65% of housekeepers, 17.43% of nursing personnel and only 17.20% of doctors were practicing proper waste segregation [Table 2]. The overall practice of waste management was found to be fair among 39.15% of the health-care providers. Older age (>40 years), technical qualification and in-service training were statistically significantly associated with fair waste management practice (P < 0.05) [Table 3]. Among all the PHC setups, segregation of waste at source was practiced in 53.33%, colored bins were in place in 60%, PPDs for waste handling were available in 16.67%, and waste management policy was displayed in 33.33%, but none of them maintained waste management records [Table 4]. Deep burial inside the hospital premises was found to be the most common (53.33%) mode of disposing HCW.

## Discussion

The present study detected 90.62% of the health-care workers as aware regarding the hazardous nature of HCW and Malini and Eshwar have found it to be 96.7%.[17] Awareness regarding proper segregation of HCW in colored bins was 23.34% across all categories of participants, which was consistent with the findings of Holla et al.[18] and Ismail et al.[19] Whereas, Mathur et al.[4] reported it to be 91%, 92%, and 85% among doctors, nurses and laboratory technicians respectively, which may be due to the different study setting and in-service training of staff. Housekeeping staff had the poorest level of awareness regarding waste segregation, which was in agreement with the findings of Gupta et al.,[20] and lower literacy may be the reason for this. Knowledge regarding HCWM was significantly higher among health-care workers having technical qualifications and it was similar with the findings of Mathur et al.,[4] Pullishery et al.,[21] Madan et al.,[22] and Sahoo et al.[23] While handling HCW, majority of the health-care workers have used PPDs either occasionally or never. Moreover, it was similar with the findings of Holla et al.,[18] but differed from that of Kumar et al.[24] and Chudasama et al.[25] The present study has detected the use of needle destroyers by 79.6% of the health-care workers, which was at par with Malini and Eshwar.[17] In this study, 23.34% of health-care workers were found to segregate HCW at source, which was similar with the findings of Ismail et al.[19] and Azage and Kumie.,[26] but differed from the findings of Kumar M et al.[24] Fair HCWM practice rate of 39.15% was

## Table 1: Waste management knowledge of the health-care workers by sociodemographic and service-related factors

| Variables | Subgroups | Knowledge regarding HCWM | | Significance |
| --- | --- | --- | --- | --- |
| | | Fair, n (%) | Poor, n (%) | |
| Age group (years) | 20-30 | 110 (62.85) | 65 (37.15) | $\chi^2$=82.471, P=0.00 |
| | 31-40 | 63 (35.00) | 117 (65.00) | |
| | 41-50 | 23 (16.55) | 116 (83.45) | |
| | >50 | 9 (18.00) | 41 (82.00) | |
| Gender | Male | 79 (42.02) | 109 (57.98) | $\chi^2$=2.302, P=0.13 |
| | Female | 126 (35.39) | 230 (64.61) | |
| Education qualification | Illiterate | 0 (0.00) | 13 (100) | Fisher's exact value=168.10, P=0.00 |
| | Primary | 16 (13.55) | 102 (86.45) | |
| | Secondary | 24 (14.81) | 138 (85.19) | |
| | Technical diploma | 82 (60.29) | 54 (39.71) | |
| | Technical graduate | 83 (72.17) | 32 (27.83) | |
| Category of health-care provider | Doctors | 67 (72.04) | 26 (27.96) | $\chi^2$=167.94, P=0.00 |
| | Nurses | 75 (56.82) | 57 (43.18) | |
| | Laboratory technicians | 23 (88.46) | 3 (11.54) | |
| | Housekeepers | 40 (13.65) | 253 (86.35) | |
| Nature of employment | Temporary | 108 (48.86) | 113 (51.14) | $\chi^2$=19.82, P=0.00 |
| | Permanent | 97 (30.03) | 226 (69.97) | |
| In-service training | Received | 31 (68.89) | 14 (31.11) | $\chi^2$=20.34, P=0.00 |
| | Not received | 174 (34.87) | 325 (65.13) | |

HCWM: Health-care waste management

## Table 2: Waste management practices by category of the health-care workers

| Waste management practices | Category of HCWs | | | |
|---|---|---|---|---|
| | Doctors (*n*=93) | Nurses (*n*=132) | Housekeepers (*n*=293) | Laboratory technicians (*n*=26) |
| Segregation of HCW at source | 66 (70.96) | 101 (76.52) | 225 (76.79) | 24 (92.30) |
| Regular use of PPDs | 36 (38.70) | 25 (18.93) | 146 (49.82) | 9 (34.61) |
| Regular use of needle destroyers | 77 (82.80) | 97 (73.48) | 237 (80.89) | 22 (84.61) |
| Segregation of HCW into colored bins | 16 (17.20) | 23 (17.43) | 81 (27.65) | 7 (26.93) |
| Disinfection of waste prior to disposal | 63 (67.74) | 65 (49.24) | 125 (42.66) | 19 (73.07) |

HCWs: Health-care wastes, PPDs: Personal protective devices

## Table 3: Health-care waste management practices by sociodemographic and service-related factors of health-care workers

| Variable | Subgroups | HCWM practice | | Significance |
|---|---|---|---|---|
| | | Fair, *n* (%) | Poor, *n* (%) | |
| Age group (years) | 20-30 | 69 (39.43) | 106 (60.57) | $\chi^2$=10.740, *P*=0.013 |
| | 31-40 | 60 (33.33) | 120 (66.67) | |
| | 41-50 | 69 (49.64) | 70 (50.36) | |
| | >50 | 15 (30.00) | 35 (70.00) | |
| Gender | Male | 78 (41.49) | 110 (58.51) | $\chi^2$=0.657, *P*=0.417 |
| | Female | 135 (37.92) | 221 (62.08) | |
| Educational qualification | Illiterate | 0 (0.00) | 13 (100.00) | Fisher's exact value=16.97, *P*=0.002 |
| | Primary | 55 (46.61) | 63 (53.39) | |
| | Secondary | 71 (43.83) | 91 (56.17) | |
| | Technical diploma | 44 (32.35) | 92 (67.65) | |
| | Technical graduate | 43 (37.39) | 72 (62.61) | |
| Category | Doctors | 33 (35.48) | 60 (64.52) | $\chi^2$=5.865, *P*=0.118 |
| | Nurses | 42 (31.81) | 90 (68.19) | |
| | Laboratory technicians | 12 (46.15) | 14 (53.85) | |
| | Housekeepers | 126 (43.00) | 167 (57.00) | |
| Nature of employment | Temporary | 87 (39.63) | 134 (60.64) | $\chi^2$=0.007, *P*=0.933 |
| | Permanent | 126 (39.00) | 197 (61.00) | |
| In-service training | Trained | 26 (57.77) | 19 (42.23) | $\chi^2$=7.142, *P*=0.008 |
| | Not trained | 187 (37.47) | 312 (62.53) | |

HCWM: Health-care waste management

## Table 4: Waste management facilities found available in the study institutions (*n*=30)

| Waste management facilities | *n* (%) |
|---|---|
| HCWM records | 0 (0.00) |
| HCWM policy display | 10 (33.33) |
| Authorization for handling of HCW | 1 (3.33) |
| Color-coded bins | 18 (60.00) |
| Waste segregation system | 16 (53.33) |
| Disinfection before disposal | 10 (33.33) |
| PPD for HCW handling | 5 (16.67) |
| Hub cutter | 28 (93.33) |
| Sharp's pit | 8 (26.67) |

HCWM: Health-care waste management, PPD: Personal protective device, HCW: Health-care waste

similar with the findings of Ranu *et al.*[27] but differed from the findings of Mostafa *et al.*[28] Except medical colleges, none of the health institutions had authorization for HCWM and record of waste handling was not found anywhere. In contrast to the finding of Pullishery *et al.*,[21] 53.33% of the institutions disposed the waste by means of deep burial and 33.33% institutions threw their waste indiscriminately, which were at par with the findings of the INCLEN Program Evaluation Network study.[29] Primary care physicians were mainly the fresh medical graduates and in spite of BMW management being taught in the MBBS curriculum, its application in real time was found to be lacking. This may be attributable to the deficient waste management infrastructure at the primary care setting and inadequate in-service training.

## Conclusion

Segregating HCW at source, storing of waste in specific colored bins, use of PPDs for waste handling, displaying waste management policy etc., were practiced in 60% or less number of the PHC setups in Tripura. In about one-third of the health-care setups, HCWs were thrown away indiscriminately. The overall knowledge and practice of fair HCWM was found to be <40%. Technical qualification and in-service training

of the health-care workers were identified as the important determinants of their waste management practice.

## Conflicts of interest

There are no conflicts of interest.

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