Research Article

Evaluation of bio medical waste management practices in select health care facilities of Karnataka, India

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ABSTRACT

Background: Health care sector has expanded to a great extent in both private and public sectors to cater to the needs of the increasing population of the country. Mismanagement of bio medical waste can expose health care personnel and public to various potential hazards.

Methods: Cross sectional study was conducted during September- November 2014 to assess current practices of Bio-Medical waste management (BMW) among the health care facilities (HCF) that had participated the selected districts level training program. Two stage sampling method was used to select eight districts and 15 HCFs in each district of Karnataka. An observational check list was used to observe macro and process areas of BMW.

Results: Efficiency of each of the process of waste management was calculated by using a scoring system. A total of 116 HCF were observed-9 large, 17 medium and 90 small. Segregation efficiency was poor in 22 (24.4%) small HCFs. Disinfection was practiced in 50% of the locations observed in small HCFs. The storage efficiency was excellent in 56.3% and 57.7% among medium and small HCFs respectively. No containment of sharps was observed in 34.7%, 23.4%, 26.8% locations of small, medium and large HCFs respectively. Final disposal of waste was managed by common treatment facility in 88.8% of large and 88.2% of medium sized hospital respectively.

Conclusions: Practices of bio medical waste management need to be improved at all levels.

Keywords: Bio medical waste management, Training, Segregation efficiency

INTRODUCTION

Health care sector has expanded to a great extent to cater to the needs of the increasing population of the country. The expansion of the health sector has been in both public as well as private sector. The quantum of waste generated has also increased and mismanagement of bio medical waste can lead to spread of some of the blood borne infections and pollution of air water and land. Realizing this, Ministry of Environment & Forests, Government of India had notified the Bio- Medical Waste (Management & Handling) Rules 1998 under the Environment Protection Act 1971. The same has been amended and new rules have been notified in 2016.¹ The rules have been framed in view of the fact that

unscientific disposal of bio-medical waste (BMW) is a health hazard and hence its treatment and disposal should be done in a scientific manner. Bio medical waste management includes all activities of segregation, disinfection before disposal, containment, storage and final disposal of waste. The major challenge in sound management of bio medical waste is the attitude of Health care workers. To address this, training and re-training of health care workers will help in achieving the objectives of the BMW rules and also aid in scientific disposal of bio-medical waste.

Towards an effort to build the capacity of health care personnel in the state of Karnataka, a Training of Trainers (ToT) programme on BMW was conducted by

Environmental Management and Policy Research Institute (EMPRI) is an autonomous institution conducting applied research on environmental issues and providing training and advisory services to government, industry and civil society. TOT was conducted for a team of six persons identified from each district as master trainers during the last quarter of 2011. These master trainers in their respective districts, over the next six months in 2012 undertook district level training programme. Health care personnel were trained in the area of bio medical waste management in both government and private sector HCFs at the district level. It is believed that the training received at district level would have an impact on the practices of bio medical waste management at their respective health centers and also the knowledge would be shared with the other health care professionals.

With this background, this endeavor was undertaken to evaluate the Bio-medical waste management practices in the health care facilities (HCF) that participated in the district level training programme.

METHODS

Cross sectional study was conducted during the period September-November 2014 to assess the current practices of Bio- Medical waste management among the health care facilities that participated in the district level training.

Study unit

HCFs which had participated at district level training programme on BMW wherein at least one of its health care personnel should have undergone training were the study unit. Health care facilities were classified as Large, medium and small sized HCF based on number of beds.

For operational purposes large hospital was defined as those above 500 beds, medium size hospital is defined as those with 100-500 beds, small hospital includes less than 100 beds like Primary Health Centre / Community Health Centre / General Practitioners clinic / Nursing Home / Lab / Blood Bank / Laboratory etc. or by any other name.

Sample size

Sample size was estimated based on the findings of situation analysis of health care facilities and Common treatment facilities undertaken under the Project-“Environmentally Sound Management of Medical Wastes in India, in 2009 funded by GEF/UNIDO/GOI where it was observed that the median segregation efficiency in HCFs of Karnataka state was 43%.² Expecting similar results with 21% relative precision and 95% confidence level, this study required a minimum of 115 centres in the state.

Sampling technique

Two stage random sampling method was adopted to select the 115 health care facilities, that had participated in the district level training on BMW.

Stage 1

To have a representative sample across the state, all the four revenue divisions were considered to select HCFs. Two districts in each of the revenue division was randomly selected using random number table. The required sample size was equally divided between the selected eight districts and hence the sample size in each district was 14-15 HCFs.

Stage 2

All the Health care facilities within the selected district which participated in the district level training on BMW constituted the sampling frame. All the HCFs were listed according to alphabetical order and a numerical identification code was given. Among them, 15 HCFs were randomly selected in each district using simple random technique.

Method of data collection

M. S. Ramaiah Medical College was the nodal centre for conducting the evaluation and Department of Community Medicine of the medical college in the respective districts were identified as coordinating centre to carry out the evaluation in their districts. Two representatives not below the rank of Assistant professors from Department of Community Medicine formed the evaluation team for the respective district and underwent training at the nodal centre (M.S. Ramaiah Medical College and Hospitals) to conduct evaluation in the selected HCFs.

A field manual was developed and was shared with each of the coordinating centers. The field manual consisted of explanation to the observational check list that was used for evaluation. The evaluation team from the coordinating centre visited the selected HCFs and evaluated the HCF for biomedical waste management practices using the observational checklist provided.

Tool

Observational check list used for assessing the Bio Medical waste management practices of the HCFs consisted of three parts which included general description of the HCFs, macro areas and processes of Bio-medical waste management. The macro areas that were evaluated were written policy on infection control and hospital waste management, presence of committees of waste management and infection control, Standard operating protocols, authorization from PCB, monitoring mechanism of waste management and injuries. Processes which were evaluated were segregation, disinfection,

transportation and storage, containment of waste sharps. All the processes of waste management were assessed at various locations in the hospital e.g. outpatient department of different specialties (OBG, paediatrics, medicine, surgery etc.), minor OT, intensive care units, diagnostic labs, wards etc.

A scoring system was evolved and the efficiency of each of the process of waste management was calculated. The Processes of segregation, transport and storage were scored on a 0-4 point scale. A maximum score of 4 was given, when the processes was done according to BMW rules of 1998. Zero score was given if processes were not followed. The description for scoring was provided in the field manual and the evaluators were specifically trained at the nodal centre for the same. Efficiency of the processes was calculated by adding the scores of all the locations in the hospital (observed score) and dividing the observed score by maximum possible score in percentage.

For example, Segregation efficiency of the hospital was calculated by adding the observed scores of all the locations in the hospital divided by the maximum score. (Segregation efficiency: segregation score obtained/maximum segregation score possible X 100, expressed as system operating currently with ___% of efficiency).

RESULTS

Table 1: Macro areas-policy issues of Biomedical waste management in large and medium sized HCFs.

Macro issues	Large (n= 9)	Medium (n= 17)
Infection Control policy present	5 (55.6%)	2 (11.8%)
Hospital waste management policy present	5 (55.6%)	4 (28.6%)
Infection control committee exists	6 (66.6%)	3 (17.7%)
Hospital waste management committee exists	7 (77.8%)	8 (47.0%)
Spill Management protocol present	3 (33.3%)	5 (29.4%)
Policy on mercury present	2 (22.2%)	1 (5.9%)

A total of 116 HCF were included for analysis of which 9 were large, 17 medium and 90 small Health care facilities. Of which, 27 (23.3%) HCFs were from the private sector and 89 (76.7%) were from the government sector. Among the 90 small HCFs, 52 (57.8%) were Primary health centers, 12 (13.3%) were community health center and the rest 3 were clinics, 5 nursing homes. Presence of written policies and committees for infection control and hospital waste management was observed only in the large and medium sized HCFs. While only 2

of the large and only one medium hospital had mercury policy in place, none of the small HCFs had any policy in place (Table 1).

At the time of the survey 3/9 (33.3%), 5/16 (31.3%) and 15/76 (19.7%) of large, medium and small HCFs respectively had obtained authorization from the state pollution control board but had not renewed it. Overall monitoring of injuries was satisfactory in 34% of HCF. Periodic monitoring of waste management system was undertaken with report available in 33.3%, 12.5% and 15.9% of large, medium and small HCFs respectively. Waste management register was maintained in 66.7% of large; 80.0% in medium and 43.9% of small HCFs. Injury register was maintained in 20 of HCFs overall (Table 2).

Table 2: Macro areas-monitoring system related to biomedical waste management in large, medium and small HCFs.

Components	Large	Medium	Small
i) Waste Management register	(n= 9)	(n= 15)*	(n= 82)*
Present	6 (66.7%)	12 (80.0%)	36 (43.9%)
Absent	3 (33.3%)	3 (20.0%)	46 (56.1%)
ii) Injury register	(n= 9)	(n= 14)*	(n= 84)*
Present	2 (22.2%)	4 (28.6%)	14 (16.7%)
Absent	7 (77.8%)	10 (71.4%)	70 (83.3%)
iii) Monitoring of injuries	(n= 9)	(n= 17)	(n= 87)*
Not satisfactory	4 (44.4%)	11 (64.7%)	60 (69.0%)
Satisfactory	5 (55.5%)	6 (35.3%)	27 (31.0%)
iv) Periodic monitoring of waste management system	(n= 9)	(n= 16)*	(n= 88)*
No monitoring and reports	2 (22.2%)	8 (50%)	28 (31.8%)
Monitoring undertaken but no reports	4 (44.4%)	6 (37.5%)	23 (26.1%)
Monitoring undertaken and with reports	3 (33.3%)	2 (12.5%)	14 (15.9%)
Not applicable#	-	-	23 (26.1%)

*n varied as there were missing information in the proforma

NA- Small HCF which did not have beds were not considered

The median quantum of waste generated across the different sizes of HCFs in the yellow colour code that

includes human anatomical waste was 40, 30 and 66.7 gms / day in large medium and small HCFs respectively. Quantum of waste in the yellow colour code in the small HCFs was observed to be more than that in the medium and large size HCFs. The reason for the same could be that the segregation efficiency was observed to be poor and average among 50% of the small HCFs (Table 3).

Table 3: Quantum of waste as per different sizes of HCFs.

Colour code	Large median (IQR)	Medium median (IQR)	Small median (IQR)
Yellow	40.0 (17.3-75.6)	30.0 (20.0-55.0)	66.7 (30.8 - 166.7)
Red	31.6 (13.8-108.8)	20.0 (20.0-32.5)	40.0 (31.7-83.3)
Blue	22.8 (14.9-142.5)	27.5 (20.0-60.0)	66.7 (33.3-166.7)
White translucent	20.0 (13.5-192.3)	10.0 (9.0-20.0)	66.7(26.7-155.0)
Black	22.3 (8.8-728.7)	45.0 (15.0-60)	33.3 (28.6-100.0)

Table 4: Efficiency score for key processes of Biomedical waste management.

Efficiency score	n (%)	n (%)	n (%)	n (%)
Segregation	Large n=9	Medium n=17	Small n=90	Total n=116
Poor (0-25)	Nil	Nil	22 (24.4%)	22 (19.0%)
Average (26-50)	2 (22.2%)	4 (23.5%)	24 (26.7%)	30 (25.9%)
Good (51-75)	3 (33.3%)	6 (35.3%)	23 (25.6%)	32 (27.6%)
Excellent (76-100)	4 (44.4%)	7 (41.2%)	21 (23.3%)	32 (27.6%)
Transportation of waste	Large n= 5	Medium n= 15	Small n=54*	Total N=74
Poor (0-25)	1 (20.0%)	3 (20.0%)	20 (37.0%)	24 (32.4%)
Average (26-50)	2 (40.0%)	1 (6.7%)	11 (20.4%)	14 (18.9%)
Good (51-75)	0	5 (33.3%)	11 (20.4%)	16 (21.6%)
Excellent (76-100)	2 (40.0%)	6 (40.0%)	12 (22.2%)	20 (27.0%)
Storage of waste	Large* n= 8	Medium* n=16	Small* n=52	Total n=76
Poor (0-25)	0	3 (18.8%)	11 (21.2%)	14 (18.4%)
Average (26-50)	4 (50.0%)	3 (18.8%)	7 (13.5%)	14 (18.4%)
Good (51-75)	2 (25.0%)	1 (6.3%)	4 (7.7%)	7 (9.2%)
Excellent (76-100)	2 (25.0%)	9 (56.3%)	30 (57.7%)	41 (53.9%)

It is observed that segregation efficiency in the medium and large HCFs was average to excellent, while segregation efficiency was poor in 22 (24.4%) of small HCFs (Table 4).

Information on transportation efficiency was available for only 74 HCFs as against 116 as it was not applicable in some of the small HCFs such as primary health centers and centers with no beds (no inpatient facility). Overall transportation efficiency was excellent in 27.0% of HCFs and good in 21.6% of HCF (Table 4).

Efficiency of Storage of waste varied from average to excellent among the large hospitals. The storage efficiency was excellent in 56.3% and 57.7% among medium and small HCFs respectively (Table 4).

Disinfection process was observed at different locations of the HCFs. Among the 354 locations observed, in small HCFs 50% of them practiced disinfection before disposal of waste (Table 5).

Table 5: Disinfection practices in various locations of health care facilities.

HCF	Large n (%)	Medium n (%)	Small n (%)
No. of locations observed	n=90	n=121	n=354
Disinfection practiced	60 (66.6%)	78 (64.5%)	175 (49.4%)
Disinfection not practiced	40 (33.4%)	43 (35.5%)	179 (50.6%)

Table 6: Sharps management practices in various locations of health care facilities.

HCF	Large n (%)	Medium n (%)	Small n (%)
No of locations observed	95	107	299
Sharps are disinfected and contained in puncture proof container	41 (43.2)	50 (46.7)	111 (37.1)
Sharps are contained in puncture proof container without disinfection	12 (12.6)	9 (8.4)	47 (15.7)
Sharps are burnt using needle burner	7 (7.4)	9 (8.4)	26 (8.7)
Sharps are disfigured with needle/ hub cutter and disinfected	2 (2.1)	14 (13.1)	35 (11.7)
None of the above	33 (34.7)	25 (23.4)	80 (26.8)

Containment of sharps is important irrespective of the size of the HCFs. In 43.2%, 46.7% and 37.1% of the

locations in large, medium and small HCFs respectively had correct practice of disinfection and proper containment of sharps. It was observed that no specific practice was done for sharps in 34.7%, 23.4% and 26.8% of locations in large, medium and small HCFs respectively (Table 6).

Waste was handed over to common treatment facility in 8/9 (88.8%) of Large, and 15/17 (88.2%), of medium sized hospital. Whereas in small HCF, only 42 out of 90 HCF (46.7%) handed over health care waste to common treatment facility and 48/ 90 (53.3%) managed their waste on-site for final disposal. Among the onsite

managed small HCF, 38 (79.1%) had Waste Sharp pits and 40 (83.3%) had deep burial facility.

It was observed that nearly about 50% of the HCFs used Liquid waste management system developed by Karnataka Health Systems Development Reforms Project for disinfecting liquid waste before disposal. Only one large hospital had an effluent treatment plant of its own. No specific treatment of liquid waste was observed in 17 (14.6%) of all the HCFs put together.

Figure 1: District-wise comparison of segregation efficiency of waste management.

DISCUSSION

Infection control and hospital waste management policies and committees are guiding forces for good practices in large and medium sized hospitals. It ensures establishment of effective and safe management of bio medical waste in the health care institutions. Regular monitoring of bio medical waste management ensures occupational safety of health care personnel and also further strengthens the waste management systems.

It was observed in the present study, policies for bio medical waste and infection control was observed in only 50% of the large hospitals. Monitoring of injuries, waste management systems and documentation was not satisfactory in majority of health care facilities found across the different categories of HCFs studied.

Information from the state pollution control boards (2007-08) state that 53.25% of health care establishments are in operation without obtaining authorization from their respective state pollution control boards. Approximately 56.87% of 506.74 tons of health care

waste generated is being treated through 159 common bio medical waste treatment facilities.³ In 2014 state pollution control board of Karnataka had identified 26,927 HCFs; and 27 common treatment facilities in the state.² Quantum of infectious waste generated in a tertiary care hospital was 101 Kg per day.⁵ The median quantum of infectious waste generated in our study was 31.6 gms /day (IQR 13.8-108.8) among large hospital. However, the information on the quantum of waste generated was not forthcoming in most of the places. Quantum of waste generated could not be ascertained accurately as there was a mix up general and bio medical waste.⁶ The observation regarding the quantum of waste generated in the HCFs depends on: good documentation procedures, the time of visit of the investigating team, frequency with which bio medical waste is collected from the HCFs by the common treatment facilities and segregation practices followed at the HCFs. Documentation of quantum of waste generated by the HCFs is mandated as per BMW rules.

Study on current practices of health care waste management in small health care facilities in one of the wards under BBMP area revealed that segregation at the

point of generation was observed in 22 (62.9%) of HCF and segregation process was complaint as per BMW rules of 1998 in only 5 (16.1%) of HCFs. Containment of sharps and disinfection process was found to be deficient in most of the centres.⁶

Situational analysis of bio medical waste management done in the 25 districts of 20 states of India in 388 health facilities (194 public+194 private); revealed that 82% of primary care, 60% of secondary and 54.2% of tertiary care facilities were in RED zone with no credible waste management system in place.⁷ Mean percentage scores for condition of the receptacles, segregation, mutilation and disinfection of waste at the emergency room of a tertiary care hospital in North India was 87%, 92%, 85% and 86% respectively. Comparison of different areas of the hospitals showed there was no statistically significant difference with regard to segregation of waste and condition of waste receptacles.⁸

In the present study, it was observed that the segregation efficiency in small facilities was distributed equally among grades of poor to excellent. However, 77.7% of the large and 76.4% of the medium sized HCFs and 48.8% of the small HCFs were observed to have segregation efficiency of good and excellent. The findings of the present study are similar to that of the above mentioned studies.

Transportation efficiency among the large HCFs- 60% of them had an efficiency of poor to average, 26.6% of medium sized HCFs showed a transport efficiency of poor to average. A median score of 5 (IQR 5-5) 5 (IQR 5-6.7) was observed for process of transportation in secondary and tertiary care hospitals respectively.⁷ Adequate importance has to be given to in house as well as transportation to common treatment facility to achieve safe management of bio medical waste management.

Median score for storage was 4 (IQR 1.1- 7) and 6 (IQR 2.5-8) in secondary and tertiary care hospitals respectively.⁷ Storage efficiency was good to excellent in 50 % of large HCFs and in 62.5% of medium sized hospitals. Storage facility for bio medical waste should have facilities to maintain the segregation and should be accessible to only authorized personnel. Often this aspect of storage is neglected in the planning phase of the health care facility.

It was observed in the present study that the efficiency of transportation and storage also need improvement. Disinfection of waste at the point of generation reduces the chances of transmission of infections among health care personnel and general public at large but is not practiced at all the locations of health care facility. Sharps have the potential to transmit infection like HIV and Hepatitis B and it was observed that about one third of the locations did not practice safe management of sharps. Liquid waste management is one of the neglected areas of bio medical waste management. However in the present

study it was found that in more than 75% of health care facilities were disposing their liquid waste safely.

Bio Medical waste management is beyond just compilation of the data on process and enforcement of regulations; it has to be supported by appropriate education, training, commitment of health care staff within an effective policy frame work.⁹

CONCLUSION

Bio medical waste management is more of human attitudinal issue than technological. Hence, it is important that training programmes give equal importance to address issues of attitudinal change across all categories of health care personnel for sustenance of sound and safe Bio medical waste management practices. Segregation at source of generation being the heart of waste management processes needs to be strengthened by regular monitoring With amended BMW rule of 2016 in place, it is imperative that all the personnel involved in waste management need to be re-trained in this regard.

The evaluation was conducted post training and baseline information on Bio medical waste management systems before training was not available for comparison.

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