



Medical Waste Management: A Case Study on Rajshahi City Corporation in Bangladesh

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Abstract: The management of medical waste (MW) is of great importance due to its impact on human health and environment. The present practices of improper management of generated medical wastes in different Healthcare Establishment (HCEs) in Rajshahi City Corporation (RCC) is playing a contributing role to create vulnerable condition in spreading out the Diarrhea, Hepatitis and various skin related diseases. The objectives of the study are to identify different types of wastes, its generation rate and assess the existing waste management in various HCEs. The study was carried out in 14 different HCEs that generated much portion of MW of total generated MW in RCC. The methodology of this project was descriptive and consisted of the use of field survey and interviews with the relevant authorities and personnel involved in the management of MW. It was found that the surveyed HCEs generate a total of 1495 kg/day of MW; of which about 1328.6 kg/day (88.87%) are non-infectious and about 166.4 kg/day (11.13%) are infectious. The average waste generation rate for surveyed HCEs is 1.54 kg/bed/day or 0.30 kg/patient/day. It was found from the survey that there is no proper and systematic management of medical wastes. The study reveals that lack of awareness; financial support and willingness are responsible for improper management of MW. So the RCC and HCEs authorities should adopt appropriate policy regarding this issue and provide training program on relevant personnel who are engaged in medical waste management.

Keywords: Healthcare Establishment, Management, Medical waste, Rajshahi City Corporation

Introduction

Medical wastes are infectious and hazardous. It poses serious threats to environmental health and requires specific treatment and management prior to its final disposal (Hossain *et al*, 2008). Medical wastes are arising from diagnosis monitoring and preventive, curative or palliative activities in the field of the veterinary and human medicine (BAN & HCWH, 1999). The recent developments in healthcare units are precisely made for the prevention and protection of community health. Uses of sophisticated instruments are increasing various operations for diseases treatment. Such improvement and advances in scientific knowledge has resulted in per capita per patient generation of wastes in healthcare units (Radha *et al*, 2009). The safe disposal of Medical waste has been ignored in Bangladesh. Medical waste is a source of contamination and pollution to both humans and the environment. Medical waste is capable of causing diseases and illnesses to people, either through direct contact or indirectly by contaminating soil, groundwater, surface water and air (PRISM Bangladesh, 2005). Wind from these dumps can also carry pathogens and hazardous materials. Where domestic animals are allowed to graze in open dumps, there is a risk of reintroducing pathogenic microorganisms into human body through food chain. Medical waste therefore, poses a risk to individuals, communities, and the environment if not carefully handled (Akter *et al*, 2005).

As Rajshahi is one of metropolitan cities in Bangladesh, it is expanding very rapidly. The present population of Rajshahi City Corporation (RCC) is about 0.75 million. Due to fulfill the healthcare

demand of huge population, healthcare establishments (HCEs) are growing rapidly. By this way, amount of medical wastes are increasing day by day. The duty of the conservancy division of RCC is to dispose of and manage waste including the medical wastes. The amount of medical waste collected by the RCC is 2-2.5 ton/day (according to RCC conservancy division). Usually the hazardous medical waste collected daily is disposed off in the Rajshahi Medical College Hospital (RMCH) incinerator. Non-hazardous wastes generated in different HCEs are temporary stored either containers or heap up at the side of premises and finally disposed of in Nowdapara Bhagar (disposal site) for dumping carried by RCC fixed vehicle. The principal objective of the study was to estimate the amount and types of MW produces in HCE's of RCC and also study the type of management system used for these MW.

Methodology

Study area

There are about 0.75 million people live in the RCC area of 97 square km. A total of 53 health care establishments are in the city according to RCC deliberation, 2007. They have no present report about the number of HCEs existing here. Most of the hospitals, clinics and diagnostic centers are situated at laxmipur area in Rajshahi city. Fourteen HCEs of different types which were public hospitals, private hospitals, clinics and diagnostic centers were surveyed. The surveyed HCEs were Rajshahi Medical College and Hospital (RMCH), Islamic Bank Medical College and Hospital (IBMCH), Islamic Bank Hospital (IBH), Zamzam Islamic Hospital (ZZH), Mukti Clinic (MC), Dalphin Clinic (DC), Mahanagar

Clinic (MHC), New Ibna sina Hospital (NISH), Podma Clinic, Popular Diagnostic Centre (PODC), Plasma Diagnostic Centre (PLDC), Al-baraka Islamia Diagnostic Centre (ADC), Seba Diagnostic Centre (SDC), City Diagnostic Centre (CDC) that are mostly biggest and popular in RCC.

Definition and Classification

Medical waste is defined as waste generated during the diagnosis, testing, treatment, research or production of biological products for humans or animals. Medical waste includes syringes, live vaccines, laboratory samples, body parts, bodily fluids and waste, sharp needles, cultures and lancets according to Pasupathi *et al* (2011). Various authors introduce different ways for classifying medical wastes. These are based on medical waste state (solid and liquid), character, source and effects. Medical wastes are classified into four different categories based on their sources and potential hazards (Aker, 1998). These are

a) **Clinical waste:** this includes body fluid, drainage bags, blood collection tubes, vials, culture dishes, other types of broken/unbroken glassware that were in contact with infection agents, gauges, bandages or any other materials that were in contact with infectious agents or blood, pathological waste including organs, body parts, tissues.

b) **Laboratory waste:** This includes chemical used in the pathological laboratory, microbial cultures and clinical specimens, slide, culture dish, needle, syringes, as well as radioactive waste such as Iodine-125, iodine-131 etc.

c) **Non-clinical waste:** this includes wrapping paper, office paper, and plastic that has not been in contact with patient body fluid.

d) **Kitchen waste:** this includes food waste, wash and waste water. It is a potential source of pests and vermin, such as cockroach, mice and rats and is thus an indirect potential hazard to the staff and patients in a hospital.

Generally, In HCEs, two types of wastes are generated: non-hazardous or non-infectious and hazardous or infectious. The first group contains the domestic wastes in terms of paper, kitchen wastes, food wastes and other form of hospital services, the second group includes wastes, which are produced in laboratories, operation room, consulting and various hospital units. According to Pasupathi *et al* (2011), approximately 75-90% of medical waste is non-hazardous and as harmless as any other municipal waste. The remaining 10-25% is hazardous and can be injurious to humans or animals and deleterious to environment.

Data collection planning

The methodology is very important of any project to bring about the detail work schedule in summary. A lot of formal and informal approaches were adopted in order to collect data. Before entering into hospitals or clinics, the study group was trying to get permission of concerned authority of each hospital, clinics, and diagnostic centers. The MW of different HCE's firstly segregated according their types and then weighted. During data collection phase in RMCH, we spent lot of time with ward master, lab-technicians, nurses and cleaners for building a report.

Data analysis

Analysis of data was done sincerely. The amount of different types of wastes generated at surveyed HCEs on different days of six months were collected and verified it whether it was true or not. Then it was represented in tabular form. Then waste generation rate in different HCEs were calculated in term of Kg/day, Kg/bed/day and Kg/patient/day by mathematical approach. In addition, a number of statistical graphs in terms of pie diagram, bar chart, etc, were used to clearly focus the situation with the help of MS Excel.

Results

No of respondents on questionnaire survey



Figure 1: No of respondents according to profession

Inventory of HCEs

It was found that RMCH offer medical facilities for 530 residential patients and 2050 out- patients with pathology, surgery, radiology, therapeutics, microbiology and gynecology etc. per day. IBMCH, the largest private clinic in Rajshahi city, provides health-care facilities for 250 residential patients and 500 out-going patients. Other private clinics provide facilities for 15-50 residential patients and 25-300 out-going patients. Diagnostic centres have no residential patients. The surveyed diagnostic centres provide health-care facilities for 200-300 patients daily.

Sources and Quantification

Medical wastes are produced by various activities. Different units within a hospitals and clinics such as Medical ward, Operation theatres and surgical ward,

Health-care units, Laboratories and Pharmaceutical and Chemical stores would generate different wastes.

Table 1. Amount of wastes with types generated in all surveyed HCEs

Type of Wastes	Amount of waste (kg)										
	RMCH	IBMCH	IBH	MC	MHC	ZZH	DPC	NISH	PC	DC	Total
Sharp instruments	14	10	4	2.5	2.5	1.5	1	1.5	1	8.3	46.3
Vial-ampoules	15	9	2	2	2.5	5	1.5	2	1.5	-	40.5
Cottons, bandages	30	13	2	2	1	5	1.5	2.5	3	0.9	60.9
Saline bags	30	18	10	6	3	5	1.5	2.5	2	-	78
Bodyparts (liquid, solid)	10	6	2	1	1	2.5	1	1	1.5	2.2	28.2
General wastes (Food waste, Medicine box, papers)	680	290	45	40	17	30	17	15	15	0.5	1149.5
Blood and Urine Bags	10	7	2	2.5	1	5	1.5	1.5	0.5	-	31
Other (Chemical waste, plastic bottles and tissue papers)	25	11	4	5	3	5	1	2	1.5	3.1	60.6
Total	814	364	71	61	31	59	26	28	26	15	1495

The amount of waste generated in hospitals depends upon various factors such as the number of beds, types of health services provided, economic, social and cultural status of the patients and the general condition of the area where the hospital is situated (Askarian et al, 2004). It was observed that the surveyed HCEs generated pathological wastes, sharp instruments (e.g. needles, syringes, and broken glassware instruments), saline and urine bags, cotton-bandages, papers, food wastes etc (Table 1).

All the surveyed HCEs generated totally 1495 kg/day of wastes, of which 166.4 kg/day are infectious wastes and 1328.6 kg/day are non-infectious wastes. In table-1, sharp instruments, cotton-bandage, body parts, blood or urine bags comprises Infectious wastes where Vial-ampoules, saline bags, general wastes (Food waste, paper, medicine box), others (liquid drags, tissue paper, solid drugs) comprises non-infectious wastes. Results reveal that the average waste generation rate for all the surveyed HCEs on the basis of beds available is 1.54 kg/bed/day (Table 2).

Table 2. Waste generation rates in surveyed HCEs

HCE types	Patients		Total Patients	Waste generation rate		
	Beds	Out patients		Kg/day	Kg/Bed/day	Kg/patient/day
RMCH	530	2070	2600	814	1.54	0.31
IBMCH	250	500	750	364	1.46	0.49
IBH	50	300	350	71	1.42	0.20
MC	25	150	175	61	2.44	0.35
MHC	20	40	60	31	1.55	0.52
ZZH	30	250	280	59	1.97	0.21
DPC	25	30	55	26	1.04	0.47
DC	-	685	685	15	-	0.02
NISH	20	40	60	28	1.40	0.47
PC	20	25	45	26	1.30	0.58
Total	970	4090	5060	1495	1.54	0.30

Discussion

Medical Waste Management: A Recent Scenario

a) Segregation: The key to minimization and effective management of health-care waste is segregation and identification of waste. Appropriate handling, treatment and disposal of waste by type reduce costs and do much to protect public health. It was observed that there were no segregation systems for infectious and non-infectious wastes at the site of production almost in all the HCEs. There was little systematic collection in the surveyed HCEs. RMCH, the biggest hospital in RCC keeps the hazardous

wastes such as syringes, gauges, cotton, blades, knives and infectious substances in red and yellow colored containers and non-hazardous wastes such as saline bags, plastic bottles, paper, kitchen garbage etc in the green and black colored containers. Liquid substances such as Liquid drags, X-ray water and kitchen garbage were kept in Polythene bags. On the contrary, it was observed in most of the times that cleaners were not conscious about the separation of the wastes according to the containers and they have the tendency to cast away the wastes into the containers as their willing. Moreover at the time of dumping, they were found to mix hazardous waste with non-hazardous waste. The waste management

systems in other surveyed HCEs were very poor except IBMCH and IBH. Though the waste management system of IBMCH and IBH were not superior, they were better than other surveyed HCEs. IBMCH, the second biggest hospital in RCC and IBH, most popular clinic in Rajshahi City produced huge amount of medical wastes but segregation according to WHO guideline were little followed. They provide different size buckets at almost every corner of the wards, cabins, OTs, administrative units and the appointed cleaners take those full-filled baskets to the containers which have been labeled with different colors for segregating waste according to hazardous and non-hazardous wastes. But they are always found to mishandle these wastes. Moreover, when they dump the waste at specific storage site, frequently they mix hazardous waste with non-hazardous waste due to lack of consciousness.

b) Temporary storage: The place/storage area where medical wastes were kept before transporting to the incinerator or final disposing site was termed as temporary waste storage. Most of the surveyed HCEs in surveyed keep their wastes in different type of containers or buckets located in the corner of the hospital yard. Then all the wastes generated were

finally intermingled in the large storage container/bin. In some HCEs, the infectious and non-infectious wastes were kept in separate containers and were not mixed together in the Hospital’s own bin. It was also found that there were few HCEs which heap up their wastes at the corner of their premises. Mukti Clinic heaps up their wastes at the corner of their building which was very unhygienic and spread bad odor to environment.

c) Off-site transportation: Medical waste should normally be collected everyday due to its hazardous nature. The RCC has the responsibility for off-site transport of the waste for final disposal or dumping. RCC authorities provide a van for collecting wastes from different HCEs. Every early morning, they collect wastes from HCEs and these collected wastes were transported to either the incinerator which is located at RMCH premises or Nowdapara Bhagar for dumping. A fixed amount of charge is paid to RCC authorities by HCEs for off-site transportation. In this survey, it was found that the charges of different HCEs varies according to waste generation of the HCEs.

Table 3. Charge to be paid by HCEs to RCC

HCEs	RMCH	IBMCH	IBH	MC	MHC	ZZH	DPC	NISH	PC	DC
Charges(TK)	Free	1500	1500	1500	800	800	800	800	800	500

d) Incineration: The wastes which were considered as hazardous or infectious were managed by incineration process. There was only one incinerator in RCC which is situated at the RMCH premises. The hazardous waste generated in RMCH as well as other HCEs in RCC are treated in this incinerator. The incinerator was established in 1998 with a cost of TK. 10 hundred thousand. The incinerator which has a capacity of 18 cubic meter/ hour was formally inaugurated on June 5, 2001. Every morning the

wastes are combusted into it. It has two opening; one is in front of it and the other is at the behind which is at the top of the first one.

A stair is provided beside the incinerator for entering wastes into it through behind opening. The ashes produced by the combustion of wastes were taken out by the first opening. Then the ashes were carried out with other types of non-hazardous wastes to final disposal site.



Fig.1. Incinerator in RMCH premises



Fig.2. Dumped wastes at Nawdapara Bhagar

e) Final disposal: The final disposing site in RCC was situated at Nawdapara which was locally called “Nawdapara Bhagar”. Medical wastes were collected everyday by RCC van due to its hazardous nature. Every early morning, the collected wastes are finally dumped by RCC registered cleaners to this “Bhagar”. It was found from the survey that there was no consideration of distinguishing infectious waste with non-infectious waste when dumping. So, it may cause pollution to the environment as well as health hazard to people.

f) Segregation of waste for recycles: It has been found a different situation during this field survey. It was investigated that refused medical wastes have been segregated in terms of sharp instruments, saline and blood bags, plastic material, and tubes and so on from the wastes. Some people were responsible in collecting, segregating and selling these wastes either for resale or reuse. They collect these either from HCEs bins or final disposal site. In contrast it is found during our field survey that there was no authorities from RCC who investigate what have been done with the recyclable wastes. Thus awareness towards this

issue could be effective until formulating new laws to protect people and environment.

g) Disposal of liquid substances: It was found from the field survey that all the HCEs discharged their liquid pharmaceutical and chemical waste into the general sewers or drains in Rajshahi City because none of them have any proper liquid waste management facilities. Liquid waste was mainly generated from patients’ service units, operation and surgical units, laboratories and kitchen.

Effect of Medical Waste

Due to lack of awareness of collecting, handling, processing and disposing of medical waste, several health and environmental risks cause a great extent. Also there is a risk of injuries related to medical waste handling and carrying by waste haulers and cleaners. For example cut injuries, punctured wound, laceration, strain and sprain of the joint of limbs and backache are common due to load hauling. Akter *et al* (1998) showed few examples of different pathogen and disease caused by them.

Table 4 Pathogens present in infectious wastes and Diseases caused by them

Bacterial	Tetanus, gangrene and other wound infection, anthrax, cholera, other diarrhea diseases, enteric fever, shigellosis, plague etc.
Viral	Various hepatitis, poliomyelitis, HIV-infectious, HBV, TB, STD rabies etc.
Parasitic	Ameobiasis, girdiasis, ascariasis, ankylostomiasis, echinococcosis, malaria, leishmaniasis, filariasis etc.
Fungal infection	Various fungal infections like candidiasis, cryptococcoses, coccidiomycosis etc.

Apart from health issue, environmental impact associated with the improper disposal of medical waste has taken also. These are-1) Pollutants from medical waste (heavy metals) are persistent in environment. 2) Ground water contamination, decrease in water quantity. 3) Bio-accumulation in organism’s fat tissues and biomagnified through the food chain. 4) Repeated and indiscriminate application of chemicals over a long period of time has serious adverse effect on soil microbial population reducing the rate of decomposition and generally lowering the soil fertility. 5) Windblown dusts from indiscriminately dumping also have the potential to carry hazardous particulates. 6) Public nuisance (e.g. odor, scenic views, block the Walkway, aspheric etc). 7) Plastics bags, plastic containers, if not properly destroyed may contaminate the soil and also reduce the chance for water percolation into the soil during precipitation. 8) Open air burning does not guarantee proper incineration and releases toxic fumes (dioxin) into the atmosphere from the burning of plastics.

Awareness and training

Awareness is very important to improve the present status of medical waste management in RCC area. For doing so, personnel associated with HCEs such as Doctors, nurses, cleaners etc. even general people should come forward regarding this issue. Proper and systematic waste management rely on appropriate training on it which increases level of awareness. But it was found that Most of the HCEs provided a few training on concerning authorities about medical waste management. Some hospitals and clinics provide training for the staff and in some nurses regarding sanitization. On the contrary surveyed diagnostics centers did not provide any type of training to their appointees. It was investigated from field survey that almost all the respondents from all the surveyed HCEs focused their opinion in favor of training concerning to the waste management. Some respondents urged on practical training rather than the traditional theoretical training for proper waste management. As cleaners (Sweepers, Ayas) are directly involved contacts with collecting, handling, processing and disposing of medical wastes, RCC or HCEs authorities should pay priority to provide

practical training on them. RMCH, the biggest HCEs in RCC has 100% trained cleaner who were directly involved in medical waste management. Other HCEs have also some trained clearers. Moreover, lack of willingness of cleaners and personnel associated with medical waste management was also responsible for disappointing conditions.

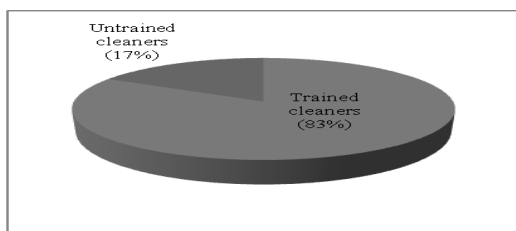


Fig.3. Present situation of HCEs cleaners of RCC

Conclusion

This study was carried out to assess medical waste management practices in different HCEs of Rajshahi City Corporation, Rajshahi. It identified waste generation rate, segregation procedure and waste disposal options of different surveyed HCEs. It was investigated from our field survey that the HCEs authorities also have lack of willing to collect generation data of medical wastes and proper management of those. So it was very difficult to manage appropriate information about waste generation and management. In the field survey, it was tried to collect information about different types of waste generated in Hospitals, clinics and diagnostics centers premises. The survey was conducted on 14 HCEs in RCC and numbers of respondents especially ward masters of different HCEs who helped us to get relevant information and data about medical wastes and its management techniques. The collected field data showed that all surveyed HCEs generated about 1.495 ton/day (1495 kg/day) of wastes of which only about 166.1 kg/day were infectious wastes and 1328.6 kg/day were non-infectious wastes. The average waste generation rate for the surveyed HCEs was 1.55 kg/bed/day. The RMCH alone generate more than half (54.45%) of the total wastes generated in surveyed HCEs. The RMCH itself generate about 814 kg/day of total waste of which 64 kg/day (4.28%) was infectious wastes and 750 kg/day (52.17%) was non-infectious wastes. It was found from field survey that some cleaners were engaged to mishandle the generated wastes. They did not segregate infectious wastes from non-infectious wastes. Most of the wastes were taken by RCC van for dumping at Nowdapara dumping site and rest of it were burnt by incinerator. The level of awareness on medical waste was high, but they were not able to manage the wastes systematically since there were lacking of systems, willingness, rules and regulation

and financial support. Therefore, it becomes imperative for the RCC authorities and HCEs personnel to adopt sound medical waste management policy according to the guidelines of World Health Organization (WHO) to avoid the enormous future cost of abating medical waste related problems.

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