

Management of Hospital Solid Wastes: A study in Pokhara Sub-Metropolitan City

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Abstract

Introduction: Hospital waste can be defined as the total waste stream that is generated from health care establishments. Health care wastes usually consist of sharps, human or animal tissues or body parts, their body fluids and other infectious materials produced during the course of treatment.

Methods: For the purpose of the study, population was defined in terms of the medical hospital, having inpatient facilities located within Pokhara Sub-Metropolitan City (PSMC). The total numbers of health care institutions (HCIs), having inpatient facilities, were 14 and all were sampled for the study. Questionnaires were prepared to meet the objectives of the study.

Results: Various categories of health care waste have been generated in the health care institutions of PSMC which depend on size of individual health care facility, types of medical specialties practiced, and nature of HCIs. Waste generated from health care activities have been categorized as general or non-hazardous waste, and hazardous waste and are separately segregated into 4 different categories, like general waste, infectious wastes, sharps, and saline bottles.

Conclusion: Most health care institutions in Pokhara Sub-Metropolitan City depend upon the municipality services for the disposal of health care waste materials collected. The municipality disposed the waste without any segregation and treatment in the sanitary land fill site treating them as a municipal solid waste. There is no separate mechanism for the proper treatment of medical wastes. There should be integrated waste management system and centralized waste management system managed by the municipality under health care waste management act to solve the gravity of problems. If it is not improved the problem of serious environmental health problem will arise in future thus an appropriate management of hospital solid waste should be undertaken.

Key words: hospital waste, health care institution, waste management

Introduction

Environment and development are the two sides of the same coin; yet, the impact of development on environment is very nominal if their dimension is same. A good environment is necessary for healthy living. Contrary to this fact, people are facing various problems

regarding health, environment, and sanitation due to poor management of health care waste. The major portion of waste generated in health care activities consists of general waste that can be treated in the same way as domestic or municipal waste; therefore not all of health care wastes are harmful or hazardous. This remains true only when proper segregation and separation of

waste is practiced according to the type at the source. Health care waste can be a source for transmission of infectious diseases like AIDS, Hepatitis B, Hepatitis C, Tetanus, Diarrhea, Tuberculosis, Cholera, and serious environmental problems in terms of air, water and soil pollution, whenever handled improperly.

Methods

Purposive sampling and case study with descriptive technique was adopted as research design for this research study. For the purpose of the study, population was defined in terms of the medical hospital, having inpatient facilities located within Pokhara Sub-Metropolitan City. The total number of health care institutions (HCIs), having inpatient facilities, were 14. Out of 14 HCIs, all were sampled for the study because of their various specialties in nature and types. Out of 14 HCIs, having inpatient facilities, one community hospital, one government hospital, one NGO run hospital, one INGO run hospital, one nursing home, eight private hospitals and one teaching hospital were surveyed for the study and this study is to reveal the present practices of hospital solid waste management in inpatient health care institutions in Pokhara Sub-Metropolitan City to the concerned authorities and stakeholders.

Questionnaire Survey

During the study, 14 healthcare institutions were visited. Also the waste disposal area within each health care institution and Sanitary Landfill Site at Bachebuduwa, Pokhara-18, were visited. Pokhara Sub-Municipality Office was visited to know the current situation of health care waste management as well as municipal solid waste management practices. The personnel in the administrative section of the health care institutions were contacted for the basic information. House keeping officer, senior nurse and senior waste collector/handler in each institution were contacted as a key respondent for detailed information. In addition to that, to get reliable data as far as possible, inspection and informal talks with relevant persons were conducted. Structured questionnaires were used for conducting in-depth interviews and to record information provided by key respondents. The study was conducted after verbal discussion and getting approval as of ethical clearance from sampled health care institutions in Pokhara Sub-Metropolitan City. Also, informed consent was obtained from all the respondents of sampled health care institutions. A total of 42 key informants were

involved in providing the information. The total number of respondents and their type in questionnaire survey has been given in Table 1.

Table 1. Profile of Questionnaire Survey with Respondents

S.N.	Type of Respondents	Interviewed No. (N = 42)	Percentage (%)
1	House Keeping Officer	14	33.33
2	Senior Nurse	14	33.33
3	Senior Waste Collector/ Handler	14	33.33
Total		42	100

Data Analysis

After taking observation and extracting required data and information, the collected information was edited, coded, and entered into a computer. With the help of the computer; required tables, graphs, charts were prepared, and were made ready for analysis and presentation in tabular and diagrammatic form. Basically, the percentages, projection analysis, simple average, and scenario analysis were used as analysis tools.

Results

Various categories of health care waste have been generated in the health care institutions of Pokhara Sub-Metropolitan City (PSMC); which depend on size of individual health care facility, types of medical specialties practiced, and nature of HCIs. Waste generated from health care activities has been categorized as general or non-hazardous waste, and hazardous waste. For the waste analysis purpose, 14 health care institutions, having inpatient facilities, with varying number of bed capacities were selected because of its various specialties in nature and types. The waste generated per day by each HCI under study was classified, and separately segregated into 4 different categories, like general waste, infectious wastes, sharps, and saline bottles. The general waste includes paper, plastic, packaging material, cardboard, metal containers, floor sweeping, laundries, food scrap and kitchen waste, which have no risk to human health. The infectious wastes, which carry the potential to cause hazards to health and life of human beings that, transmit of viral, fungal, bacterial or parasitic diseases to human beings. These include laboratory waste, waste from

surgery, cotton, gauge, soiled bandage, cotton used for dressing, blood bags, human tissue, body parts, disposable surgical gloves, and any other soiled materials that have been used during treatment. The sharps include whether infected or not infected needles, syringes, lancets, scalpels, blades, broken glass, glass slides, cover slips, infusion sets, saws, knives, and items that can puncture human skin and cause infection. The saline bottles include empty bottles generated during the process of medical treatment. The segregated waste samples were weighed, and the values (in wet weight) were recorded as below table 2.

Table 2: Waste Generation by HCIs under Study in PSMC

S.N.	Name of HCIs	Bed Occupied (N0.)	Waste Generation in kg./day				Total (Kg. per day)	Waste Gene. Kg./ bed/day
			General	Infectious	Sharps	Saline Bottle		
1	Abihiyan	11	12	5	0.5	2	19.5	1.77
2	Budda	3	1.75	0.5	0.1	0.5	2.85	0.95
3	Charak	8	7.3	2.9	0.4	2.6	13.2	1.65
4	Fewa City	25	26.7	10.1	1	11.2	49	1.96
5	Fishtail	20	20	7	0.75	8	35.75	1.79
6	Green Pasture	73	17.7	4.25	0.3	1.75	24	0.33
7	Himalayan Eye	33	12.5	4	0.4	6.6	23.5	0.71
8	Manipal	245	209.75	48.25	6	15	279	1.14
9	Model	6	3.75	1.75	0.1	0.8	6.4	1.07
10	Padam	30	16.75	6.75	0.5	3.5	27.5	0.92
11	Pokhara	8	4.75	1.75	0.2	1.25	7.95	0.99
12	Pokhara Om	16	9.5	2.75	0.35	1.5	14.1	0.88
13	Shree Ram	3	1.6	0.6	0.04	0.4	2.64	0.88
14	Western Regional	294	233.75	86.25	6.75	18.25	345	1.17
Total		775	577.8	181.85	17.39	73.35	850.39	-
Waste Generation (Kg./ bed/day)		-	0.74	0.23	0.022	0.095	1.09	-

Generalization of Waste Composition in PSMC

The generalization of waste composition was carried out in 14 inpatient health care institutions of PSMC. The total waste generated in PSMC was generalized, based on the waste types, and its quantity of generation. The composition of healthcare waste in PSMC is given in table 3.

Table 3: Composition of Health Care Waste in PSMC

Types of Waste	Waste Generation (kg/day)	Percentage (%)
General	577.8	68
Infectious	181.85	21
Sharps	17.39	2
Saline Bottles	73.35	9
Total	850.39	100

Current Practices of Health Care Waste Management

Waste Segregation

Proper segregation of waste is essential so as to have an effective management of health care waste. Waste segregation reduces the cost for treatment and disposal of hazardous waste, and also protects public health and environment. If health care waste is segregated properly in each HCI of PSMC, then more than 77% of the wastes are potentially non-infectious, which can be treated in the same way as the municipal waste. Thus, segregation of hazardous waste from the total waste stream should be carried out at the point of generation. The current health care waste segregation practices were not effective in almost all HCIs due to lack of standardized color-coding system. The colored plastic buckets as well as metal containers were used

for the purpose of segregation and collection of general wastes, infectious wastes and sharps. Most of the HCIs were using their own color-coding system and no strict color-coding system with uniformity was followed. Segregation practices of different types of health care waste within HCIs are presented in table 4.

Table 4: Segregation Practices of Health Care Waste within HCIs

Categories of Waste	No. of HCIs	(%)
Sharps, general & infectious	2	14.3
Sharps, organic, general & infectious	5	35.7
Sharps, organic & general, infectious	3	21.4
Sharps, hazardous, inorganic, organic	4	28.6
Total	14	100

The waste segregation practice within HCIs was found to be unsatisfactory and did not confirm to common practices with uniformity. Out of 14 HCIs, 14.3% separated their waste only into two categories as sharps, and general & infectious; 35.7% separated their waste only into three categories as sharps, organic, general & infectious; 21.4% separated their waste only into three categories with combination as sharps, organic &

general, and infectious; 28.6% separated their waste into only four categories as sharps, hazardous, inorganic, and organic waste. This scenario stated that only 50% of the surveyed HCIs were practicing proper waste segregation system at the point of generation without mixing general waste with hazardous waste, where as the rest were practicing improper waste segregation practices, mixing general and hazardous waste and making the entire waste stream hazardous.

Waste Collection

Collection of health care waste is a process which is done after effective segregation of waste at the point of generation. Codification is a color-coded system, which defines the containers in which waste must be collected without confusion to the generators of health care waste once segregated. During waste collection, it is also equally important to ensure that the waste collection bins or containers have been covered and labeled properly; as uncovered collection can be a potential source for transmission of diseases through flies and other vectors. The colored plastic buckets as well as metal containers were used for the purpose of segregation and collection of general, infectious wastes, and sharps in most of HCIs of PSMC. Waste collection practice with covered and labeled waste containers in HCIs is given in Table 5.

Table 5: Waste Collection Practice with Covered and Labeled Waste Containers in HCIs

Categories of Waste	Covered Practice						Labeling Practice					
	Yes		No		Total		Yes		No		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Non Infectious	8	57.1	6	42.86	14	100	7	50	7	50	14	100
Infectious	7	50	7	50	14	100	7	50	7	50	14	100
Sharps	13	92.9	1	7.14	14	100	10	71.43	4	28.6	14	100

It was observed that only 57.14%, 50% and 92.86% of the HCIs used receptacles with proper covers for non-infectious, infectious, and sharps waste respectively. The study also revealed that 50%, 50%, and 71.43% of the HCIs were practicing receptacles with labeling for non-infectious, infectious, and sharps waste respectively. Among the surveyed HCIs, 14.3% were removed daily, 57.1% were removed twice a day, and 28.6% were removed thrice a day by a waste collection containers from each ward, department, and other location. Health care waste was mixed during collection and storage in some of the HCIs though it was segregated properly. The reason behind such mixing of waste is due to lack of awareness about the changing pattern of waste, and negligence of waste handlers.

Waste Treatment

The health care waste treatment system in HCIs of PSMC was found very unsystematic and unscientific which cannot guarantee that there is no risk to environment and public health, as well as safety for personnel involved in health care waste treatment. Waste treatment technologies used in HCIs is given in table 6.

Table 6: Waste Treatment Technologies used in HCIs

Treatment Technologies	Waste Treatment				Total	
	Yes		No			
	No.	%	No.	%	No.	%
Shredding	1	7.14	13	92.86	14	100
Encapsulation	—	—	14	100	14	100
Chemical Disinfection	13	92.86	1	7.14	14	100
Microwave	—	—	14	100	14	100
Autoclave	14	100	—	—	14	100
Incineration	8	57.14	6	42.86	14	100
Hydroclave	1	7.14	13	92.86	14	100
Burial	7	50	7	50	14	100

Out of the HCIs surveyed, only 7.14%, 92.86%, 100%, 57.14%, 7.14%, and 50% of them were practicing shredding, chemical disinfection, autoclaving, incineration, hydroclave, and burial waste treatment technologies respectively and no single institution was practicing encapsulation and microwave technologies. Autoclave, hydroclave, and chemical disinfection were used in the treatment of infected reusable instruments. The existing installed incinerators were of simple type (single chamber, drum), and also these were not functioning properly as per required standard. These simple incinerators were used for treatment of infectious waste, expired drugs or unused pharmaceuticals, and syringes with needle, and only one institution called Manipal Teaching Hospital was using modern pyrolysis incinerator. The use of placenta pits was observed in only one Western Regional Hospital and the rest lacked it. Different treatment technologies were used by different HCIs for different categories of health care waste. Organic waste was buried for composting in Manipal Teaching Hospital and Himalayan Eye Hospital, where as open burnt in Western Regional Hospital. In Green Pasture Hospital, it was found that the organic waste was used as pig and buffalo feed. Inorganic and infectious wastes were incinerated or transported by municipal lorry for final disposal in most of the HCIs. Sharps were incinerated or buried in most of the HCIs whereas; some few HCIs relied on municipal services. Human anatomical waste was burnt in some HCIs and buried in others. All HCIs returned expired pharmaceuticals to the suppliers; but Green Pasture Hospital was found to incinerate it. Ashes from incinerator were buried in Manipal Teaching Hospital; whereas most of the HCIs relied on municipal services. It was dumped openly

in Western Regional Hospital. The hazardous waste was not sterilized or treated prior to burial, disposal or incineration. Most of the incinerators were found overloaded during incineration, located near residential area and their chimney height was very low without any concern about environmental pollution in most of the HCIs.

Waste Disposal

A haphazard waste disposal practices was observed during the survey. The health care wastes were disposed either by the HCIs themselves or by the municipality. Both of them were not practicing effective and safe disposal method, as it was found that the waste was simply buried or openly dumped. Municipal support for disposal of waste in HCIs is given in table 7.

Table 7: Municipal Support for Disposal of Waste in HCIs

Municipality Support	No. of HCIs	%
Support Given	10	71.43
Support Not Given	4	28.57
Total	14	100

Among the surveyed HCIs, 28.57% of HCIs were found disposing their health care waste by themselves independently without any support from the municipality and remaining 71.43% of HCIs relied on municipality services for disposal in addition to burning and burying in their institution premises, however municipal authorities does not overlook such malpractices that often meet the eyes. Some HCIs disposed their waste in suction pit, dumped of waste in un-supervised areas, and

non engineered burial method while the municipality disposed the waste without any segregation and treatment in the sanitary landfill site treating it as a municipal solid waste. This could cause severe health hazard to the public and also could lead to an outbreak of communicable diseases. Those HCIs getting municipal support for disposal were paying certain unauthorized amount to waste collectors of the municipality ranging from Rs.50 to 2000 per month without any record in the municipality. The waste collectors of municipality were getting Rs.10300 per month in total from HCIs; however municipal authorities were found to ignore such malpractices that often meet the eyes. At present, there is no appropriate municipal landfill site for effective treatment and disposal of hazardous wastes. This fact shows that Pokhara municipality was not taking any managerial responsibility for the disposal of health care waste.

Discussion

The quantity of hospital wastes generated (in kg/bed/day) in general hospital is about 4.5 in USA, 2.7 in Netherlands, 2.5 in United Kingdom, and 2.5 in France. However, it is in the range of 2.63-3.8 kg/bed/day in Latin American countries, like Chile, Brazil, Argentina, Venezuela.¹ According to WHO, high-income countries generate up to 6 kg of hazardous waste per person per year, and in the majority of low-income countries, the total health care waste per person per year is from 0.5 to 3 kg.² The national ratio of production of infectious medical waste in kg/bed/day of USA is 1.2, of Japan is 0.8, of Singapore is 0.4, of India is 0.2, of Bangladesh is 0.1, of Pakistan is 0.1, and of Sri Lanka is 0.1.³ The percentage of hazardous waste in Denmark is 5% and in USA is 28%. According to source size in high-income countries, health care waste generation in university hospital has high daily waste generation of 4.1-8.7 kg/bed than general hospital of 2.1-4.2 kg/bed, general hospital in turn has high daily waste generation than district hospital of 0.5-1.8 kg /bed and least in primary health care centers of 0.05-0.2 kg /bed.⁴ In middle and low income countries health care waste generation is usually lower than in high income countries. The reports and figures available from developed countries indicate a range from 1-5 kg/bed/day with substantial inter country and inter specialty differences. Data from developing countries indicate that the figures are lower as 1-2 kg/day/patient. The amount and types of health care waste generation also differ from region to region. The daily waste generation in kg/bed is 7-10 in North

America, 3-6 in Western Europe, 3 in Latin America, 2.5-4 in Eastern Asia of high-income countries where as 1.8-2.2 of middle-income countries, 1.4-2 in Eastern Europe and 1.3-3 in Eastern Mediterranean.⁴

A survey done in Bangalore revealed that the quantity of solid wastes generated in hospitals and nursing homes generally varies from 0.5 to 4 kg per bed per day in government hospital, 0.5 to 2 kg per bed per day in private hospitals, and 0.5 to 1 kg per bed per day in nursing homes. The total quantity of hospital wastes generated in Bangalore is about 40 tones per day. Out of this total wastes, nearly 45-50 percent is infectious. Segregation of infectious wastes from non-infectious wastes is done only in about 30 percent of hospitals.⁵

There are different estimates regarding the physical composition of hazardous and non-hazardous constituents of health care waste. The study done by (Pruss et.al., 1999)⁴ estimated that between 75% and 90% of the waste produced by health care facilities is non-risk or general waste, comparable to domestic waste. The remaining only 10-25% of the total health care waste produced is regarded as hazardous in nature and may create a various very higher risk for health as well environmental pollution. WHO policy paper (2004) reported that from the total waste generated by health care activities, 15% to 25% is infectious waste among which sharps waste is 1%, body part waste is 1%, chemical or pharmaceutical waste is 3%, and radioactive and cytotoxic waste or broken thermometers is less than 1% (WHO, 2004a).⁶ WHO (2004) stated that from the total waste generated by health care activities, 80% is non-infectious waste or general waste and the balance is considered as hazardous, as it tends to be 15% of pathological waste and infectious waste, 1% of sharps waste, 3% of chemical or pharmaceutical waste and less than 1% of pressurized cylinders, broken thermometers (WHO, 2004b).⁷

The indicated variation in the amount and type of waste generation may be due to presence or absence of waste management policy, level of economic development, size of individual health care facilities, types of medical specialties practiced, living habits and standards, availability of services in the HCIs, and the ways in which health care wastes are categorized in different countries. Hospitals with surgical services and maternity services produce more health care waste where as hospitals with eye and dental services produce less amount of health care waste. Waste generation also depends on numerous factors such as geographical

location, established waste management plan and policy, type of health care establishment, proportion of reusable items employed in health care facilities or HCIs and proportion of patients treated on a day care basis.⁸

G.D. Hinshaw et al. recommended that hazardous medical waste can be incinerated safely and there is no risk of releasing toxic substances.⁹ P.S. Philips et al. mentioned in their article that there should be national waste strategy that emphasizes the key role of waste minimization and encourage hospitals, industries and public to move towards sustainable waste management practice for economic and environmental reasons.¹⁰

WHO policy paper (2004) stated that, in 2000, injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (32% of all new infections), 2 million hepatitis C virus (HCV) infections (40% of all new infections), and 260,000 HIV infections (5% of all new infections) worldwide.⁶ Epidemiological studies indicate that a person who experience one needle-stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% respectively to become infected with HBV, HCV and HIV. In developing countries, additional health and environmental hazards occur from scavenging on health care waste storage and disposal sites and manual sorting of the health care waste recuperated at the back door of health care institutions. These eye meet practices are common in most parts of the developing world. In 2002, the results of a WHO assessment conducted in 22 developing countries showed that the proportion of health care facilities that do not use proper waste disposal methods ranges from 18% to 64%.

Conclusion

There is no proper and scientific health care waste management system due to lack of awareness, accountability from actors in health care waste management, and well elaborated control mechanisms presently reigning in almost all the HCIs in the PSMC. The present handling and disposal practices of hospital solid waste does not guarantee that the health care wastes do not mix up with general municipal waste, and possess no risk to environment and public health. Health care waste generated from the HCIs should be properly handled and disposed to avoid the hazards on health and environment. From this review, it can be concluded that the government, local authorities, and concerned institutions do not have any policies,

legislation & technical guidelines to guide and regulate hospital solid waste management. In future, there should be integrated waste management system and centralized waste management system managed by the municipality by providing code of practice for the handling and disposal of waste material within HCIs with uniform standards and policies under health care waste management act, which needs to be differently implemented to solve the gravity of problems.

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