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Medical Waste Management
A Survey in Kathmandu Valley

Draft Report

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Program Team Members

1. Introduction

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1.1 Background

Hazardous medical waste management is an important aspect of solid waste management. Hospital waste should be treated separately from general waste and should be given due priority over all other forms of waste. Kathmandu, which is the capital of the country, has the highest number of healthcare institutions and is a destination for most of the patients throughout the country to cure illnesses. Due to the availability of healthcare centers with modern facilities, people prefer to come to the capital for treatment.

Over the last decade there has been a steady increase in the number of healthcare institutions in the Valley. With the number of hospital beds increasing there has been a significant rise in the amount of waste generated from healthcare institutions. So far there is no separate mechanism for the treatment of medical waste. Both the medical waste and the general household waste are being treated together as municipal waste. On the government level too, so far no policies, rules and regulation have been developed for the separate treatment of such kind of waste.

Realizing the urgency of managing Kathmandu's medical waste in an environmentally sound manner, the Kathmandu Valley Mapping Program (KVMP) of Kathmandu Metropolitan City (KMC) is in the process of establishing a separate system for managing medical waste. This study has been conducted by ENPHO to document the existing situation of waste management in Kathmandu.

1.2 Medical waste and its impacts

Medical waste refers to any liquid or solid waste generated in the diagnostic, treatment or immunization of human beings or animals; in medical research or in production of vaccines or other substances produced by living organisms. These 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. Medical waste as such should be treated separately because of its potentiality of causing infection. It has been estimated that out of the total hospital waste produced only 20 to 40% waste produced is hazardous in nature. Most of the infectious medical wastes here in Kathmandu are disposed haphazardly, some healthcare facilities dump waste into the municipal containers, whereas some burn openly, bury or either dispose along the river banks. Such mismanagement of infectious medical waste can cause a major public and occupational health hazard, resulting in the spread of infectious diseases like HIV/AIDS and Hepatitis B. The most vulnerable group to such infectious diseases can be medical care workers, other workers and scavengers involved in waste management.

Various types of disease and injuries can occur due to the exposure to hazardous healthcare waste. Healthcare waste may be hazardous if it exhibits the following characteristics:



- It contains infectious agents
- It is genotoxic
- It contains toxic or hazardous chemicals or pharmaceuticals
- It is radioactive
- It contains sharps

All individuals exposed to hazardous healthcare waste are potentially at risk, including those within healthcare establishments that generate hazardous waste, and those outside these sources who either handle such waste or are exposed to it as a consequence of careless management.

The main groups who are at risk are individuals like medical practitioners like doctors, nurses, and healthcare auxiliaries. Similarly the patients in healthcare establishments, the visitors attending healthcare establishments and the workers in support allied to healthcare establishments are also equally at risk.

In Nepal, the most vulnerable group prone to accidents due to sharp injuries and infection from hazardous medical waste are the people that are in direct contact with hazardous waste. These include waste handlers and the scavengers involved in the scrap business. Infectious waste may contain a number of pathogens and these pathogens can enter the human body through various routes like puncture, abrasion, or cut in the skin, by inhalation, by ingestion in the skin or through the mucous membranes.

1.3 Medical waste and its management in Kathmandu

A few studies on medical waste management have been carried out in the past by various organizations like GTZ in 1987, DWSS/WHO in 1995, IIDS in 1997 and by KMC in 1999. GTZ published two reports, the first report produced in 1987 gives information on medical waste management practices of the healthcare institution and the second report produced in 1988 giving details on the technical and economical aspects on medical waste management.

In Kathmandu, it has been estimated that 20 to 40% of the total waste produced is hazardous in nature. A latest study by KMC indicated that there are approximately 3516 hospital beds in the Kathmandu Valley. With an average of 0.31 kg/person/day of infectious waste generation and a 70% occupancy rate, the amount of infectious medical waste produced by the health care institutions is calculated to be about 763 kg/day.

All previous studies have indicated that Kathmandu's medical waste is not managed in a proper manner. A few institutions like Teaching Hospital, Patan Hospital have provision of incinerators for the combustion of medical waste they produce but unfortunately even these are not in proper functioning conditions. (Some hospitals such as Patan Hospital, are separating their waste and using locally made kilns to burn infectious waste.) Most healthcare institutions dump the waste in municipal containers in public places such as roads.

1.4 Study Objective

The main objectives of this survey are as follows:

1. To survey the quantity and the characteristics of the medical waste generated in Kathmandu.
2. To document the existing practices of medical waste management
3. To survey the willingness to pay for a centralized medical waste management system among the healthcare institutions and analyze the suitable mode of payment.

1.5 Methodology

- *Literature Review*

The following literature on medical waste management in Kathmandu were reviewed:

- Regmi G.C, D.N. Regmi and K. Grimm, 1987: "Collection Treatment and Disposal of Hospital Waste, Phase I Data Collection", Solid Waste Management Project, GTZ.
- Shrestha, R., 1997: "Health and Environmental Impact of Hospital Waste (A Case Study of Kathmandu Valley)", Institute for Integrated Development Studies, Kathmandu.
- SOGEA, 1997, Kathmandu Hazardous Hospital Waste Management Proposal.
- KMC, 1998: "Medical Waste in Kathmandu," Kathmandu Metropolitan City

Of these, the GTZ report was found to be most useful as it was the most comprehensive study on Kathmandu's medical waste done so far.

- *Questionnaire Survey/Field Visit*

A total of 45 healthcare institutions were surveyed using a questionnaire and interview with key hospital officials. Each of these institutions were visited by a team of environmental scientists to verify the data obtained through the questionnaire. The director or the administrative officer of the medical institution was contacted for the basic information. For detailed information about waste management practices, house keeping in-charge and/or matron was contacted, where possible. In addition to the questionnaire, inspection and informal talks with the administrators, housekeeping in-charge and all the relevant persons was also conducted to get reliable data as far as possible. The surveyed institutions included 13 government hospitals, 23 private healthcare institutions, 8 clinics and pathological labs and 1 drug manufacturing company. The survey included all major hospitals and as many healthcare institutions as possible.

- *Waste Analysis*

A team conducted detail analysis of waste from five health care institutions to determine the waste generation rate and waste characteristics. In Patan Hospital, Kathmandu Model Hospital, B&B Hospital and Medicare National Hospital and Research Centre, waste was

separated at source and analysed. Waste from each of the hospital was analysed twice. In the case of Bir Hospital, as it was not possible to separate the waste at source, all the waste generated in a 24 hour period was collected and then sorted and analysed.



Photo1: Weighing at Patan Hospital



Photo2: Waste segregation of Bir Hospital

1.6 Scope and limitations

This study only examines medical waste and its management in Kathmandu Valley. Although the study has made an effort to compile up-to-date and accurate information so that it can be a basis for establishing a medical waste management system in Kathmandu, it does have a few limitations. The main limitations are as follows:

1. Only a limited number of small scale healthcare facilities like clinics and labs were surveyed.
2. There is no accurate data on the total number of health care institutions and the number of hospital beds.
3. Some basic data like the weight or volume of waste generated and occupancy rate couldn't be obtained accurately because of lack of proper documentation system in most institutions.
4. Only five healthcare institutions were sampled for the purpose of waste characterization

5. Liquid waste, which is disposed through the sewerage system have not been considered.

1.7 Waste categories and terms used

Various terms are used in medical waste management. Some of the most common terms and their definitions as given by WHO (1999) are listed below.

Bio-medical waste: Any waste that is generated during diagnosis, treatment and immunization of human beings or animals or in research activities pertaining hitherto or in the production of testing of biological.

Hospital waste: All waste coming out of hospitals of which around 80% are actually non-hazardous, around 15% are infectious wastes and around 5% are non-infectious but hazardous wastes.

Clinical waste: Any waste coming out of medical care provided in hospitals or other medical care establishments.

Pathological waste: This includes human tissues, organs and body parts and body fluids that are removed during surgery or autopsy or other medical procedures and specimens of body fluids and their containers.

Infectious waste: All kinds of waste, which may transmit viral, fungal, bacterial or parasitic diseases to human beings. In addition to medical wastes, it includes infectious animal wastes from laboratories, slaughterhouses, veterinary practices and so on.

Sharps: Sharps are items that could cause cuts or puncture wounds, including needles, hypodermic needles, scalpel and other blades, knives, infusion sets, saws, broken glass and nails. Whether or not they are infected such item are usually considered as highly hazardous healthcare waste.

Pharmaceutical Waste: Pharmaceutical waste includes expired, unused, spilt, contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of appropriately. The category also includes discarded items used in the handling of pharmaceutical, such as bottles or boxes with residues, gloves, masks, connecting tubing and drug vials.

Genotoxic Waste: Genotoxic waste is highly hazardous and may have mutagenic, teratogenic or carcinogenic properties. It raises serious safety problems both inside and outside hospitals and should be given special attention. Genotoxic waste can include vomit, urine or faeces from patients treated with cytostatic drugs, chemicals and radioactive material.

Chemical Waste: Chemical waste consists of discarded solid, liquid and gaseous chemicals, for example from diagnostic and experimental work and from cleaning and housekeeping and disinfecting procedures. Chemical waste from healthcare can be

hazardous or non-hazardous in the context of protecting health. It is considered to be hazardous if it is toxic, corrosive (eg. Acids of pH less than 2 and bases of pH greater than 12), flammable, reactive, genotoxic (eg. cytostatic drugs).

Radioactive Waste: Radioactive waste includes solid, liquid and gaseous materials contaminated with radionuclides. It is produced as a result of procedures such as *in-vitro* analysis of body tissue and fluid, *in-vivo* organ imaging and tumor localization and various investigative and therapeutic practices. These types of waste however are not often generated by healthcare institutions in Kathmandu.

medical waste management A survey in Kathmandu Valley

2. Healthcare Institutions

2.1 Healthcare Institutions in Kathmandu

→ Kathmandu Valley mapping Program (KVMP)
→ Kathmandu Metropolitan city (kmc)

The figure on the total number of hospital and hospital beds in Kathmandu has been obtained from the survey conducted for this study and the data provided by the Department of Health Services (DHS). According to information provided by DHS, there are 62 health care institutions in Kathmandu Valley which have a capacity of 2807 hospital beds. However there are discrepancies in this data as this figure has not been accurately updated and it does not include hospitals which do not come under the Ministry of Health. For example according to the DHS data, HM hospital has 100 beds. However the ENPHO survey indicates that the hospital has only 40 beds, of which currently only 30 are being used. An updated list of hospitals and their bed capacity is provided in Table 2.1. This list does not include daycare centers and small institutions with no beds.

According to ENPHO survey there are approximately 61 healthcare institutions in the Kathmandu Valley. All together, these health care institutions have a capacity of 3905 hospital beds. Of these, 3541 hospital beds are located in Kathmandu City. Most of the bed numbers of healthcare institutions have been updated during the survey. However some figures have been left as per DHS records as they could not be contacted. The healthcare institutions comprise of government hospitals, private hospitals and nursing homes. This figure does not include small clinics with no beds. Although there are many such clinics and health centres in Kathmandu, it was not possible to obtain a list of these small clinics. The total population of Kathmandu Valley is 14,48,886 as per the Annual Health Report, Ministry of Health (MoH) 2056/57. Therefore it is observed that hospital bed and population ratio in Kathmandu Valley is at 1: 371.

Table 2.1 Healthcare institutions in the Kathmandu Valley

SN	Names of Healthcare Institutions	No. of beds
	<i>Private Hospitals and Nursing Homes</i>	
1	Baba Nursing Home, Lazimpat	18
2	Binayak Maternity Home, Chabahil	15
3	City Hospital & Research Centre PLt., Trip	50
4	Clinical Home P.Ltd., Kalankisthan	15
5	Dr. Iwamura Memorial Hos.& R.Centre, Bhaktapur	51
6	HM Hospital & Research Centre P.Ltd., Maharajung	40
7	Kathmandu Nursing Home, Tripureshwor	20
8	Manokamana Nursing Home, Kathmandu	8
9	Menlaha Nursing Home, Kathmandu	15
10	National Dental Hospital, Lazimpat	6
11	Oriental Nursing Home, Bouddha	15

12	Paravin Baidya Nursing Home, Lalitpur	10
13	Patan Nursing Home, Lagankhel	15
14	Sai Nursing Home, Kamalpokhari	20
15	Shree Nursing Home Pvt.Ltd., Putalisadak	14
16	Shrestha Nursing Home Research Centre, Lalitpur	10
17	Sitapaila Nursing Home, Kathmandu	25
18	Dans Care Nursing Home, Kupondole	25
19	United Nursing Home, Jawalakhel	14
20	Laxmi Nursing Home, Sanepa	10
21	Medicare Nepal P.Lt., Putalisadak	10
22	Pran Nursing Home P.Ltd., Tripureshwor	15
23	Annapurna Nursing Home, Bagbazar	16
24	Valley Maternity Nursing Home, Putalisadak	28
25	Hargans Nursing Home, Jawalakhel	12
26	Blue Cross Nursing Home, Tripureshwor	15
27	Sarvanga Swasthya Sadan, Kupondole	25
28	Norvic Nursing Home, Thapathali	25
29	Everest Nursing Home, Baneshwor	16
30	Ishan Baal Nursing Home, Maharajgunj	25
31	B & B Hospital, Satdobato	100
32	Om Hospital, Bagbazar	50
33	Siddhartha Apollo Hospital, Putalisadak	3
34	Kathmandu Medical College, Dallu	150
35	Kathmandu Model Hospital, Bagbazar	50
36	Himalaya Hospital, Gyaneshwor	35
37	Nepal Medical College, Jorpati	375
38	Lifecare Hospital, Bagdurbar, Kathmandu	15
39	Til Ganga Hospital, Gaushala	0
40	Medicare National Hospital, Naxal	58
41	HAMS, Tripureshwor	20
42	Shahid Gangalal National Heart Care Center, Bansbari	9
43	Ne-koria Hospital Private Ltd., Chandol	50
44	Nepal Hyata Medical Centre P.Lt., Satdobato	0
45	Nepal Shrawan Shakti Pratisthan, Kathmandu	24
46	Siddismriti Mahila & Child Hospital, Bhaktapur	20
47	Gjaimar Hospital P.Ltd, Putalisadak	15
	<i>Public Hospitals</i>	
48	Infectious Disease Hospital, Teku	100
49	Nepal Eye Hospital, Tripureshwor	98
50	Bhaktapur Hospital, Bhaktapur	50
51	TB Hospital, Thimi	0
52	Ayurvedic Hospital, Nardevi	100

53	Patan Hospital, Lagankhel	205
54	Mental Hospital, Lagankhel	29
55	Central Veterinary Hospital, Tripureshwor	0
56	Maternity Hospital, Thapathali	310
57	Kanti Bal Hospital, Maharagunj	250
58	Biendra Police Hospital, Maharagunj	150
59	Teaching Hospital, Maharagunj	401
60	Bir Hospital, Mahaboudha	354
61	Army Hospital, Chauni	300

2.2 Healthcare institutions under review

In total, 45 healthcare institutions were surveyed out of which 13 were public hospitals, 23 were private healthcare institutions (including private hospitals and nursing homes), 8 were polyclinics and pathological labs and 1 drug manufacturing company. The survey has included almost all the major hospitals in Kathmandu City and some major hospitals in Bhaktapur and Lalitpur.

Public Hospitals

For the purpose of the study, all the major public hospitals were selected within the Valley. Since most of the public hospitals are run by the government they charge a nominal amount of fee to the patients and the treatment cost are subsidized as compared to privately run institutions. For this reason, large numbers of patients are admitted to public hospitals.

Among the surveyed public hospitals, 6 hospitals are general hospitals with various departments, while 7 are special hospitals. Almost all the public hospitals were considered for the survey because it comprises more than 50% of the total beds that are available in Kathmandu. More than 80% percent of the total beds in these hospitals remain occupied throughout the year. Therefore public hospitals contributes a significant fraction of the total waste generated from healthcare institutions.

Table 2.2a: Public Hospitals surveyed

<i>General Hospitals</i>	<i>Special Hospitals</i>
Bir Hospital	Nepal Eye Hospital
Birendra Police Hospital	Kanti Bal Hospital
Bhaktapur Hospital	TB Hospital
Ayurvedic Hospital	Infectious Disease Hospital
Patan Hospital	Maternity Hospital
Teaching Hospital	Mental Hospital
Central Veterinary Hospital	

Private Healthcare Institutions

Recently, there has been a significant increase in the number of privately run healthcare institutions in Kathmandu. It is generally thought that privately run healthcare institutions are better and more efficient. Among the upper class and the higher middle class, private healthcare facilities have substituted the public hospitals. Since these institutions have gained such popularity among the people of Kathmandu, they have been multiplying in a phenomenal rate since the past few years. Because of its large number in Kathmandu and its gaining popularity, some of the major private healthcare institutions were identified for the survey. The private hospitals and nursing homes have been put under the same category as private healthcare institutions as there is no strict demarcation distinguishing private hospitals from nursing homes. The institutions have been chosen solely on the basis of their popularity.

Table 2.2b: Private Healthcare Institutions

B&B Hospital	Siddhartha Apollo Hospital
Kathmandu Model Hospital	Lifecare Hospital
Til Ganga Eye Hospital	National Dental Hospital
Medicare National Hospital	Saheed Ganga Lal National Heartcare Centre
Om Hospital	Nepal Medical College
Himalayan Hospital	Kathmandu Medical College
HM Hospital and Research Centre	HAMS Nursing Home
Annapurna Nursing Home	Ishan Bal Nursing Home
Blue Cross Nursing Home	Kathmandu Dental Nursing Home
Everest Nursing Home	Norvic Nursing Home
Hargan's Nursing Home	Valley Maternity Nursing Home
HM Hospital and Research Centre Pvt. Ltd.	

Pathological Labs and Polyclinics

It was felt necessary to consider polyclinics, pathological labs and pharmaceuticals for the survey because it also generates a considerable amount of medical waste. There are numerous small clinics, pathological labs, and pharmacy shops scattered all around the Valley. Although the waste generated from such institutions is significantly low, the cumulative effect of a large number of such institutions would result into a high amount of waste. Furthermore these institutions do not segregate their waste and hence makes the waste management more tedious. It is therefore necessary that such institutions be considered in this survey. A total of five polyclinics, three pharmaceuticals and pathological labs and one drug manufacturing company were selected randomly.

Table 2.2c: Pathological labs and Polyclinics

<i>Polyclinics</i>	<i>Pharmaceuticals and pathology lab.</i>
Siddi Polyclinic	Sankata Laboratory
Chhetrapati Nisulka Chikitsalaya	Medico Pathological Lab
Alka Polyclinic	Clinical Pathological Lab
Curex Diagonostic Centre	Royal Drugs Ltd.
Anamnagar Polyclinic	

3. Survey Findings

Based on the data obtained from the preliminary survey of various healthcare institutions the following findings have been highlighted.

- current waste management practices
- situational analysis of healthcare facilities
- waste characteristics and
- waste generation rate of various healthcare facilities.

3.1 PUBLIC HOSPITALS AND PRIVATE HEALTHCARE INSTITUTIONS

Waste management practices

3.1.1 Waste collection and segregation

Proper waste handling and segregation are key steps that should be followed carefully for the minimization and effective management of healthcare waste. Since 80 to 85 % of the waste is usually non-hazardous in nature and can be disposed easily along with the municipal solid waste, it is important that hazardous waste component is separated from the general waste. Waste segregation reduces the costs and also protects public health. It is always advisable that waste separation should be carried out at the source.

During waste collection, it is also equally important that the waste collection bins are covered, as uncovered collection can be a potential source for transmission of diseases through flies and other vectors.

The survey indicated that most of the hospital waste in the Kathmandu Valley is collected in plastic bins at the point of generation. Buckets of different sizes are placed in various wards. Most of the healthcare institutions have provided each bed with a bucket for waste disposal. But it was observed that only 58% of the surveyed institution are practicing covered collection.

Public Hospitals like Nepal Eye Hospital, TB Hospital, Ayurvedic Hospital, Patan Hospital, Central Veterinary Hospital and Maternity Hospital practice covered waste collection. Similarly, among the private healthcare institutions surveyed Lifecare Hospital, National Dental Hospital, Siddhartha Apollo Diagnostic Center, Kathmandu Medical College, Medicare National Hospital and Research Center, B & B Hospital, Nepal Medical College, Himalaya Hospital, Annapurna Nursing Home, Everest Nursing Home, Hargan's Nursing Home, Sarvanga Nursing Home, HAMS Nursing Home, Ishan Bal Nursing Home, Kathmandu Dental Nursing Home and Norvic Nursing Home have covered bins. Om hospital has covered bins in OT only. Table 3.1a shows the percentage of covered and

uncovered collection in government and private healthcare institutions. Since 8.6% of the private healthcare institutions have not responded for the particular question, the exact situation cannot be depicted.

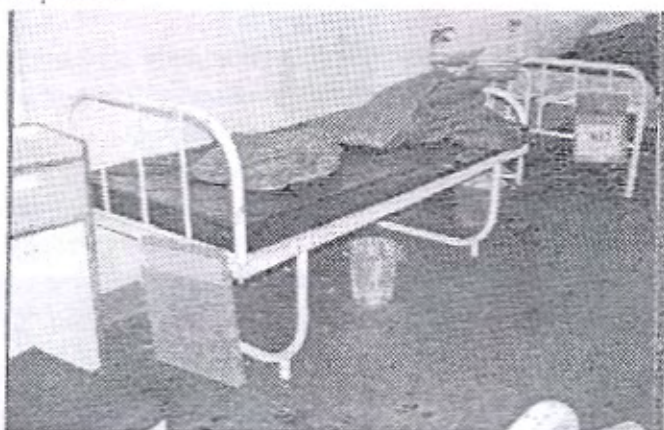


Photo3: Bedside plastic bin

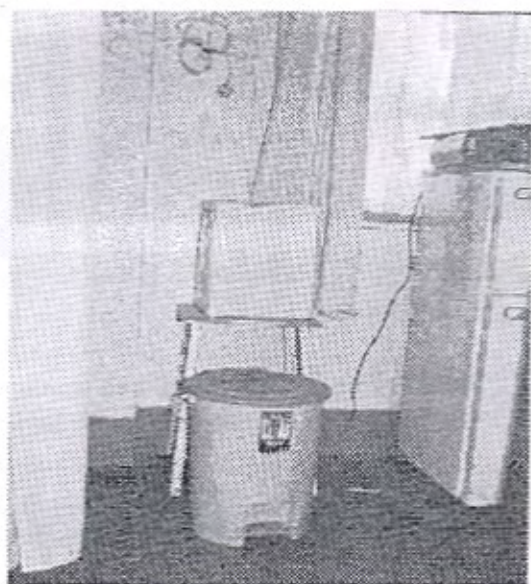


Photo4: Covered bin and container for needles

Table 3.1a: Covered and uncovered collection

Mode of collection	Values in percentage		
	Government Hospital	Private Healthcare Institutions	Average
Covered bins	46	65	55.5
Uncovered bins	54	26	40
Not known	0	9	4.5

The main danger related with mixed collection of waste is the risk of infection to the healthcare workers and other waste handlers including the scavengers. To avoid the

contamination of general waste, medical waste should be separated basically into three categories: infectious, non-infectious and sharps. The three terms have been defined under Section 1.7.

Segregation practice has not been followed strictly by most healthcare institutions. It is observed that on average, 28% separate only sharps, 19.44% separate sharps, infectious and non-infectious, 8.33% separate the waste as infectious and non-infectious, there being no separate collection of sharps and 44.44% do not segregate waste at all. As waste separation is critical in reducing the amount of hazardous waste, source separation of waste into at least three categories viz. infectious, non-infectious and sharps should be a priority.

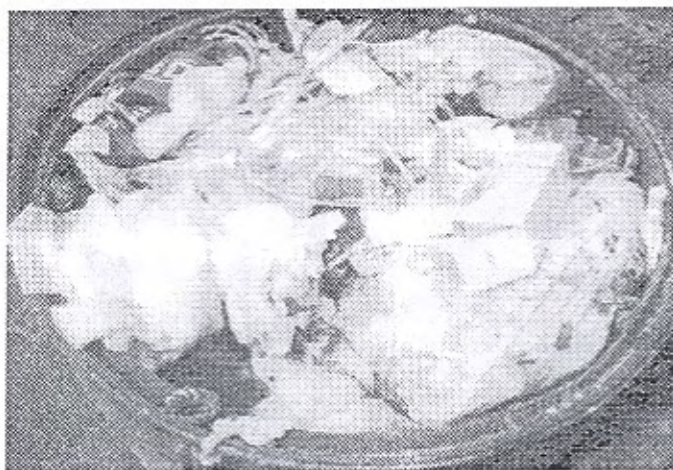


Photo5: Mixed collection of waste at Sarvanga Nursing Home

The overall scenario depicts that the private healthcare institutions are relatively more efficient in waste segregation as compared to the government hospitals. More than 50% of the government institutions do not practice waste segregation. This can be explained on the basis several reasons, the main cause why government hospitals do not practice such waste handling technique is due to poor management, lack of hospital policies, lack of awareness and the large influx of patient in government hospitals due to minimum treatment charges.

Table3.1b: Segregation of waste by healthcare institutions

Institutions	In %			
	Sharps	Sharps/Infectious/non-infectious	Infectious/non-infectious	No separation
Public Hospitals	15	23	8	54
Private Healthcare Institutions	35	17	9	39

Public Hospitals

In the government hospitals with the exception of Patan Hospital, Teaching Hospital, and Maternity Hospital, no other hospital has satisfactory segregation practices. 54% of the public hospitals surveyed do not segregate waste at all. This includes Infectious Disease

Hospital, Nepal Eye Hospital, Bhaktapur Hospital, Ayurvedic Hospital, Central Veterinary Hospital, Birendra Police Hospital and Bir Hospital.

15% of them viz. Mental Hospital and Kanti Bal Hospital separate only sharps and 8% which is TB Hospital segregate waste into infectious and non-infectious. The hospitals that follow proper segregation practices are Patan Hospital, Maternity Hospital and Teaching Hospital accounting for 23% of the total.

In Patan Hospital a good system of waste collection and segregation was observed. The hospital has a color coding system where different categories of waste are collected in buckets or containers of different colors. Each bed in the hospital is provided with a plastic bucket. It has a soiled utility section in each floor where four containers or bins are placed. Red bins are used for collecting infectious waste (clinical waste), blue ones for general waste, greens for sharps and a special container is used for collection of needles.

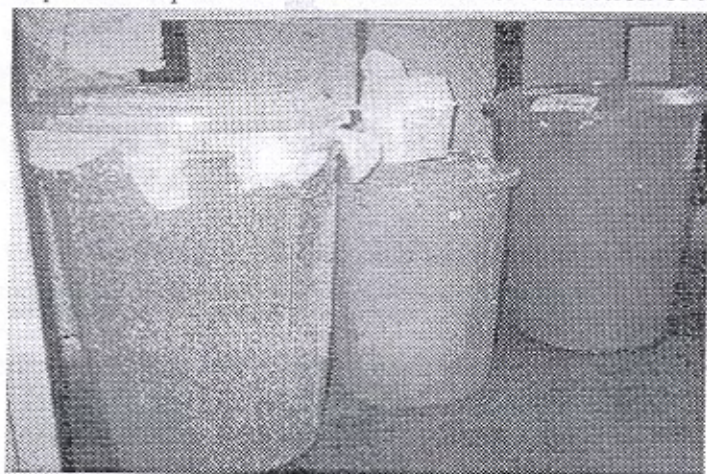


Photo6: Colour coding at Patan Hospital

Teaching Hospital has the provision of waste segregation but practically it has not been strictly practiced. However it uses separate containers for collection of dressings, needles and syringes, body parts and placenta. Saline bottles are disposed along with the infectious waste. In the past, saline bottles were separated from other wastes and sold to scrap dealer. But now the bottles are not separated mainly because of the withdrawal of scrap dealers from the saline bottle business, due to the heavy scrap tax imposed by the DDCs at Thankot.

Private Healthcare Institutions

Out of the 23 surveyed private healthcare institutions, 39% do not segregate the waste at all. Healthcare institutions like Lifecare, B&B, Norvic Nursing Home and Kathmandu Model segregate waste into sharps, infectious and non-infectious waste. Color-coded buckets are used in B&B and National Dental hospital for waste collection. Sharps are collected in separate buckets either at bedsides or in the nursing stations.

National Dental Hospital, Siddhartha Apollo Diagnostic Center, Nepal Medical College, Valley Maternity Nursing Home, HM Hospital and Research Centre, Himalayan Hospital,

Til Ganga Hospital separate only sharps from the total waste. Medicare Hospital, Annapurna Nursing Home segregates wastes into infectious and non-infectious. Kathmandu Model, Saheed Ganga Lal and Om Hospital do not segregate waste at all. No information could be obtained from Ishan Bal Nursing Home.

Though the staff of Norvic claims to use color-coded plastic bins in each nursing station for the segregation and collection of the wastes, wastes like infected cotton from dressings were spotted in dustbins on bedside normally meant for non-infectious waste. Therefore the data provided by the informants can be contradictory to what is actually being practiced. This is true for all the healthcare institutions surveyed.

3.1.2 Storage

Medical waste may need to be stored on site until a large and adequate quantity is accumulated to warrant treatment at the facility or until collection for transport to an offsite treatment facility is scheduled. The shortage of staff or malfunctioning of the treatment system may necessitate storage of waste. Similarly intermediate storage facilities are also required where offsite treatment facility is quite far. The storage facility should be well protected from the reach of outside vendors.

None of the healthcare institutions surveyed in Kathmandu have proper storage facilities. Those establishments that rely partially or fully upon the municipality services for the waste disposal usually store waste in containers provided by the municipality. The storage period may range from a day to as long as 15 days. There are no separate rooms for storage but are kept in the hospital/nursing home premises, usually at the backyard, openly before the municipality finally picks them up. Those healthcare institutions which manage their own waste collect the waste, temporarily store at the premises and either dispose it into the container or burn or dispose it in a pit.

3.1.3 Disposal practices

A mixed set of waste disposal system was observed during the survey. Most of the hospitals and nursing homes rely on Municipal services and the roadside Municipal containers for their ultimate waste disposal in addition to burning and /or burying in their institution premises.

Among the surveyed healthcare institutions, 6 manage their waste independently without any help from the Municipality comprising of 3 public hospitals and 3 private institutions. Names of these institutions are:

- i. *Public Hospitals*: Bhaktapur Hospital, TB Hospital and Central Veterinary Hospital
- ii. *Private Healthcare Institutions*: B&B Hospital, Sarvanga Swastha Sadan and Tiganga Eye Hospital

Other 15 institutions apart from either burning and/or burying their waste either dump the waste in the roadside containers or take the municipality service. There are 4 public hospitals and 11 private institutions under this category. These institutions include:

- i. *Public Hospital*: Patan Hospital, Maternity Hospital, Kanti Bal Hospital and Teaching Hospital
- ii. *Private Healthcare Institutions*: Lifecare Hospital, Kathmandu Medical College, Medicare Hospital and Research Centre, Nepal Medical College, Shaheed Gangalal National Heartcare Centre, Himalay Hospital, Kathmandu Model Hospital, Om Hospital, HM Hospital and Research Centre, Norvic Nursing Home and Annapurna Nursing Home

Patan Hospital is an example of a hospital which manages infectious waste and sharps by itself and gives the non-hazardous waste to the municipality. It disposes food waste into the container provided by the Lalitpur Sub-Municipal Corporation, which is collected twice a week for a certain charge per trip. Needles are incinerated in the incinerator and clinical waste, which include pathological and infectious waste is burnt in the locally made kiln.

Similarly, Teaching Hospital disposes general waste into the container provided by the Kathmandu Municipality. The container is collected every alternate day for a certain amount of money per trip.

The rest of the 15 healthcare institutions are entirely dependent upon the municipality for the disposal of their waste. There are 6 public hospitals and 9 private healthcare institutions under this category. These healthcare institutions are either provided with containers that are collected by the concerned municipality or simply dump the waste in the roadside containers that are picked by the Municipality. While most of these institutions dispose waste without any prior treatment, National Dental Hospital sterilizes and wraps the wastes in plastic bags before final disposal into the municipal containers. In Om Hospital, clothes and bed sheets used by AIDS and Hepatitis B patients are burned openly. The above mentioned 15 healthcare institutions are:

- i. *Public Hospitals*: Infectious Disease Hospital, Nepal Eye Hospital, Ayurvedic Hospital, Mental Hospital, Birendra Police Hospital, Bir Hospital
- ii. *Private Healthcare Institutions*: National Dental Hospital Ltd., Siddhartha Apollo Diagnostic Centre, HAMS Nursing Home, Kathmandu Dental Nursing Home, Blue Cross Nursing Home, Valley Maternity Nursing Home, Ishan Bal Nursing Home, Hargans Nursing Home, Everest Nursing Home

Most of the private hospitals and nursing homes are located in crowded residential areas in the city. The mismanaged waste disposal practices can not only affect those who are directly involved in waste handling but even those who are living in the vicinity. Those institutions that practice burning do not have a proper burning facility with most of those burning the waste practicing open burning. The harmful fumes resulting from both closed

type of burning and open type can be a big threat to the residents around such healthcare institutions.

Table 3.1c: Disposal practices of various types of institutions surveyed

I Disposal practices of public hospitals

SN	Name of Hospital	Disposal and frequency
1	Ayurvedic Hospital	Collected daily by the waste collection tractor of KMC's ward 18.
2	Bhaktapur Hospital	Dumped 50m away from the hospital, combustible wastes burnt
3	Bir Hospital	All waste is disposed in KMC container, which is collected on alternate days
4	Birendra Police Hospital	Collected by KMC twice a week
5	Central Veterinary Hospital	All waste burnt within hospital premises; expired medicines buried once in 2-3 years
6	Infectious Disease Hospital	Mixed waste is collected once in two weeks by KMC
7	Kanti Bal Hospital	Needles, papers, etc. burnt in a pit; rest given to KMC
8	Maternity Hospital	Placenta dumped into the placenta well; needles and swabs burnt once a week within compound; other waste collected every fourth night by municipality
9	Mental Hospital	Collected daily by municipality tractor
10	Nepal Eye Hospital	KMC collect waste once every fourth night
11	Patan Hospital	Needles burned separately; broken glasses buried in a pit; food waste, plastics & other waste in the container which is collected by the municipality; saline bottles returned to the dealer; other infectious waste incinerated
12	TB Hospital	Hazardous waste autoclaved and incinerated daily; ashes and autoclaved glass slides buried in a pit
13	Teaching Hospital	Wastes from dressings and needles + syringes incinerated daily, pathological waste incinerated once a week; general waste collected by municipality

II Disposal practices of the private healthcare institutions

SN	Name	Waste disposal practice
1	B&B Hospital	Open burning of gauges, cartons, bandages, etc.; pathological waste buried at the bank of Bagmati River, blood directed into separate sewer system that runs up to Gwarko, saline bottles sold; an NGO collects waste 2-3 times a week
2	Himalay Hospital	Syringes, needles, plastic, etc. are incinerated; other waste collected in plastic buckets and disposed into a nearby container
3	Kathmandu Medical College	Incinerate all the combustible materials, food waste dumped into the container
4	Kathmandu Model Hospital	Burn combustible waste, expired medicines, sharps & syringes; store body parts in formalin; for ultimate disposal dressing cotton and other incombustible wastes are wrapped in plastic and dumped in container; bottles sold
5	Lifecare Hospital	Burn gauge, cotton, etc.; plastic bottles, syringes taken by kabari or thrown in container
6	Medicare Hospital and Research Center	Syringes and pathological waste burnt & buried, disposed into KMC container;
7	National Dental Hospital Ltd.	Picked up by KMC daily
8	Nepal Medical College Teaching Hospital	Needles buried, surgical waste incinerated, pathological waste sterilized and dumped in compost pit with other decomposable; waste that are non-degradable & cannot be incinerated dumped in KMC container
9	Om Hospital	Bottles taken for reuse, things like bedclothes used by AIDS and Hepatitis B patients burnt, body parts taken to Aryaghat, rest is collected by KMC daily
10	Shaheed Gangalal National Heartcare Center	Needles and syringes dumped in a pit others dumped in the nearby container
11	Siddhartha Hospital	Separated needles and other waste dumped into container; needles sometimes burn in pit
12	Tilganga Eye Hospital	Food waste taken for pigs
13	HM Hospital & Research Centre	Needles burnt and buried in pit, others given to staff from municipality
14	Annapurna Nursing Home	Syringes autoclaved every week; food waste and glasses taken by sweeper, waste paper burnt/sold
15	Blue Cross Nursing Home	All the waste is collected by sweepers from municipality
16	Everest Nursing Home	All the waste is dumped in a drum placed in front of the nursing home which is collected by the

		municipality
17	HAMS Nursing Home	Not known
18	Hargans Nursing Home	Where the waste is disposed is not known to the administration; pathological waste is packed in plastic bags and kept in baskets which are taken away
19	Ishan Bal Nursing Home	Sharps disposed weekly, others daily (details not known)
20	Kathmandu Dental Nursing Home	Dumped in the container every 2 days
21	Norvic Nursing Home	The general waste is collected daily by KMC, medical waste incinerated
22	Sarvanga Swastha Sadan	WEPCO, a local NGO collects all the waste
23	Valley Maternity Nursing Home	Supposed to be collected by KMC daily but the service is not regular



Photo7: Mixed waste collected in KMC container within the Hospital compound at Bir Hospital

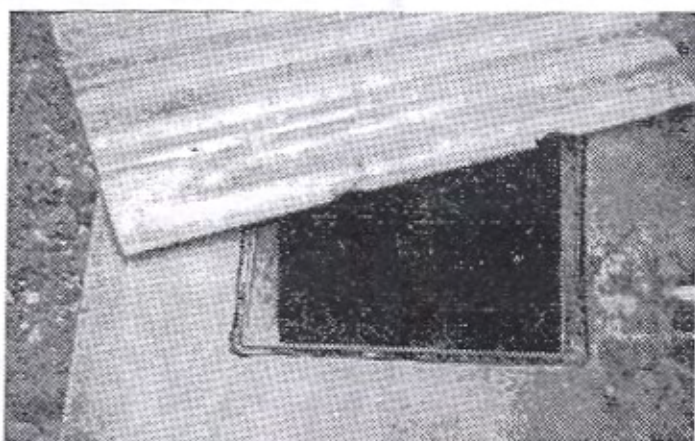


Photo8: Placenta collection in placenta well in Maternity Hospital



Photo9: Open burning at the backyard of Kanti Baal Hospital



Photo10: Backyard collection

3.1.4 Safety measures and awareness

Precaution during medical waste handling is very important since there is a high risk of injuries or punctures by contaminated needles and other broken glasses. Thus, those groups of people involved in waste handling are vulnerable to transmission of infectious diseases like AIDS/HIV, Hepatitis B, etc. Out of the 36 institutions, 56% provide gloves and/or masks to the waste handlers and a few of them even provide boots and/or aprons. In addition to gloves and masks, 19% of the institutions have provision of vaccination against Hepatitis B or other immunization injections. 25 % do not provide any kind of safety measures

Awareness among health workers and others working in the waste management regarding the hazards of mishandling of medical waste is essential for the proper handling and disposal system. Out of the 36 public and private healthcare institutions surveyed, 47% have not conducted any sort of awareness programs, only 42% have provision of training/workshop/meeting and 6% are limited to the hospital waste management system only.

Public hospitals

61.5% of the public hospitals are providing gloves as safeguard measures. Some of the hospitals even have provision of masks and aprons, but waste handlers are found working without any of these due to sheer negligence and ignorance. Some of the waste handlers feel uncomfortable to work wearing them. A comment from the TB Hospital authority is that the mask available in the market is useless as the pore size of the mask is bigger than the size of the bacteria. So they feel that the masks cannot prevent the waste handlers from being infected by the bacteria. Teaching Hospital, Birendra Police Hospital and Patan Hospital have vaccinated their waste management staff against Hepatitis B. Infectious Diseases Hospital has provided the waste handlers with immunization injection

But lack of awareness programs regarding the hazards of medical waste is very conspicuously absent in almost all the hospitals.

Table 3.1d: Preventive measures for waste handlers in public hospitals

SN	Name of Institution	Precautions for waste handlers
1	Ayurvedic Hospital	Gloves and masks
2	Bir Hospital	Gloves, apron, masks
3	Birendra Police Hospital	Gloves, masks, vaccination against Hepatitis B
4	Bhaktapur Hospital	Gloves, masks
5	Central Veterinary Hospital, Tripureshwor	No safe guard measures; feels unnecessary for small volume of waste
6	Infectious Disease Hospital	Gloves, immunization injection
7	Kanti Bal Hospital	Not known
8	Maternity Hospital	Gloves
9	Mental Hospital	No safe guard measures
10	Nepal Eye Hospital	Gloves, masks
11	Patan Hospital	Gloves ,aprons, Hepatitis B vaccine to risk group
12	Teaching Hospital	Masks, gloves, separate set of clothes, Vaccination against Hepatitis B
13	TB Hospital	None, pore size of the local masks bigger than the bacterial size

Private Healthcare Institutions

In 61% of private institutions, waste management staffs are provided with the basic safety facilities like gloves and masks. But these are not being used efficiently. Four private hospitals provide vaccination against Hepatitis B to the waste handling staff apart from providing with gloves and/or masks and other necessary safety measures. These hospitals are B&B, Nepal Medical College, Shaheed Ganga Lal National Heartcare Centre and National Dental Hospital.

With regard to awareness programs for the hospital staff, discussions and meetings regarding the waste management have been conducted in hospitals like B&B, Medicare, Kathmandu Model and National Dental. But in nursing homes like Blue Cross Nursing Home, waste handlers have not even been provided with these basic necessities. None of the nursing homes have vaccinated the waste handlers against Hepatitis B.

Awareness programs like workshops, informal discussions, meetings and formal training on waste management have been conducted in very few nursing homes like Norvic, Ishan Bal and Valley Maternity. HAMS Nursing Home holds workshops for the waste management staff.

Table 3.1e: Preventive measures for waste handlers in private healthcare institutions

SN	Name	Safeguard measures
1	B&B Hospital	Gloves, boots, Vaccine against Hepatitis B
2	Himalay Hospital	No safeguard measures
3	Kathmandu Medical College	No safeguard measures
4	Kathmandu Model Hospital	No safeguard measures
5	Lifecare Hospital	Not known
6	Medicare Hospital and research Center	Gloves, masks
7	National Dental Hospital Ltd.	Vaccine against Hepatitis B, Masks, gloves, separate set of clothes
8	HM Hospital & Research Centre	Apron, gloves
9	Nepal Medical College Teaching Hospital	Gloves, masks, disposable aprons, Hepatitis B vaccine to cleaners, collectors, etc.
10	Om Hospital	No safeguard measures
11	Shaheed Gangalal National Heartcare Center	Gloves, apron, boots, vaccination against Hepatitis B
12	Siddhartha Hospital	Gloves, masks; no vaccination
13	Tilganga Eye Hospital	Gloves, masks
14	Annapurna Nursing Home	Not known
15	Blue Cross Nursing Home	No safeguard measures
16	Everest Nursing Home	Gloves, masks
17	HAMS Nursing Home	Gloves
18	Hargans Nursing Home	Gloves, masks
19	Ishan Bal Nursing Home	Gloves, masks
20	Kathmandu Dental Nursing Home	No safeguard measures
21	Norvic Nursing Home	Not known
22	Sarvanga Swastha Sadan	Gloves, masks
23	Valley Maternity Nursing Home	Gloves, masks

3.1.5 Willingness to pay

It was found that most of the healthcare institutions are willing to adopt a centralized medical waste management system. The healthcare institutions with small bed capacities are interested because on-site treatment is not economical for them due to limited waste generation. In addition there is a lack of space to install on site treatment facilities.

The overall response from the healthcare institutions was positive. From the 36 healthcare institutions surveyed, around 86% are willing to take the service of the System whereas 14% are not willing to pay.

Table 3.1f: Willingness to pay among the healthcare institutions

Institutions	Willing to pay				Not willing to pay
	Per volume	Per bed	Weight	others	
Public Hospitals	1	2	4	4	2
Private Healthcare Institutions	10	1	1	8	3
%	31	8	14	33	14

Public Hospitals

Ayurvedic Hospital prefers to pay for the system depending upon the volume of waste generated. Teaching and Nepal Eye Hospital feel it convenient if the service charges are made per the number of beds. Infectious Disease Hospital, Patan Hospital, Mental Hospital and Maternity Hospital prefer to pay by weight of the waste. Bir Hospital has not shown much interest in the centralized system of waste management. They feel that it would be economically unfeasible for them to take the service as they generate waste in large quantity. The hospital is planning to set up its own incinerator in near future.

Private Healthcare Institutions

Most of the private institutions surveyed are willing to take the service of the centralized system. Lifecare Hospital has not shown willingness to take the services of the centralized system. Administrator of Blue Cross Nursing Home thinks that setting up a waste management system is not a very good idea, as those institutions located far from the system might not be cooperative. Kathmandu Dental Nursing Home claims that they produce very little amount of waste and thus they will not need the service of the System. B&B Hospital, Kathmandu Model Hospital, Om Hospital, Medicare Hospital, Tilganga Eye Hospital, Medicare Hospital, Himalaya Hospital, Norvic Nursing Home, Everest Nursing Home, HM Hospital & Research Centre Pvt. Ltd. and Hargans have shown preference for charges per volume of waste. Nepal Medical College and Shaheed Gangalal National Heartcare Center think that the charges should be according to the transportation and the disposal cost for the waste management. National Dental has opted to charges per bed. Sarvanga Swasthya Sadan and Valley Maternity feel that it would be better if the

charges are made according to the size, number of beds and occupancy rate of the establishments.

3.2 POLYCLINICS, PHARMACEUTICALS AND PATHOLOGICAL LABS

3.2.1 Background

There are numerous small clinics, pathological labs, pharmaceutical manufacturers and pharmacy shops scattered all around the valley which also generate some medical waste. Thus it was felt that these could not be excluded from the preliminary surveys. Although the waste generated by these polyclinics doesn't seem significant, the cumulative effect of the wastes from hundreds of such institutes in the Kathmandu Valley cannot be understated. Furthermore, most of these institutions mostly do not segregate their wastes which make the waste management more tedious.

Five polyclinics, three pharmaceuticals and pathological labs and one pharmaceutical manufacturing company were surveyed for the purpose of this study.

3.2.2 Present system of waste management

It has been observed that in most places, the safety aspects of handling medical waste is ignored. Only sharps are segregated at most places and other infectious wastes such as blood, urine and stool samples, and swabs are kept in a same container within the institute. In some places, even sharps are not separated. Safety measures such as gloves, masks, vaccines, etc. has not been provided to the sweepers and other waste management workers in most of the places.

The storage of waste is generally for a day or night and is kept in the same container, which is collected as general wastes. Most of the wastes are dumped in the common dumping places such as KMC containers or roadside dumps. Some of the institutes burn the hazardous wastes such as needles, syringes and swabs.

Only two of the institutions pay waste management cost to the waste collectors. All others use the facilities of KMC. Most of the institutes dispose their waste daily.

Out of the 8 clinics and labs surveyed, 25% segregate waste into sharps and others, 25% into infectious and others and the rest 50% do not segregate waste. 1 drug manufacturing company surveyed, Royal Drugs Limited does not produce any sort of medical waste.

Those centers that segregate waste into sharps and others are Alka Polyclinic, Siddhi Polyclinic and those that segregate waste into infectious and others are Sankata laboratory and Chetrapati Nishulka Chikitsalaya. Similarly, those that do not segregate waste are

Apollo Medical Hall, Dirgha Jeevan Clinic, Curex Diagnostic Center and Medico Pathological lab.

Waste is normally segregated into hazardous like sharps, blood samples, swabs and other waste. Most of the centers burn part of the waste generated and dispose the rest in municipal containers. Alka Polyclinic separates sharps which is stored in a separate metal container. These collected sharps are burnt at an interval of three days. Other waste is kept in plastic bucket, which is collected by sweepers for a certain charge. Siddhi Polyclinic burns infectious waste (sharps, swabs, blood samples) in a closed drum every 2-3 days. Other waste and the residue of the burnt waste is thrown in a nearby disposal site. Sankata Laboratory sterilizes sharps, blood samples and other infectious waste prior to disposal in the container. Chettrapati Nishulka Chikitsalaya collects sharps in a metal bin which is burnt in a closed drum. Swabs and other wastes are disposed in KMC container. Expired medicines are also combusted. The other wastes are collected in plastic bins. Chettrapati Nishulka Chikitsalaya provides gloves and masks to the sweepers.

The main wastes generated from Royal Drugs Limited is dust and liquid from production process, expired medicines in stock and corrugated boxes and glass bottles. Wastes from production process are drained into their own septic tank. Other wastes are stored in separate rooms. Corrugated boxes and plastics are burnt in a kiln. Expired medicines are either burnt or buried after being approved by a committee. Glass bottles are either sold to scrap dealers or collected by municipality.

4 Waste Analysis

4.1 Characterization

A detailed waste characterization was carried out in five healthcare institutions of Kathmandu Valley. The healthcare institutions were identified on the basis of their bed capacities. In order to make a homogeneous sampling, a total of 5 healthcare institutions with different bed capacity were selected. Kathmandu Model Hospital and Medicare National Hospital with 50 and 58 beds respectively, B&B Hospital with 100 beds, Patan Hospital with over 200 beds and Bir Hospital with 354 beds were selected. Waste samples were collected twice at each institution over a 24hrs period except for one healthcare institution where sample was collected once. The waste handling staffs, the house keeping in charge, the administration were contacted prior to the sampling day and briefed about the characterization procedure. The main objective was to find out the percentage of infectious, non-infectious and sharps from the total waste. Different colored plastic bags were provided to separate waste into the above mentioned categories. After every 24-hour sampling period the samples were weighed.

The saline bottles generated from the healthcare institutions have been taken under a separate category. Since most of the bottles are recycled and reused it has not been included either as infectious nor as non-infectious waste.

Table 4.1a: Healthcare institutions selected for waste characterization

Names of hospital	Bed capacity	Type
Medicare National Hospital	58 beds	Small
Kathmandu Model Hospital	50 beds	Small
B & B Hospital	100 beds	Medium
Patan Hospital	251 beds	Large
Bir Hospital	354	Large

4.1.1 Kathmandu Model Hospital

Situated in Bagbazar, this private hospital has the capacity of 58 beds. It has various wards like maternity ward, surgical ward, general ward, medical ward, operation theater and emergency services. It has the capacity to conduct major and minor operations. The type of patients visiting these institutions varies from simple curable illness to more complex form. It has 105 staff members in its team out of which 35 are waste management staff. This was selected as a small healthcare establishment for the waste characterization. The administration, nursing in charge, waste-handling staff were contacted prior to the sampling day. A 24-hour sampling was done on two days in September. Wastes were

collected from emergency ward, maternity ward, surgical ward, general ward and post-operative ward.

Table 4.1b: Waste generation in Kathmandu Model Hospital

Sample	In % Bed occupancy rate	In kg/day					In kg/person/day	
		Non-infectious	Infectious	Sharps	Saline bottles	Total Waste	Infectious	Total
1 st	84	19.5	6.5	1	24.8	51.8	0.18	1.23
2 nd	58	11.5	17.7	0.5	18.4	48.1	0.63	1.66
Average	71	15.5	12.1	0.75	21.6	50	0.4	1.45

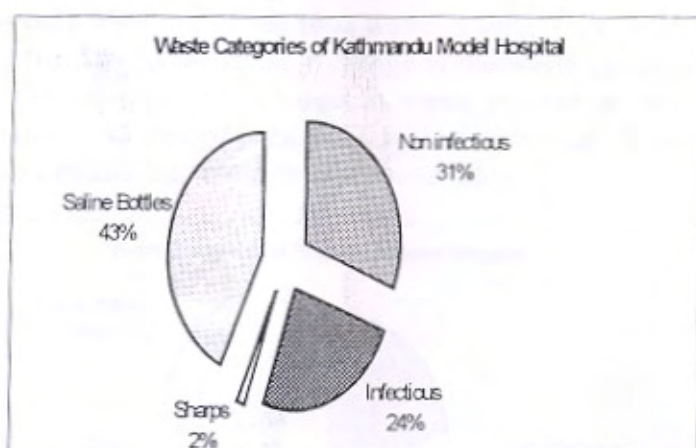


Chart 1: Waste categorization in Kathmandu Model Hospital by Weight

Out of the average waste generated in the days of sampling, 26% of the total waste is infectious in nature. From table 4.1b it can be seen that there is an increase in the total waste generation rate when there is fall in bed occupancy rate from 84 to 58. This change may be due to the fact that there might have been more number of operations during the second sampling or it may be that more number of patients may have been treated for emergency cases. Hence more medical aid may have been used increasing the total waste generation rate.

4.1.2 Medicare National Hospital

This private hospital has a capacity of 58 beds. The hospital consists of various types of wards like medical wards, CCU, pathological lab, Operation Theater, ICU emergency room and other facilities. The hospital consists of 75 staffs with 25 staffs involved in waste management. This hospital was selected as a small healthcare institution for the waste characterization. The average occupancy at the time of sampling was 76%. The hospital administration, chief matron, the house keeping in charge were contacted and briefed in detail about the survey. Plastic bags of different colors were provided on the previous day

of the sampling. Samplings were carried out on a 24hrs basis twice. The waste was collected and weighed, the corresponding figures of waste were noted.

Table 4.1c: Waste generation in Medicare National Hospital

Sample	In %	In kg/day					In kg/person/day	
	Bed occupancy rate	Non-infectious	Infectious	Sharps	Saline bottles	Total waste	Infectious	Total
1 st	47	17.15	2	0.3	8	27.45	0.09	1.02
2 nd	84	31.65	14	0.7	16	62.35	0.3	1.27
Average	65.5	24.4	8	0.5	12	50	0.19	1.15

It is observed that only 19% out of the total waste is infectious. With a significant rise in the bed occupancy from 47 to 84% a clear change in the waste generation rate from 0.09 to 0.3kg/patient/day can be seen. The change in waste generation rate signifies that more patients were admitted and treated during the second sampling. A corresponding increase in all form of waste can also be seen from the above table.

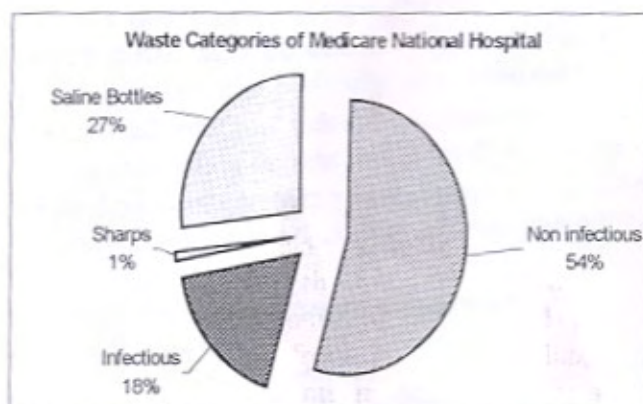


Chart 2: Waste categorization in Medicare National Hospital by Weight

4.1.3 B&B Hospital

This hospital was chosen as a medium capacity hospital with a total of 100 beds. This hospital is mainly renowned for its specialization in Orthopedics and is located in Gwarku, Satdobato. Large number of patient visit this hospital. The hospital has a total of 250 staffs. The occupancy rate during the sampling was recorded as 75%. During the waste characterization waste was collected from pathological lab, lobby, emergency, OPD, general wards, maternity, OT, CCU, Canteen and other areas inside the hospital. Similar procedures were followed prior to the sampling as explained in other institutions. Here,

waste were collected and weighed twice in a day, one in the morning and one in the afternoon depending on their frequency of waste collection.

Table 4.1d: Waste generation in B&B Hospital

Sample	In % Bed occupancy rate	In kg/day					In kg/person/day	
		Non-infectious	Infectious	Sharps	Saline bottles	Total waste	Infectious	Total
1 st	75	132.8	60.4	8.05	35.2	236.45	0.91	3.15
2 nd	75	144.3	55.25	4.7	47.2	251.45	0.80	3.35
Average	75	138.5	57.8	6.37	41.2	243.95	0.85	3.25

The occupancy rate for both the sampling remained constant at 75%. On an average 27% of the total waste was infectious in nature. The infectious waste generated in kg/patient/day shows a remarkable increase as compared to other hospitals. This may have been due to the extensive use of disposable and other use and throw items during the course of treatment. The first sampling shows that more infectious waste was produced as compared to the second sampling, which could also be due to more number of surgeries or emergency patients undergoing treatment on that particular day. However, in the second sample more saline bottles have been used which is therefore contradictory, as more patients may have been treated under emergency cases on that too. Therefore it is hard to define the cause and effect relationship regarding waste generation and patients admitted. A long-term research and sampling is necessary to determine accurate findings in such cases.

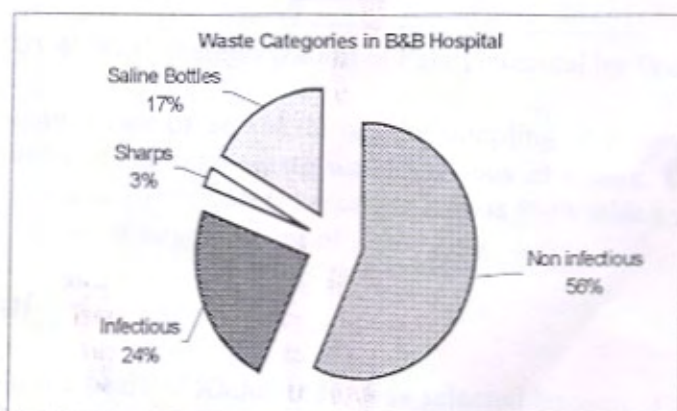


Chart3: Waste categorization in B&B Hospital by Weight

4.1.4 Patan Hospital

This hospital was chosen as a large hospital with a capacity of 251 beds. The hospital is run under the missionary program and has a very good management and well-trained staffs. It is located in Lagankhel in Patan. During the waste characterization process, waste

were collected from the hospital compound, private ward, maternity, gynecological, OT, surgical ward, office, central supply, ICU, medical ward, laboratory, dental, children's ward, store room, laundry, pharmacy, kitchen, emergency, birthing center and canteen. Sampling was done twice during September. Different colored plastic bags were provided in order to segregate waste during waste sampling. The nursing in charge, Chief Matron, waste handling staffs, administration were contacted prior to sampling.

Table 4.1e: Waste generation in Patan Hospital

Sample	In %	In kg/day					In kg/person/day	
	Bed occupancy rate	Non-infectious	Infectious	Sharps	Saline bottles	Total waste	Infectious	Total
1 st	90	248.5	115	7	10.2	380.7	0.54	1.68
2 nd	83	220	146.5	4.5	7.2	378.2	0.72	1.81
Average	86.5	234.25	130.75	5.75	8.7	379.45	0.63	1.74

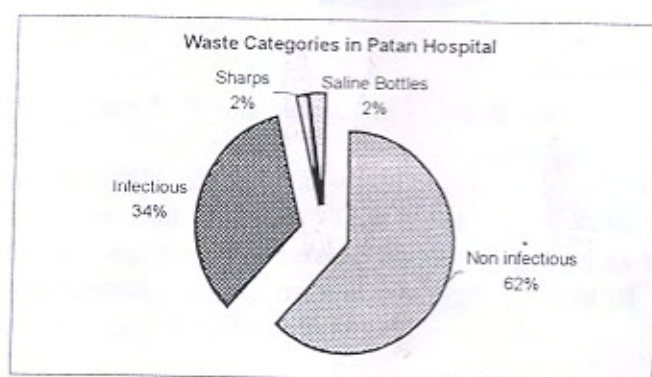


Chart 4: Waste categorization in Patan Hospital by Weight

With an average occupancy rate of 86.5% during the sampling, it generated an average of 379.45 kg of waste. 36% of the total waste was infectious in nature. Compared to other hospitals the infectious waste generated in kg/patient/day is high which may be due to the high occupancy rate and use of large amount of disposable.

4.1.5 Bir Hospital

Bir Hospital, located in the heart of Kathmandu, was selected because it is a large hospital with a capacity of 354 beds. As it is one of the most popular government run hospital, patients from all over the country come here for treatment. It provides treatment cost at a subsidized rate and therefore the bed occupancy ratio usually remains more than 85% throughout the year. During the waste characterization process since it was difficult to segregate waste at the source, waste over a 24hrs period collected in a container and segregated at the transfer station in Teku. The different waste categories have been shown in Table 4.6.

Table 4.1f: Waste generation in Bir Hospital

Sample	In %	In kg/day					In kg/person/day	
	Bed Occupancy rate	Non infectious	Infectious	Sharps	Saline Bottles	Total Waste	Infectious	Total
Bir Hospital	90%	259.74	39.74	16.31	42	357.79	0.17	1.08

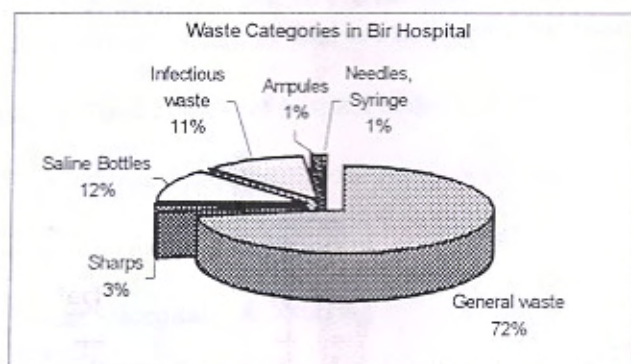


Chart 5: Waste categories in Bir Hospital by Weight

It is observed that only 16% of the total waste is infectious which is comparatively less in comparison to the other four hospitals. This is mainly because the sorting of waste was done manually to the best possible extent. Waste categories as shown in chart 5 reveals that if waste is segregated properly only a minimum percent of waste will be infectious. The infectious waste generation rate is 0.18 per patient/day.

4.2 Waste Generation

4.2.1 Waste per patient/occupied bed

The waste generation rate has been calculated on the basis of weighted average between waste generation rate and the bed occupancy ratio of the corresponding healthcare institutions. A total of 9 samples have been taken into consideration. From the calculation it is found that:

Infectious waste generated = 0.48 kg/person/day

Total waste generated = 1.72 kg/person day

Using standard deviation the infectious waste generated ranges from a minimum of 0.249 kg to a maximum of 0.711 kg/person/day, with a confidence interval of 95%. The standard error for the mean value is value is 0.096.

4.2.2 Total no of hospital beds

The total number of hospital beds in the Kathmandu Valley (Kathmandu, Bhaktapur and Lalitpur) has been estimated to be 3905. This includes all the public hospitals private hospitals and nursing homes. In addition to the surveyed hospitals the remaining figures on hospital beds were obtained from the data documentation unit of the Ministry of Health (MOH).

Besides the healthcare institution there are 6 Primary Health Care Center (PHCC) in Kathmandu Valley with 3 in Kathmandu, 2 in Lalitpur and 1 in Bhaktapur. Each PHCC consists of 3 beds and are used for primary treatment. These numbers have not been included since the beds remain unoccupied and are used only for basic treatment.

Table 4.1g: Total number of hospital beds

S.N	Type of Healthcare Institution	No of beds
1	Government Hospitals	2347
2	Private Hospitals & Nursing Homes	1558
	Total:	3905

4.2.3 Bed Occupancy Rate

In most cases data on bed occupancy rate in different hospitals was not available due to poor record keeping. In 1986, the GTZ/SWMB survey had calculated the BOR as 68.2%. In 1997, SOGEA had assumed the BOR to be 70%.

From the limited data collected during the surveys conducted for this study, the average bed occupancy rate was found to be about 80%. To suit the present conditions of the present survey BOR has been considered to be 70% for the existing healthcare facilities in the Kathmandu Valley.

4.2.4 Total Infectious Waste Generated in Kathmandu City and the Valley

The total amount of infectious waste generated in Kathmandu per day has been calculated by multiplying the total number of beds by the bed occupancy rate and the amount of infectious waste generated /person/day. The waste generated from polyclinics, pathological labs and drug stores have not been taken into account, as there are no data on the number of such clinics.

Total infectious waste generated in Kathmandu City

$$\begin{aligned} &= \text{Total number of beds} \times \text{BOR} \times \text{infectious waste/person/day} \\ &= 3541 \times 70\% \times 0.48 \end{aligned}$$

$$= 1189 \text{ kg/day}$$

The total infectious waste generated in Kathmandu Valley

$$= \text{Total number of beds} \times \text{BOR} \times \text{infectious waste/person/day}$$

$$= 3905 \times 70\% \times 0.48$$

$$= 1312 \text{ kg/day}$$

Table 4.1h: Amount of infectious waste generated in Kathmandu City and Valley

Degree of infectious waste generation	Waste generation rate in kg/person/day	Total infectious waste generated in Kathmandu City in kg/day	Total infectious waste generated in Kathmandu Valley in kg/day
Minimum waste generation	0.25	620	684
Current waste generation	0.48	1189	1312
Maximum waste generation	0.71	1760	1941

4.2.5 Short term projection

Some healthcare institutions are planning to extend their existing bed capacities. Mental Hospital is constructing a new building to extend its bed capacity from 29 to 50. Patan Hospital is constructing children's ward of 30 beds. Saheed Gangalal National Heart Care Center, which has 9 beds at present, is planning to extend its bed capacity to 60 within the next 6 months and 100 in future. Teaching Hospital is planning to build a new 300 beds ward. Similarly, Siddhartha Apollo Hospital aims to build a hospital in Balaju with 100 beds within one and half years. Therefore there will be an expected increase of 242 beds within the next three to four years. The amount of infectious waste generation will therefore increase by about 81kg/day.

4.2.6 Long term projection

Projecting the total number of health care institutions and hospital beds in Kathmandu is not an easy task. Generally it can be said that the number of health care institutions will continue to increase with increasing population and demand for better health care services. However, due to the lack of accurate data on the change in the number of hospitals and beds over the years, predicting a trend is difficult. Under these circumstances, comparing the bed numbers of healthcare institutions in the year 1986 and 2000, a simple projection can be established. According to GTZ, 1987 report there were 1780 beds in Kathmandu Valley in the year 1986. From the present ENPHO survey it is found that there are 3905 beds in Kathmandu Valley at present. This means that the number of hospital beds have increased by 119 percent in the past 14 years which translates into an average annual

increase of 5.38 %. Assuming that the number of hospital beds continue to increase at an average rate of 5.38% per year, the total number of beds in Kathmandu in the year 2010 will be 6593.

5 Conclusion and Recommendation

Looking at the present scenario of medical waste management practices of healthcare centers, it can be understood that majority of these do not practice safe waste handling, storage and disposal methods. Out of the surveyed healthcare institutions only one third practice proper waste segregation. In terms of prevention of infectious diseases spreading inside and outside the healthcare institutions, as a result of mismanagement of medical waste, proper management of waste at the point of generation is of paramount importance. For this, training to the hospital staff and waste handlers on the need and methods of safe waste handling practices is a basic requirement.

It is recommended that in order to solve the present problem of medical waste management, implementation of a centralized medical waste management system is essential. More than 85% of the surveyed institutions are in the favor of this system and this should be taken as an advantage to start with. Before establishing this system it is of utmost importance for the government to establish and strictly enforce national level policies, legislation and standards regarding medical waste and its management.

Annex 1

**Hospital Waste Management
Preliminary Survey Sheet**

A) Name: _____ Phone: _____

B) Address: _____

C1) Contact Person (Hospital In-charge): _____
Post: _____

C2) Contact Person (Waste In-charge): _____
Post: _____

D) Type: 1. Public Hospital 2. Private Hospital 3. Nursing Home 4. Clinic 5. Lab
6. Pharmaceutical Industry 7. Pharmaceutical Shop _____
8. Specialized Institute _____ 9. Others _____

E) No. of Beds: _____ No. of Out Patients/ day: _____ Patients/month: _____

F) Bed Occupancy Rate: _____

G) Main Departments:

- 1: Emergency 2: Maternity 3: Gynecology 4: General 5: Pediatrics
6: Operating Theatres 7: Burns and Dressing Unit 8: ENT 9: Radiology 10: Pharmacy
11: Blood Bank 12: Lab 13: Others: _____

H) Total nos. of staffs : _____ H2) Waste Management Staffs _____

I) Waste Generation Rate: _____ m³/day _____ kg/day

J) Provision of waste collection: a) Plastic bins
b) Metal bins
c) Covered ____ Yes ____ No

K) Is Waste Segregated? ----Yes ---- No
If Yes: Hazardous ____ Kg/day Non-Hazardous ____ Kg/day
Method of separation: _____

L) Present Practice:

1: Handling _____

2: Storage _____

**Hospital Waste Management
Preliminary Survey Sheet**

3 Disposal and frequency _____

M) Estimated Cost of Waste Management: Rs./month _____

N) Willingness to pay Centralized Waste Management System: ___ Yes ___ No

O) What would be the Appropriated System of payment? Rs./Bed/Month _____

Or Rs./20 liter/day/month _____

P) Have there been any programs to educate hospital staff on waste management?

___ Workshops/ ___ meeting/ ___ pamphlet/ ___ hospital policy

P) Other Comments _____

Prepared by: _____ Date: _____

Checked by: _____

Annex 2

Present situation of Public Healthcare Institutions

SN	Name of Hospital	Address	No of beds	BOR(%)	WGR (mg/d)	Storage	Estimated cost of waste mgmt	willingness to pay	System of payment	Awareness program	Other Comments
1	Infectious Disease H	Teku, Ktm	100	No known	0.12	No storage facility	Not known	Yes	Weight	Workshop	
2	Nepal Eye H	Tripatheshwor, Ktm	95	50-70%	0.3	Container for 15 days	1500	Yes	Bed/month	Hospital policy	
3	Bhaktapur H	Bhaktapur	50	100	0.05	Pit 50m away from the hospital (currently has been 7 mths.)	None	Yes	Not known	None	Planning to purchase incinerator at a cheaper price
4	TB H	Thani	no beds	-	0.02	No storage facility	Not known	No		Not known	Satisfied with the present system
5	Ayurvedic H	Naradevi, Ktm	100	3	1.5	KMC container	Do not pay	Yes	Volume	None	Need of proper solution for needles, syringes
6	Pain H	Laganikhel, Patan	205	100	2	In select utility rooms and container provided by municipality	Not known	Yes	Weight	Hospital policy, universal precautions provided to all the staff	Willing to segregate
7	Mental H	Laganikhel, Patan	29	80	1.15	No storage facility	Not known	Yes	Weight	None	Need of incinerator
8	Central Veterinary H	Tripatheshwor, Ktm	no beds	-	0.012	No storage facility	Not known	Yes	Any	None	
9	Maternity H	Thapothali, Ktm	310	75	0.15	Container within the hospital	Not known	Yes	Weight	Training on infection prevention once a year	
10	Kanti Bal H	Maharajgunj, Ktm	250	100	0.7	In container of KMC till full	750	Yes	Not known	Not known	
11	Birendra Police H	Maharajgunj, Ktm	150	11.3	1.2	Stored in a container provided by KMC	3000	Yes	No idea	Meeting	
12	Teaching H	Maharajgunj, Ktm	401	100	0.7	KMC container for 2 days	22500	Yes	Bed/month	Workshop, training	Irregular collection causing problems inspite of good effort to manage waste properly inside the hospital
13	Bir H	Mahaboudha, Ktm	354	90	2.5	In container	11250	No	-	None	Planning to have their own incinerator

Note
BOR: Bed Occupancy Rate
WGR: Waste Generation Rate

Present situation of Private Healthcare Institutions

SN	Name	Address	No. of Beds	BOR (%)	WGR (m ³ /day)	Storage	Cost of waste management (Rs/m ³)	Safeguard measures	Training (risk to pay)	System of payment	Awareness program	Comments
1	Lifecare H	Bagbazar, Ktm	15	10	0.001	Not known	500	Not known	No		No need of training	Will have own incinerator when the volume of waste increases
2	National Dental H. Ltd.	Lazimpat, Ktm	17 (dental chairs)	75-100	0.005	Covered & kept at backyard	16250	Vaccine against HepB, masks, gloves, separate set of clothes	Yes	Bed/milli	Workshops, meetings, press conference, national seminar	Waste should be autoclaved, shredded for vel Reduction and disposed safely
3	Siddhartha H	Putalisadak, Ktm	30 inpatients	Ne	0.014	Not stored, dumped into container daily	400	Gloves, masks	Yes	Whatever is decided	Trained persons available	Going to establish incinerator at Balaju within one and half years where they will have the hospital capacity of 100 beds
4	Kathmandu Medical College	Dalbu, Ktm	150	40	7.24	No storage facility	Make no payments	None	Yes	Not known	No	
5	Medicare Hospital and research Center	Naxal, Ktm	50	30-55	0.45	Wastes stored in buckets and disposed within 24 hours	Make no payments	Gloves, masks, masks generally not used	Yes	Volume	Training	
6	Nepal Medical College	Jepok, Ktm	250	70-80	0.83	Not known	250000	Gloves, masks, disposable aprons, HepB vaccine to cleaners, collectors	Yes	According to location	Discussions in health hazards workshop in every three months	Awareness very important, KMC need to consider an effective and environmentally sound system
7	Shaheed Ganga Lal National	Baneshan, Ktm	9	100	0.001	Not known	None	Gloves, aprons, boots, vaccination against HepB	Yes	According to transportation and disposal	None	If hospitals cannot afford incinerator then centralised system of waste management will be better
8	B&B H	Gwarko, Lalpur	100	80-85	0.36	Stored in open space	14000-15000	Gloves, boots, Vaccine against HepB	Yes	Volume	Workshop twice a week	Need for a centralised system of waste management
9	Himalay H	Gyaneshwor, Ktm	35	Not known	0.1	No storage but probably in the incinerator as they operate it when full	Not sure	None	Yes	Volume	Pamphlets	
10	Kathmandu Model H	Bagbazar, Ktm	50	71	0.084	Temporary, disposed every night	minimal	None	Yes	Volume	meetings	
11	Tiganga Eye H		No beds		0.02	No storage system, but sharps are stored in saline bottles which are filled in 2 months	None	Gloves, masks	Yes	Volume	None	Training should be provided
12	Om H	Kantipokhari, Ktm	50	40-60	1-1.5	In the container provided by KMC	3000 to KMC	None	Yes	Volume	Workshops, meetings, hospital policy	Incinerator is the best solution, need for waste water treatment, legislation required
13	Kathmandu Dental NH	Jyatha, Ktm	No beds		0.025	In a bucket for 2 days	Minimum	None	No		None due to small scale	
14	Blue Cross NH	Trinapani, Ktm	15	No inpatients	0.070	In a bin before it is collected by sweepers	9000	None	No		training lower	
15	Valley Maternity NH	Putalisadak, Ktm	20	10	0.025	The separated waste is stored in plastic bags provided by Kamachari Kalyan Kesh affiliated to KMC	1000	Gloves, masks	Yes	Depending on the type of hospitals	Meetings	KMC's service should be efficient and regular, need of strong legislation

Present situation of Private Healthcare Institutions

16	Norvic NH	Thapathali, Ktm	25	75	02-03	General waste in the container of KMC, other waste in litter room for a week	30000	not known	Yes	Volume	Trainings	Autoclaving can be the best option after which waste can be shredded for volume reduction and can easily disposed
17	Arunapoma NH	Bagbazar, Ktm	16	23	0.07	Stored in a trolley for 24 hours	1440	Not Known	Yes	Weight	Workshop 3 years ago, most recently	Syringes should not be discarded outside
18	Ishan Bal NH	Narayan Gopal Chowk, Ktm	25	10 to 50	Not known	Till disposal (where, how not known)	Not known	Gloves, masks	Yes	Decision after discussions	Matter discussed occasionally informally	Hospital will be willing to pay for the centralised management system
19	Sarvanga Swasthya Sadan	Kopundola, Lalitpur	25	2 to 3	0.025	Open storage in boxes	1800	Gloves, masks	Yes	Depending on the type of hospitals	Incentives by increasing grades	
20	Hargyas NH	Jawalakhet, Lalitpur	12	3.2	0.025	Open storage in baskets	2300	Gloves, masks	Yes	Volume	None	
21	Everest NH	New Baneswor, Ktm	16	2	0.1	No storage facility	30000-40000	Gloves, masks	Yes	Volume	None	Every hospital should have its own incinerator
22	Hans	Tripatheshwor, Ktm	20	60-70	0.02	Not known	2000-3000	Gloves	Yes	Payment depending on the business view	Workshops	Excellent plan if implemented soon
23	HM Hospital &	Maharajjung	40	60	Not known	no storage facility	1200	Gloves and apron	Yes	Per volume	none	

Present situation of Pharmaceuticals and Pathological Labs

SN	Name	Type	Address	Patients/day	WGR (in 3 days)	Waste disposal practice	Cost of waste mgmt. (Rs/month)	Safe guard measures	Willingness to pay	System payment	Awareness program	Comments
1	Apello Medical Hall	Pathological lab			0.002	burned, weekly.			yes			
2	Alka Polyclinic	Polyclinic	Jawalakhet, Lalitpur	15-20	0.001	sharps burned every 3 days, non- returnable medicine burnt, others collected by sweeper daily	Rs. 500/monthly	None	yes	Have no idea	Not known	
3	Dirgha Jeevan Clinic	Pathological lab	Tripureshwor, Ktm	8 to 9 cases	0.005	Daily at nearest collection point by sweepers	Rs. 500/monthly	Gloves	yes	weight	Not known	Incinerator should be set up at different locations as people will not go far to dispose the waste
4	Corex Diagnostic Centre	Polyclinic	Patalasadak, Ktm	Not known	0.01	daily in container	Not known	Gloves	Not known	-	Not known	
5	Siddhi Polyclinic	Polyclinic	Dillibazar, Ktm	Not known	0.01	syringes and infectious stuff burned, others thrown away	Not known	Not known	No	-	Not known	
6	Sankata laboratory	Pharmaceutical lab	New Road, Ktm	15-20	0.008	daily including sterilized sharps into the container	Not known	Gloves during sterilization	yes	Not known	General training given	KMC should manage medical waste either by secure landfilling or by incineration
7	Medico Pathological Lab	Pathological lab	New Road, Ktm	20-25	0.008	disposed in 1 or 2 days	None	Not known	yes	Volume	General	KMC responsible for collecting waste
8	Chhetrapati Nivaha Chikitsalaya	polyclinic	Chhetrapati, Ktm	200	0.015-0.020	needles & syringes burned, disposable syringes reused, others dumped into container container daily	None	filters, mask to sweeper	Yes	As decided by board	General instruction	Public consciousness needed, waste segregation necessary, separate disposal system of hospital waste