

**A SURVEY OF HOSPITAL WASTE MANAGEMENT IN BIR  
HOSPITAL, PATAN HOSPITAL AND TRIBHUVAN  
UNIVERSITY TEACHING HOSPITAL**

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# CHAPTER ONE

## INTRODUCTION

### 1.1 Background Information

A hospital is a service-oriented residential establishment that provides short term and long term medical care facilities comprising of observation, diagnostic, therapeutic and rehabilitative services for persons suffering from or suspected to be suffering from any kind of disease or injury. A vast amount of medical waste is generated in the diagnosis, treatment or immunization of human beings in the hospital. Between 75% and 90% of the waste produced by health-care providers is non-risk or 'general' health-care waste, comparable to domestic waste. It comes mostly from house keeping functions of health-care establishments, food stuffs and general materials brought by visitors to their patients. The remaining 10-25% of health-care waste is regarded as hazardous and may create a variety of health risks if not handled or treated properly. Hazardous wastes usually consist of sharps, human tissues, their body fluids, and other infectious materials produced during the process of treatment, damaging chemicals and drugs.

A steady increase in the number of healthcare institutions and the number of hospital beds has caused large flow of patients to these hospitals in Kathmandu valley. As a result there has been significant rise in the amount of waste generated in the hospitals. Improper disposal of wastes generated in hospitals can have direct and indirect health impacts on those who work in hospital, the surrounding communities, and on the environment. Such practices may contribute to the spread of disease, as well as pollution of the air, soil and water.

Hospital waste management refers to all the activities, administrative and operational, involved in the handling, treatment, conditioning, storage, and disposal of waste. The management of hospital waste requires its removal and disposal from the health care establishments as hygienically and economically as possible, by methods that all stages minimizes the risk to public health and to the environment.

A scientific system with appropriate facilities for the management of hazardous waste is lacking in most health-care establishments in Kathmandu valley. Hazardous wastes in many hospitals are treated negligently and carelessness in the management of these wastes in a hospital tends to spread infection and contaminate environment. Most health-care institutions depend upon the municipality services for the disposal of waste materials collected. There is no separate mechanism for the proper treatment of medical wastes and both medical and general wastes are treated as municipal wastes. Improper disposal of medical waste has emerged a major problem in Nepal. Infectious and hazardous waste disposal emerged as a major health concern to the public, particularly the waste contaminated with communicable disease agents such as the AIDS and the

hepatitis B viruses. In Nepal lack of any legislation on handling, storage, treatment and disposal of hospital waste aggravates the present health care system and possibly contribute to the occurrence of hospital acquired infections.

There are about 70 health care establishments in Kathmandu including hospitals, nursing homes and small clinics. Small drug dispensary also practice investigation and immunization activities. In small scale these are also producing general and hazardous waste including sharps. There are only few hospitals and clinics, which have on- site waste management system such as burning, burial, autoclave, waste segregation etc. Many research findings have shown that there is a lack of awareness, concern, and knowledge of appropriate handling and disposal methods of medical waste in Nepal.

This study encompasses on an in-depth analysis of the present conditions of waste management systems in three major hospitals in Kathmandu valley.

## **1.2 Definition and Classification of Hospital waste**

### **1.2.1 Definition of Health care wastes**

The definition of hospital waste encompasses a wide range of categories, depending upon the type of hospital waste.

**Medical waste:** Medical waste is a term used to describe “any waste that is generated in the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biological.”

**Bio-medical waste:** Bio-medical waste is defined as “any solid, fluid or liquid waste, including its container and any intermediate product, which is generated during the diagnosis, treatment or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biological and the animals waste from slaughter houses or any other like establishments.”

**Clinical waste:** Clinical waste in defined as “any waste coming out of medical care provided in hospitals or other medical care establishments, but does not include waste generated at home.

**Hospital waste:** Hospital waste refers to all waste, biological or non-biological that is discarded, and is not intended for further use in a hospital. The classification and quantification of hazardous and non-hazardous, infectious and non-infectious etc. are essential for scientific management of hospital waste. Around 80% of the waste coming out of hospital is general (i.e. non hazardous), which may be dealt with by the normal domestic and urban waste management

system. Around 15% of wastes include pathological and infectious waste, 1% sharps and 4% non-infectious but hazardous waste.

### 1.2.2 Classification of Hospital wastes

#### WHO classification

WHO has classified the health-care wastes into different categories based on the nature and degree of risks of wastes. Following are the categories of health care wastes:

1. General Waste
2. Pathological waste
3. Infectious waste
4. Sharps
5. Pharmaceutical waste
6. Genotoxic waste
7. Chemical waste
8. Wastes with high content of heavy metals
9. Pressurized containers
10. Radio active waste

**Table 1.a Categories of health-care waste**

Waste category	Description and example
General waste	Waste that represent minimal or non-risk to human health such as kitchen waste, packaging materials, paper plastic, general sweeping and other non infectious materials which do not require special handling.
Infectious Waste	Waste suspected to contain pathogens e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta.
Pathological waste	Human tissue or fluids e.g. needles; infusion sets; scalpels; knives; blades; broken glass.
Pharmaceutical waste	Waste containing pharmaceuticals e.g. pharmaceutical that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substance with genotoxic properties e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances eg. Laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressuized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources.



### **1.3 Hospital Waste Problem in Nepal**

There are 83 hospital, 10 health centers, 700 health posts, 285 Ayurvedic services centers, 3171 sub-health posts and 180 primary health centers in the year 2000/01 (CBS, 2002). Moreover, there are 9 teaching hospitals under the administration of the Ministry of education, of which the Tribhuvan University Teaching Hospital (TUTH) in Kathmandu is the largest. There are around 100 nursing homes and clinics all over the country.

The condition of health care waste management in other parts of Nepal is still in grave condition. It has been observed that some of the wastes from healthcare institutions are thrown directly into the river system without proper treatment. Hospitals in Kathmandu represent more than 50% of the total bed capacity of all health care facilities in Nepal. Thus in gross, Kathmandu alone and the rest of the country produce almost equal amounts of health care waste. Even the most sophisticated city Kathmandu has such a grave condition in waste management, one can easily foresee the condition in rest of the country. Most of the private health care establishments are defective and are housed in residential buildings and most of them do not have the facilities for adequate waste management. Scavengers sort waste without special precaution and are in danger of becoming seriously injured or infected. Many hazardous waste materials around the country are open dumped; easily accessible to birds and rodents. So it is likely that waste pickers, cleaners and general people will be infected from these materials. Therefore, spread of infectious organisms through various means from medical waste pollute the environment and increase the risk of silent epidemics of infectious diseases like viral hepatitis, Typhoid, Pneumonia, AIDS etc.

Thus, most of the health care sectors in Nepal practice improper waste management. There are no national studies done on a broader horizon about health-care waste management in Nepal.

### **1.4 Objectives of the Study**

In general, the main objective of this survey is to find out the current practice of hospital waste management in three major hospital of Kathmandu, namely Bir Hospital, Patan Hospital and T.U. Teaching Hospital.

**The specific objectives of the study are outlined below.**

- a) To review the current status of hospital waste management in Kathmandu valley.
- b) To determine the daily waste generation in specific wards of three hospitals with regard to specific waste categories such as general waste, hazardous waste and sharp.
- c) To study the present methods of collection, segregation, storage, treatment and disposal of hospital waste in three hospitals.
- d) To determine the probable health effect and potential hazards associated with waste management practices of waste cleaners and sweepers in these hospitals.
- e) To assess the knowledge, attitude and practice of waste cleaners and sweepers in these hospitals.
- f) To provide suggestion for good management and improvement of current practices.
- g) To study the organizational, functional and staffing pattern of house-keeping department in three hospitals.

### **1.5 Study Outputs**

The expected outcomes of this study are:

- a) Information on quantity, quality, handling and disposal methods of general, hazardous and sharps waste in three hospitals.
- b) Information on awareness of waste handlers and identification of weakness of improper waste management.
- c) Development of awareness regarding human health effect and environmental impact posed by such wastes.

### **1.6 Scope and Limitations of the Study**

Relevant data have been collected from three major hospitals ( Patan, Bir and T.U teaching hospital). The scope of the work for carrying out this study focus on waste management practices applied for handling treatment, storage and disposal methods of all kinds of waste in these hospitals. The hospitals surveyed are

national top-most health-care institution and are focus to public for many kinds of health services. They are major producers of health care waste in Kathmandu valley as well as in Nepal. So data gathered from these hospitals may give a true picture about the management of waste in other hospitals too. Information on knowledge, attitude and practice, safety precaution and hospital policy will make evaluation more scientific. Assessment of the current practices regarding health care waste in these hospitals would help to develop action programs and strategy development at management level.

This study examines and characterizes medical wastes from three selected departments of three hospitals. Thus, quantitative data obtained will be limited to the studied wards and the categories of wastes determined (general, hazardous and sharps) in terms of their weight or volume couldn't be generalized to the whole hospital. The quantities of all wastes, which are disposed of through the sewerage system in studied wards, are not included in the data. The estimations and analysis is done on the basis of data obtained during survey and field observations. Suggestion and recommendation given for waste management will be specific to these hospitals only.

# **CHAPTER TWO**

## **INTRODUCTION OF HOSPITALS AND HOUSE KEEPING SERVICES**

### **2.1 Introduction of House Keeping Services**

Good housekeeping is of paramount importance in providing a safe, clean, pleasant, orderly and functional environment for both patients and hospital personnel. Good housekeeping is an asset to the hospital not only because of its public relations and psychosocial effects upon patients, visitors and employees, but also important from the point of view of economy as well. People often form their opinion about the hospital on the basis of its appearance and cleanliness, which has a direct bearing on the prestige and reputation of the hospital. Properly maintained buildings have potentially longer and less expensive life while poorly maintained ones deteriorate faster and consequently prove more expensive in the long run.

The primary activities of the housekeeping department include the routine cleaning, dusting, mopping, waxing, removal of trash, window and wall washing and related domestic duties involved in maintaining a high standard of cleanliness in the institution. The direct budget for housekeeping may only be 3% of the total (Mc Gibony, 1990)

House keeping department in a hospital needs to be co-ordinated with other departments for proper waste management. Schedules, with procedures, should be in writing for the proper handling, segregating, and managing health care waste. Since house-keeping service is also called environmental service, a high degree of awareness should be created to the staffs of this department in order to provide sound skill for the proper management of health care wastes.

A hospital is a temporary home for the patients. Hospital-acquired infections may be high if the hospital adopt improper waste management practices. The hospital which have best doctors, good staffs and modern equipment but poor housekeeping services, it will overshadow the effect of all other things.

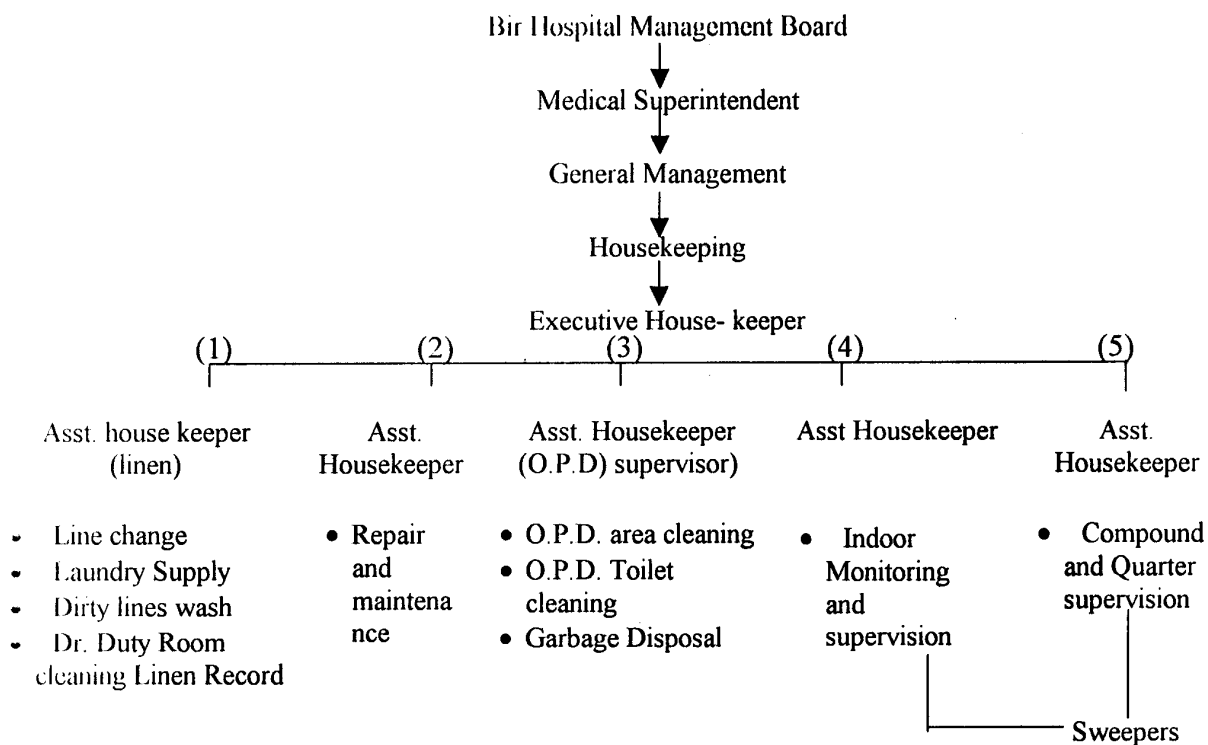
### **2.2 Introduction of Bir Hospital**

Bir Hospital is the oldest, largest and central hospital established in 1947 B.S. and is situated in the centre of the city, on an area of 50 ropanis (2.5 ha). This is the

biggest hospital in Nepal rendering services not only to the population of Kathmandu valley, but also to the entire population of the country. It is a central referral hospital with specialized and super-specialized services in medical and surgical field. It is a major centre for the training of manpower at undergraduate levels both in the medical and nursing field. In the beginning there were only 15 beds but at present there are 426 hospital beds, which include beds from medical wards, cabins, emergency services, dialysis center, and Radiotherapy ward. Since it is a government run hospital, people get services free of charge for general wards. However, for the cabin people have to pay certain charge. At present it is providing services in the following fields. General medicine, Medical surgery, Neuro-surgical, Eye, ENT, Dermatology, Dental, Paediatrics, Orthopaedic, Nephrology, Cardiology, Gastroenterology, Burns Plastic and Reconstructive Surgery, Radiotherapy, Haemodialysis etc. There are 5 operation theatres with 13 specialized and super-specialized wards. Approximately 10,228 are treated as in-patients and 329877 person as out patients in the year 2059. Emergency service is available 24 hours a day and 57661 patients got treatment in the year 2059. The hospital has a bed occupancy rate of 94% with an average stay 8.2 day per patient. The total male admitted as in-patients are 6088 where as the number of female, in-patients amounts to 4140. Altogether 610 types of diseases were diagnosed in the year 2059.

### **2.2.1 House Keeping Department of Bir Hospital**

The organization pattern of house keeping department is different in Bir Hospital than other hospitals. The house-keeping department of Bir Hospital is responsible for laundry supply, linen change, other laundry works, indoor-monitoring and supervision, compound, quarter and wards cleaning etc. The total numbers of person involved in the department are 198, among which 94 are sweepers. The waste management team comprises of peons, sweepers and ward coolies. Others are ward attendants who indirectly help in the management of hospital waste. The organization pattern of house keeping department of Bir Hospital is illustrated hereunder.



There are many sub-departments under the house-keeping department. Currently only 1, 4 and 5 house keeping department of Bir Hospital are functional. Some posts are vacant and responsibility of other sub-department is carried out by these departments. Bir Hospital does not have its on-site laundry washing facility and the laundries are given to Dhobi on contract. Similarly few months ago the cleaning responsibility of emergency department was given on contract to outside people but now it is managed by the housekeeping department.

## 2.3 Introduction of Teaching Hospital

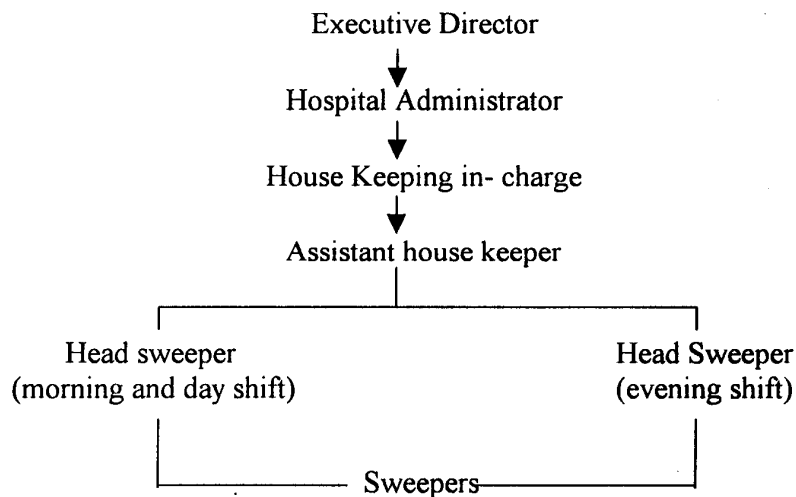
Teaching hospital began to provide OPD services to the public since 1983 and indoor service from 1985. It was established by the cooperation of Japan and Nepal. The hospital belongs to Tribhuvan University, and is used to provide health services to the public and is engaged also in teaching activities. TUTH is situated in Maharajgunj, the northern part of Kathmandu and is spread over 162 ropani.

The hospital has at present a total of 428 beds distributed over its take-care wards and cabins. It provides investigative, curative, restorative and preventive services. The clinical sector includes general medicine, central surgery, neurology, orthopaedics, gynaecology and obstetrics, dentistry, eye, ENT, dermatology and

others. Investigative services include pathology, haematology, microbiology, biochemistry, radiology, USG endoscopies, echocardiography, EEG, medical CT scan and others. Besides these services the hospital provides specialize services such as, Cardiography, Gastroenterology, Open-heart surgery, Urology, Neurology etc. The hospital is provided with ICU, CCU, ICCU and SICU service system. Within the hospital compound there is BP Koirala eye centre for ophthalmic studies. Many undergraduate, graduate and postgraduate programmes for medical and nursing faculties are run by the institute. The hospital provides services to the patients in 2 shifts (9 am to 5 pm). Altogether 1200 persons are working in TUTH for providing health services directly or indirectly.

### 2.3.1 House Keeping Department of T.U.T.H.

The house keeping department of TUTH is responsible for whole hospital cleanliness. Daily cleaning of hospital wards and hospital surroundings are major activities of this department. The department also takes care of hospital waste by the methods of segregation collection, transportation and disposal of produced waste. Sweeping, wet mopping, managing waste from Doctor's room and general wards are some of the responsibilities of the staffs from this department. Total staffs involved in this department are 77. The laundry section is not under the house keeping department of TUTH. The department is headed by a house keeping in- charge (1), Asst. housekeeper (1), Head sweeper (2) and Sweepers (73). Altogether 200 attendants are indirectly assisting in the management of house keeping department. The organization pattern of house keeping department of TUTH is illustrated hereunder.



## **1.4 Introduction of Patan Hospital**

Patan Hospital began to provide services to the public since November 1982. The 25 bedded district hospital of Patan and 135- bedded Shanta Bhawan Hospital was Co-jointly organized as Patan Hospital. The Patan Hospital Board is under the Joint authority of HMG and UMN. The members of the Board are representative from 1/3 HMG Health Directorate, 1/3 UMN and 1/3 community. The board makes policies and procedures, prepare budgets for a year, do auditing and the like. Patan Hospital is financially run by patient charges, HMG subsidy, UMN subsidy, personnel contributed service, hospital income, Gifts and charity in terms of cash and material.

The hospital is situated in 50 Ropanis of land at Lagankhel, Patan. Patan hospital provides services as Emergency, Out patient, Dental, Physiotherapy, Pharmacy, Paediatrics, Orthopaedics, Maternity, Birthing centre, Lab, X-ray, Medical, Surgical, Obstetrics and Gynaecology. Patan Hospital also has social services, Helping volunteers, patient counsellor, disaster response committee and infection control committee. The hospital is also a training center for resident doctors and paramedical and staffs nurses. The Lalitpur Nursing Campus has used the hospital to train nurses. It also provides other types of training to human resources from remote hospitals in Nepal. In last fiscal year 2059 it provided OPD services for 330, 113 persons, in-patient services for 16,654 patients. OPD service is open only 5 days a week. The hospital has 289 beds with hospital bed occupancy rate 81%. An average day of stay per patient is 5 days. There are altogether 600 staffs working in Patan Hospital.

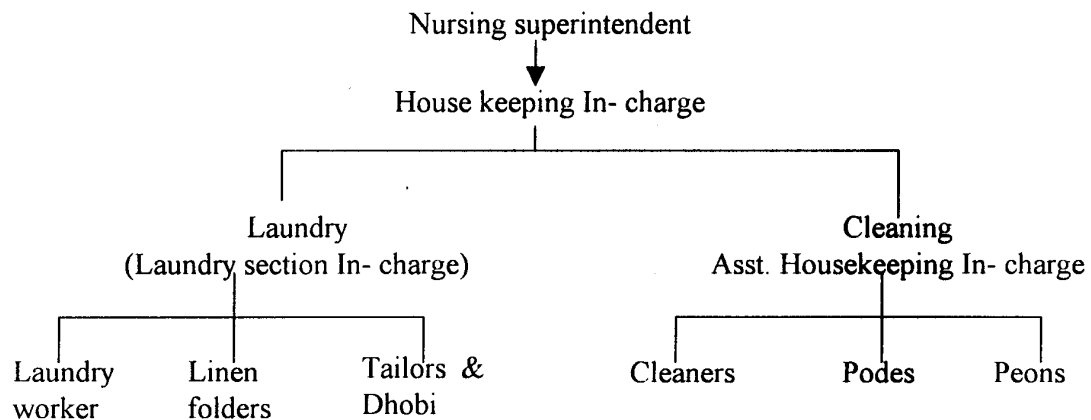
### **2.4.1 House Keeping Department of Patan Hospital**

The house keeping department of Patan Hospital is responsible for total cleanliness of hospital premises through periodic cleaning of hospital wards and removing hospital waste on a regular basis. Daily cleaning procedures like sweeping, wet mopping of corridor and wards, trash and garbage removal, scrubbing and washing of specific places are some of the activities carried out by the department. The housekeeping department has link to all other department of the hospital and take responsible for management of wastes from respective wards. This department is interlinked with the laundry department.



Total personnel involved in this department are 58 (excluding laundry section and incinerator section). House keeping In- charge (1), Asst. House Keeping in- charge (1), cleaners (54) and Peon (2) are included in this department. 4 persons from maintenance section are responsible for incinerator works. A total of 14 personnel are involved in laundry section which is under the house keeping department and include laundry section in -charge, laundry worker, liner folder, tailor and dhobi.

The house keeping department is runned in two shifts (morning and day). However, evening and night shifts are taken care by nursing supervisor. The organization pattern of house keeping department of patan hospital is illustrated hereunder.



## **CHAPTER THREE**

### **REVIEW OF LITERATURE**

#### **3.1 Review of National Policies on Health Care Waste Management**

Nepal lacks effective waste management facilities and relevant government policy and regulation to guide health-care establishments. In Kathmandu valley the solid waste management and Resource mobilization center (SWM & RMC) and the municipalities have been operating their services only in the management of municipal waste, i.e. the general waste of non-hazardous type. Besides, there are special wastes of hazardous nature e.g., hospital waste, industrial waste, slaughter waste, dead animals etc. which need special policies and guidelines for treatment and final disposal.

The solid waste management and resource mobilization rule-1989, which came in force since June 1989 sets forth the rules to implement the solid waste Act 1987. The Rules contain provision about rendering disposal services of hazardous and infectious waste generated from industries, institutions, individuals etc. by the SWM and RMC. The solid waste act-1987 not only gives right to the SWM & RMC to deal with but also prohibits the general public to throw harmful wastes (e.g. hospital waste, industrial waste dead animals etc.) into the streets or public space and imposes penalties to the violators.

Although the solid waste act-1987 gives right to the SWM and RMC to deal with infectious and hazardous wastes and prohibits the general public to throw harmful wastes into the streets and open spaces, a central system with necessary facilities for the proper management of these wastes has not yet been developed. This act doesn't provide a comprehensive national framework law and many aspects of this Act have never been enforced for all practical purposes.

The Ninth, five year plan has included consideration for the proper management of municipal solid waste by setting strict implementation of norms and standards for handling solid waste. These policies, however, didn't specifically mention about health care waste management.

The environmental protection act 1997 and environment protection rules have made provisions dealing with pollution control, Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA) etc. These provisions include

stopping emission and discharging solid waste against the standards and to install and maintain the equipment or treatment plants properly.

Though EIA could be extended for the development of policies and guidelines for management of hazardous waste from health-care institutions, little care has been given to this and the law is not made mandatory and hence the environment protection act is inflexible with regard to health care waste.

Under the National Health Care Technology strategy of the second health plan (1997-2017), a functional guideline to manage medical waste at all levels, including private sector has been proposed.

Nepal health research council (NHRC) has published 2 booklets namely National Health Care Waste Management Guidelines and Health Care Waste Management-training Manual for medical professionals, which is a good initiative for enforcing health care institution to implement such guidelines in their health-care establishments.

## **3.2 Review of Related studies**

### **3.2.1 International studies**

Approximately 465,000 tons of bio-hazardous waste is generated by United States each year by 377,000 health care facilities. Hospitals, which comprise only 2% of the total number of generators, produce the greatest quantity (approx. 77%) of the bio-hazardous waste among the different types of institution (Green, 1992). The average generation rate (kg/bed/day) of total hospital waste is about 4.5 in USA, 2.7 in Netherlands and 2.5 in France. However, the average hospital waste generation rates are in the range of 1- 4.5 kg/bed/day in Latin American countries like Chile, Brazil, Argentina, Venezuela (Monreal, 1991). The percentage of hazardous waste is 5% in Denmark and 28% in USA. The indicated differences may be due to geographical location, living habits and standards, availability of different treatment facilities, and the ways in which solid wastes are categorized in different countries.

255 tons of hospital wastes are generated in Dhaka every day (Rahman & Ali, 2000). University hospital has high Daily waste generation (4.1-8.7 kg/bed) than general hospital (2.1- 4.2 kg/ bed). General hospital in turn has high daily waste generation than district hospital (0.5-1.8 kg/bed) and primary health care centers (0.05-0.2 kg/ bed). A research on average composition of hospital waste in India showed the following result in wet-weight basis. Paper 15%, Plastics 10%, Rags

15%, Metals, Sharps etc 1 %, infectious waste 1.5%, Glass 4% and general waste 53.5% (WHO, 1999). 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 i.e. 1-2 kg/day/patient. According to a WHO report, around 85% of the hospital wastes are actually non-hazardous, 10% are infective (hence, hazardous), and the remaining 5% are non- infectious but hazardous (chemical, pharmaceutical and radioactive).

Waste generation depends on numerous factors such as established waste management methods, type of health-care establishments, hospital specializations, proportion of reusable items employed in health care and proportion of patients treated on a day care basis.

Our neighbour country India has implemented rules under environmental protection Act, 1986 named as Bio-Medical Waste Management and handling rules of 1998, which is applicable to all health care institutions generating Bio-medical wastes.

### **3.2.2 National Studies**

Not many studies have been carried out on national level about health-care waste management. Some of the noticeable studies were done by organization like GTZ in 1987, DWSS/WHO in 1995, IIDS in 1997, KMC in 1998, ENPHO/KMC in 2000 and SEF in 2001.

The most elaborative study was done by the solid waste management project in collaboration with GTZ in 1987/88. The first report produced in 1987 on collection, treatment and disposal of hospital waste (Phase I: Data Collection) gives detail information on medical waste management practices in Kathmandu valley and the second report produced in 1988 (Phase 2: Technical and economic planning) gives details on the technical and economical aspects on medical waste management.

The study conducted by SWM and RMC in 1986 (Regmi/Regmi/Grimm) on hospital waste generation in Kathmandu valley showed that ~ 89% of the total hospital waste is generated in Kathmandu, 8% in Patan and the remaining 3% in Bhaktapur. The biggest waste producer was the Bir Hospital, which contributed ~23% of the total followed by the Military Hospital and T.U teaching hospital each generating about 12% of the total. Total average waste quantity produced per

patient was 1.27 kg per day, and the figure in terms of volume was 4.84 ltr. Usually this rate is higher in general hospitals with OPD departments and is lower in such institutions where medical treatment plays minor role.

The study showed that the major share is non-hazardous waste (~75%) that can be handled and disposed on normal dumping sites without particular health risks. A comparably small amount (~25%) only is of hazardous nature, which requires special handling and treatment prior to final disposal. In terms of weight, the hazardous waste groups such as infectious dry waste (Sharp or non sharp) and infectious wet waste represent only 14% and 10% respectively, in the total.

The same study showed that on an annual average total waste generation of all hospitals and clinics amounts to 1,536 kg per day or 560 tons per annum. Waste generation is lower during the months of winter, i.e. December until February when outbreak of diseases is comparatively lower and the cold climate keeps off people from staying in hospital. The project surveyed many hospitals and found out that the total waste generation was 1.13, 1.33, 1.63 kg per day per patient in Patan hospital, T.U. Teaching hospital and Bir Hospital respectively. The SWM and RMC survey results (1986) projected waste generation per day in Kathmandu valley as follows: 2.4 tons total including 1.8 tons non-hazardous and 0.6 hazardous. Many other studies had forecasted 3.6 tons total waste in a day including 2.7 tons non-hazardous and 0.9 hazardous waste for the year 2003.

IIDS carried out a study on medical waste management focusing private health care establishment in 1997. The study found out that private health care establishments are poorly managed and the cleaners are not trained properly for effective management of waste. Some nursing homes, pathology laboratories and x-ray clinic discharged their wastes like blood, pus, developer and other liquid wastes into the public drain without any treatment. Most of the private health care institutions disposed their wastes without proper treatment into municipal waste containers and sometimes even in public place. The study calculated from its survey that about 80% of the sampled institutions dumped their waste in public places.

A study by KMC in 1999 indicated that approximately 3516 hospital beds in Kathmandu valley produce an average of 0.31 kg/person/day of infectious waste. With a 70% occupancy rate, the amount of infectious medical waste produced by the health care institutions was calculated to be 763 kg/day.

A report on "Medical waste management, a survey in Kathmandu valley" done by environment and public health organization (ENPHO, 2000) shows various

aspects of health care waste management in government, semi-government and private health care establishments. It surveyed a total of 45 health care institutions out of which 13 were public hospitals, 23 were private hospitals and nursing home, 8 were polyclinic and pathological labs and 1 was drug-manufacturing company.

The study indicated that most of the medical waste in Kathmandu valley is collected in plastic bins at the site of generation. Most of the hospitals have provided separated bucket for each bed but only 58% of the surveyed institutions practiced covered collection.

The study also depicts grave condition for segregation of medical waste and finds no defined procedure for such segregation. Most health care institutions do not strictly follow segregation practices. The study observed that on average, 28% separate only sharps, 19.44% separate sharps, infectious and non infectious waste, 8.33% separate the waste as infections and non-infectious but do not separate sharps and 44.44% do not segregate waste at all.

The study revealed that more than 50% of the government institutions do not practice waste segregation. The overall scenario depicts that the private healthcare institutions are relatively more efficient in waste segregation as compared to the government hospitals. The hospitals that follow proper segregation practices are Patan hospital, Maternity hospital and T.U teaching hospital. Similarly, none of the health care institutions surveyed have proper storage facilities. Most of the hospitals and nursing homes rely on municipal services and the roadside municipal containers for their ultimate waste disposal. Some of the healthcare establishments burn and/or bury wastes in their institutional premises. Patan and teaching hospitals manage infectious waste and sharps by themselves and give non-hazardous waste to municipality.

Study on 36 institutions by ENPHO showed that 56% provide gloves and or masks to the waste handlers. In addition to gloves and masks, 19% of the institutions have provision of vaccination against Hepatitis B, 25% do not provide any safety measures. Out of 36 public and private institutions surveyed, 47% have not conducted any sort of awareness programs; only 12% have provision of training/workshop/ meeting.

The study calculated a total of 379.45 kg waste generation per day in Patan Hospital which equals to 1.74 kg/ person/ day. Where as infectious waste generation was 0.63 kg/ person/ day. With an average occupancy rate of 86.5% during the sampling period, 36% of the total waste was infectious in nature.

Similarly ENPHO calculated total waste generation in Bir Hospital with total 357.79 kg per day. Total waste was found to be 1.08 kg/person/day where as infectious waste was 0.17 kg/person/ day. With bed occupancy rate 90% only 16% of the total waste was infectious in nature.

ENPHO study estimated 3541 hospital beds with 70 % occupancy rate in Kathmandu. It also calculated an average infectious waste of 0.48 kg/person/day. This accounts to a total of 1312 kg of infectious waste produced per day in Kathmandu valley for the year 2000.

A Similar study conducted by Save the Environment Foundation (SEF, 2001) shows that most health care establishments lacks effective waste management, hygiene and infection control responsibilities. The study also shows that both hazardous and non hazardous wastes are collected in the container provided by the Kathmandu Metropolitan city, which is later landfilled. The study shows very poor management at all levels in clinics and nursing homes and many hospitals lack environmental awareness and the legal obligations to provide a safe and effective medical environment.

Many studies have pointed out that due to poor management, absence of policy/ guidelines/ legislation, lack of health awareness in public and health officials and large influx of patients to government hospital are the key reason for improper waste management.

Many studies also stressed out that there are very few national workshops on hospital waste management. One workshop, which was organized by Ministry of Health, was held on 11-12 December 1997 and it recommended to develop national policies/ guidelines, develop co-operative treatment facility and national training program and generate legal provision for health care waste management (SEF, 2002). Till now nothing has been done so far to implement such recommendation by the government.

# CHAPTER FOUR

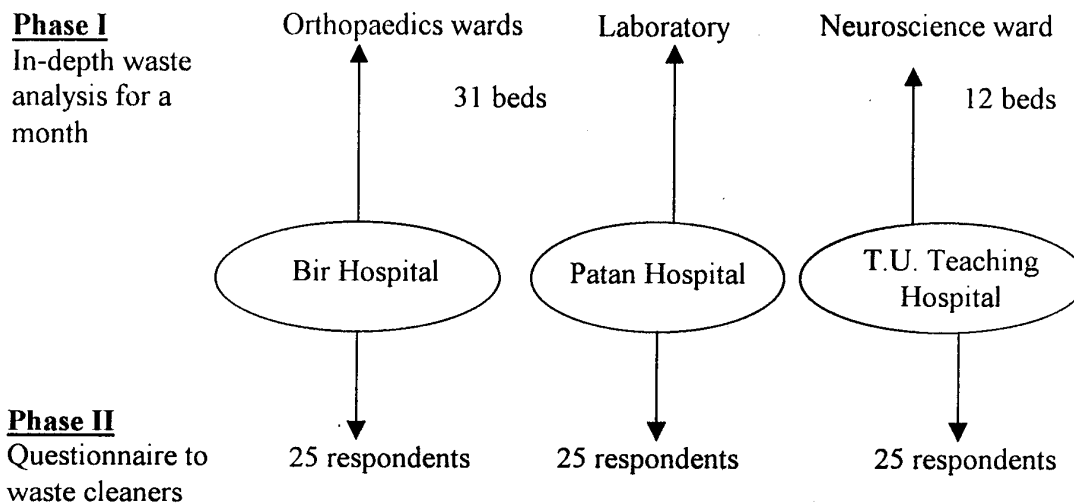
## METHODOLOGY AND PROCEDURE

### 4.1 The Research Design

The study is designed to assess the present status of hospital waste management in Bir Hospital, Patan Hospital and T.U. Teaching Hospital. All of the surveyed hospital are public hospitals and represent government (Bir Hospital) Teaching and Semi government hospitals (Patan and T.U.T.H hospital). The surveyed hospitals cover 1143 beds i.e. 21.8% of the total 5250 government hospital beds in Nepal and approximately 32.3% of the total 3541 beds in Kathmandu city. To study and characterize all the wastes generated is time consuming and technically infeasible due to limited finance, thus specific wards were chosen from three hospitals to characterize medical waste for a month. Two questionnaires were developed to assess the methods adopted by hospitals for waste management and to assess the knowledge, attitude and practice of the cleaners and sweepers. The study has adopted a model to make a comparative analysis of waste management in three hospitals.

Review and analysis of available literature/ documents pertaining to the study from former research projects and sample survey especially with reference to medical waste management were also carried out.

#### 4.a. Research design flow chart



**Phase III** Interview to heads/ house keeping in charge;  
On-site observation for hospital waste management in three hospitals.



## 4.2 Medical Waste Characterization Procedure

In this study, attempts have been made to classify the waste into three categories viz; General waste, Hazardous waste and sharps. WHO and different countries have their own classification system, which are neither applicable nor practical in context to Nepal. So simpler categories in which personnel associated with waste in hospital can identify and manage the waste with examples are as follows:

**General waste (non hazardous waste):** Domestic types of waste which do not pose special handling problems to health and environment are included in this category. This type of waste includes paper, cardboard, metal containers, floor sweeping, kitchen waste and other non-infections materials of little health hazard risks.

**Hazardous waste:** Hazardous wastes are those wastes which have intrinsic potential property or ability (for example by any agent, equipment, material or process) to cause injury or damage to health and/or environment. This type of waste includes infectious waste (contains pathogens in sufficient concentrations that exposure to it could result in disease), pathological waste (include blood, body fluids, tissues, organs, body parts, laboratory waste etc.), sharps, pharmaceutical and chemical waste. Though sharps belong to hazardous waste, it is classified separately because it needs more precautions in handling, and requires different treatment options.

**Sharps:** Sharps include needles, hypodermic needles, blades, scalpels, broken glass, infusion sets, saws, nails and any items that could cause cut or puncture to human skin. Whether or not they are infected, such items are usually considered as highly hazardous health-care waste.

Based on the above three categories of hospital waste, the waste from three departments of three hospitals which are included in this study are given hereunder.

**Table 4. b. Categories of the wastes included in the study**

<b>Hospital name</b>	<b>General waste</b>	<b>Hazardous waste</b>	<b>Sharps</b>
Bir Hospital (Orthopaedic Department)	Paper, cardboard, X-ray paper, plastic material, discarded food items, fruits peels, floor sweeping, bottles (plastic and Glass), wrap paper etc	Soil bandages, cotton used for dressing, gauze, blood and urine bags, all the material that came under wound cleaning and treatment process, gloves body parts, amputated organs, spilled blood and waste from HIV patient	Syringes, needles, pins, blades broken glass etc.
Patan Hospital (Laboratory)	Plastic and paper wrapping, cardboard floor dust ,	<b>Microbiology:</b> Culture plates with disposable culture media, bottle containing media (bottle reusable) liquid broth, swab-sticks, biochemical test reagents culture tubes, slides. <b>Parasitology :</b> stool and urine sample, sputum and slides etc. <b>Haematology:</b> Blood samples <b>Blood Bank:</b> Used blood packets <b>Chemistry Lab:</b> serum samples blood samples, reagents etc.	Small tubes ampoules, whole syringe, pins, non-recyclable glass rods slides, blades etc.
T.U. teaching Hospital (Neuro- Science ward)	Three separate collection buckets for only food items, only paper items and only bottle items. (bottles reusable or disposable)	Used treatment things like dressings cotton and bandages, blood and urine bags, gloves etc.	Whole syringes, needles, infusion sets, blades, broken glass etc.

### **4.3 Survey Methods and Data Gathering Procedure**

In this study, Survey method is applied as a technique of investigation and information were collected through direct observation, questionnaires and interviews. Similarly analytical survey was carried out to establish relationship between quality and quantity of waste produced and its relation to the waste-generating department of a hospital. Data were collected during the period of February- September 2003.

### **4.3.1 Analytical Survey Method**

Before the study, the head of the hospital and the housekeeping in-charge were contacted and the objective and outcomes of the study were discussed. Following this nursing in-charge and head of respective departments were visited. The in-charge and heads of the respective departments were requested to direct other staffs and waste cleanliness to segregate waste at the generation point so that analysis would be perfect. In case there was mixed and improper segregation the investigators themselves segregated the waste.

Three departments were selected from three hospitals. The team members including principal investigator and co-investigators were Kiran Sapkota for Bir hospital study, Mr. Nabaraj Adhikari for Patan hospital study and Mr. Rajan Devkota for T.U. Teaching hospital study. The three selected departments include orthopaedic ward from Bir Hospital, Neuro-science ward from T.U.T.H and laboratory department from Patan hospital. The selected two wards from Bir Hospital and T.U.T.H were general wards which produced high quantity of non-hazardous waste, however the laboratory from Patan Hospital produced high quantity of hazardous waste.

The orthopaedics ward of Bir Hospital contains 31 beds with 4 sub wards (2 male wards, 1 female ward and 1 children ward). The generated waste was analysed two times a day in terms of general waste and hazardous waste. The sharps were analysed once or twice a week from respective wards. The study was carried out for 31 days in the month of March- April 2003. (12<sup>th</sup> Chaitra 2059 to 12<sup>th</sup> Baisakh 2060). Both weight and volume analysis was done for the generated wastes at 9:00 AM and 1:00 PM. This time was most favourable time for the waste cleaners to dispose collected waste to the municipality containers. The weighing was carried out for all the items generated by a spring balance (max. capacity 20 kg)

An overwhelmingly large quantities of waste is generated from the orthopaedics ward. To characterize them in terms of weight and volume, following strategy has been adopted.

1. The weight of empty bucket was taken.
2. The weight of collected wastes in the bucket was taken and the actual weight of waste was calculated by subtracting the weight of empty bucket.
3. The orthopaedic ward has many buckets for waste collection. The two types of bucket have 25 litres and 12 litres capacity with respective weight 1140 gm and 450 gm. For volumetric analysis of generated waste, the bucket capacity was divided into 4 sub-parts. The volume occupied into the subparts is calculate as follows:

<b>For 25 litre bucket</b>		<b>For 12 litre bucket</b>	
¼ of the bucket	= 5.2 litres	¼ of the bucket	= 2 litres
½ of the bucket	= 11 litres	½ of the bucket	= 5 litres
¾ of the bucket	= 17.5 litres	¾ of the bucket	= 8.5 litres
Full bucket	= 24 litres	Full bucket	= 12 litres

The sharp container has approximately 16 litre capacity so, ¼ of it cover approx. 4 litres ½ of it cover 8 litres, ¾ of it cover 12 litres and full volume covers 16 litres.

Each day the waste generated from the ward was weighted. The volume occupied by the waste was inspected, categorized into four sub-parts, calculated and recorded into the data sheet.

Similarly Laboratory Department of Patan Hospital was selected for waste analysis in terms of general waste, hazardous waste and sharps. The study was carried out for 31 days in the month of February-March 2003 (9<sup>th</sup> Falgun 2059 to 9<sup>th</sup> Chaitra 2059). Only weight analysis was done for three kinds of wastes due to inconstancy of different buckets, waste binds and collecting instrument in the laboratory. A spring balance with maximum capacity 22 kg was bought and waste weight was taken at 8:00 AM daily.

Similarly, the Neuro-Science ward of T.U. teaching hospital was selected for in-depth analysis of generated waste in terms of general waste, hazardous waste and sharps. The ward contains 12 beds and is highly monitored and cleaned to prevent cross-infection. The hospital has provision for segregating waste into 5 types namely only food, only plastic and paper, only plastic and glass bottles, only treatment things and only Sharps. All types of segregated waste except sharps was weighted daily in the morning for 30 days. The study was carried out in the month April-May 2003 (1<sup>st</sup> of Baisakh 2060 to 30<sup>th</sup> of Baisakh 2060). Only weight analysis of generated waste was taken into consideration. The ward has provision of collecting waste into 15 litre and 17 litre buckets. The actual weight of collected waste was calculated by subtracting the weight of empty bucket.

The investigators met almost often and discussed about the recorded data. Compilation of the data was done daily.

Protective things like apron, surgical gloves and masks were worn where necessary while handling hazardous waste and sharps

### **4.3.2 Questionnaire survey method**

A questionnaire was set up which was conducted to people responsible for cleaning, sweeping and handling hospital waste. Different sets of semi-structured questionnaires were used for qualitative data gathering. The main purpose of this activity was to assess the level of knowledge, attitude, practice, awareness and safety methods adopted while handling wastes. The other objective of the questionnaire was to determine the hospital policy, probable health effect of waste cleaners and to identify factors responsible for improper management of wastes in the surveyed hospitals. A total sample size of 75 cleaners (25 in each hospital) was interviewed to fill up the questionnaire.

In the second stage a different questionnaire was designed by modifying the WHO survey questionnaire for hospital waste management. The matron, house keeping in-charge, the infection control officer of the hospital were interviewed on their hospital waste management issues, and their basic understanding about hospital policies on waste management. In addition to the questionnaire informal talks with wards in-charge and other hospital officers were also conducted to get reliable data as far as possible.

### **4.3.3 Field Observations**

Field observations were made in different wards of a hospital. Different locations like waste generation point, segregation practices, storage, transportations and disposal practices adopted by the hospital, on-site treatment methods like incineration, waste pit, burial etc were examined critically. Observations also covered the attitude, behaviour, and safe practices of waste cleaners on the issue of proper waste management. Observations were also made at the municipal landfill site, which is responsible for disposing hospital waste. Photographs were taken from respective hospitals.

## CHAPTER FIVE

### ANALYSIS OF BIOMEDICAL WASTE

Results obtained by waste characterization in the selected departments of three hospitals indicate variation in the composition of waste generation. The following are data obtained from the analytical survey carried out in three respective departments of three hospitals.

#### 5.1 Biomedical Waste composition

##### 5.1.1 From Orthopaedic Ward of Bir Hospital

Both volume and weight analysis was done from this department relating to general waste, hazardous waste and sharps.

**Table 5. a. Daily waste generation from orthopaedic ward**

Date	General waste		Hazardous waste		Sharps	
	Weight(kg)	Volume(l)	Weight(kg)	Volume(l)	Weight(kg)	Volume(l)
2059/12/12	30.74	83	2.05	5		
2059/12/13	7.32	41.5	1.55	5		
2059/12/14	20.34	76.5	3.25	11		
2059/12/15	14.72	48	0.95	8.5		
2059/12/16	11.31	36	2.51	17.5		
2059/12/17	19.47	53.5	0.86	5.2		
2059/12/18	16.78	52.5	4.35	14	2.0	8
2059/12/19	10.92	48	6.91	19.5		
2059/12/20	18.98	59	3.32	28.5		
2059/12/21	25.28	65.5	4.1	20.5		
2059/12/22	7.86	24	3.86	11		
2059/12/23	17.92	48	7.2	28		
2059/12/24	15.22	48	5.55	12		
2059/12/25	18.94	64.2	3.66	11	2.8	8
2059/12/26	8.01	29.5	4.86	17.5		
2059/12/27	10.86	24	9.72	24		
2059/12/28	21.72	48	3.55	12		
2059/12/29	18.64	57	1.75	12		
2059/12/30	16.48	65.5	1.86	5.2	4.2	12
2060/1/1	15.38	59	1.35	5		
2060/1/2	18.00	74.5	4.6	17		
2060/1/3	29.22	76.5	0.55	5		
2060/1/4	24.22	48	2.05	12		
2060/1/5	15.44	57.7	3.72	24		
2060/1/6	25.33	67.5	5.41	29		
2060/1/7	41.08	72	1.05	5		
2060/1/8	13.72	48	3.55	12	3.1	8
2060/1/9	12.72	48	5.96	28		
2060/1/10	13.72	48	1.55	12		
2060/1/11	30.58	72	5.1	24		
2060/1/12	10.45	53.5	1.55	5		
Grand total	561.37	1696.4	107.94	445.4	13.3	40

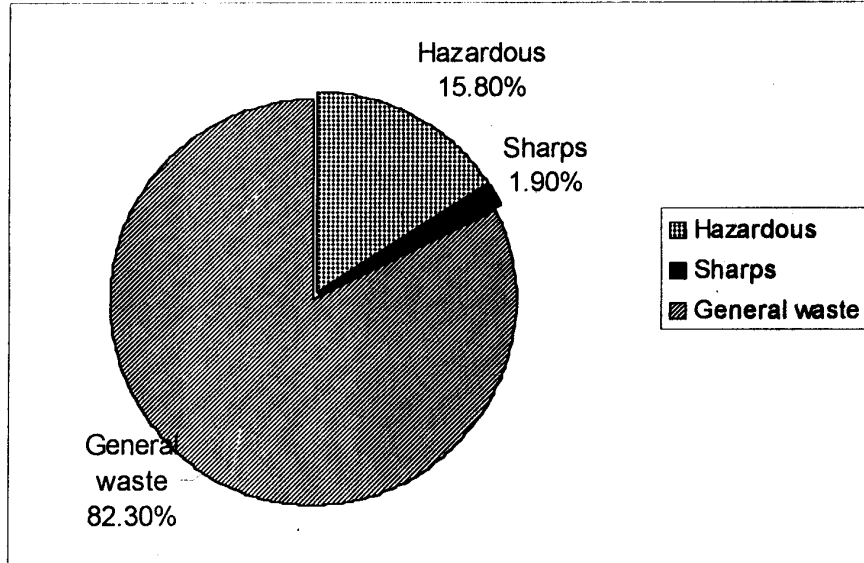
**Table 5. b. Monthly waste generation from orthopaedic ward.**

Study period	Bed occupancy rate	Measurement	General waste	Hazardous waste	Sharps	Total waste	
March to April 2003	Almost 100%	In kg	561.37	107.94	13.3	682.61	
		Weight %	82.3%	15.8%	1.9%	100%	
		In Litres	1696.4	445.4	40	2181.8	
		Volume %	77.8%	20.4%	1.8%	100%	
		Avr. Waste in					
		a day (kg)	18.1	3.48	0.42	22	
		(litre)	54.72	14.36	1.29	70.37	
		In kg/bed/day	0.58	0.11	0.01	0.7	
In ltr/bed/day	1.76	0.46	0.04	2.26			

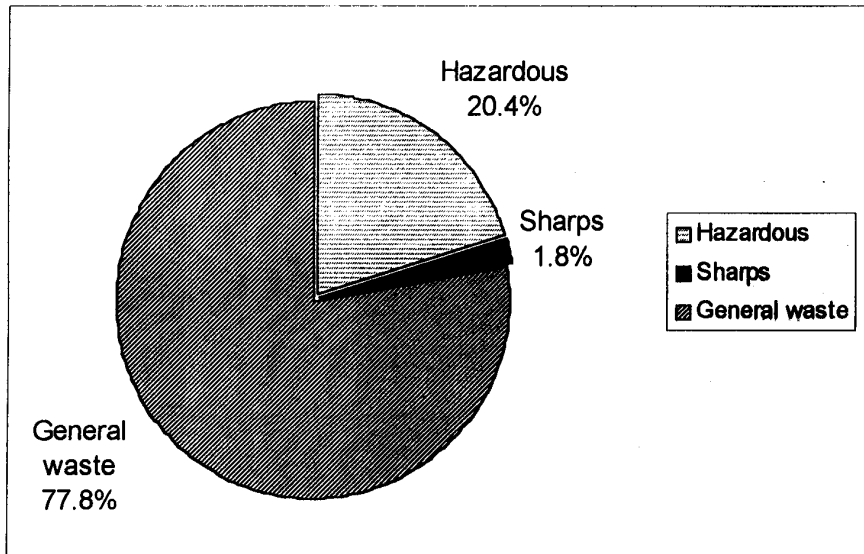
This ward has a total of 31 beds with 4 sub-wards. Waste samples were analysed two times over a 24 hours period and the study induced waste categories as described in table (4 b.). The study was carried out for a month. The basic design of orthopaedic ward is illustrated in Annex 3

The ward is almost full everyday. Some beds are vacant for few hours but they are occupied soon. In some instances patients are treated on a corridor because of inavailability of beds. Hence the bed occupancy rate during the study period has been taken 100%. The patients treated in orthopaedics ward stay in the bed for longer duration because of chronic nature of their diseases. Table 5.a and 5.b. give overview of total waste generated in the ward during the analytical survey period. In spite of maximum care, produced wastes are mixed sometime which make segregation difficult and may affect the final result. The waste from operation theatre (O.T.), which is mainly of hazardous nature, is not included in the study because of uncertainly of operation day and difficulty in accessibility. Thus it is expected that the amount of hazardous and sharp waste would increase if all these were taken into consideration.

From the calculation (Table 5.b.) it has been found that 15.8% by weight and 20.4% by volume of the total waste is hazardous in nature. 1.9% by weight and 1.8% by volume of the total waste is sharp. General waste ranks to higher percentage i.e. 82.3% by weight and 77.8% by volume.

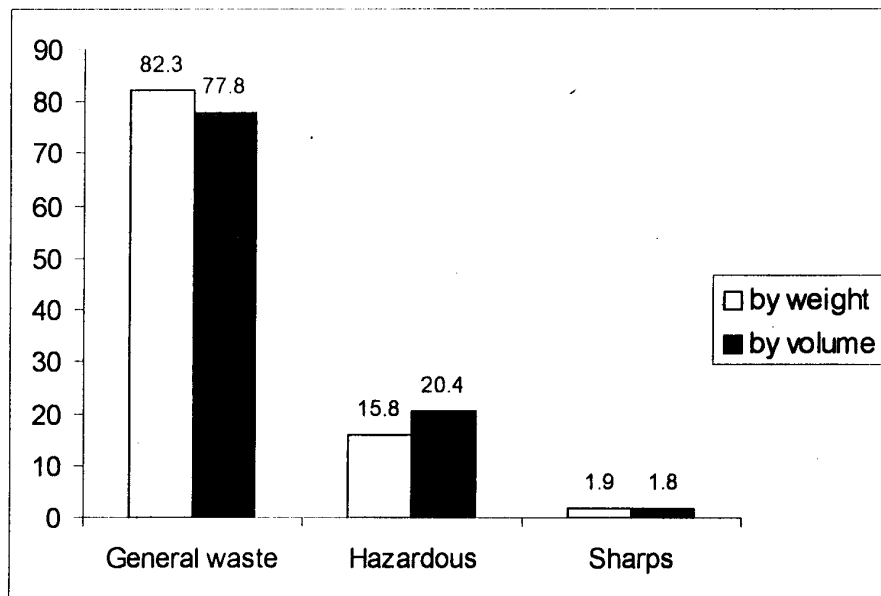


**Chart 1: Biomedical waste composition (by weight) in orthopaedic department**



**Chart 2: Biomedical waste composition (by volume) in orthopaedics department**





**Chart 3: Comparative bar diagram of Biomedical waste composition by weight and by volume.**

Average waste produced per day per patient is 0.58 kg by weight and 1.76 litres for general waste, 0.11 kg by weight and 0.46 litre by volume for hazardous waste similarly 0.01 kg by weight and 0.04 litre for sharps.

### **Biomedical waste composition from**

#### **5.1.2 The Laboratory of Patan Hospital**

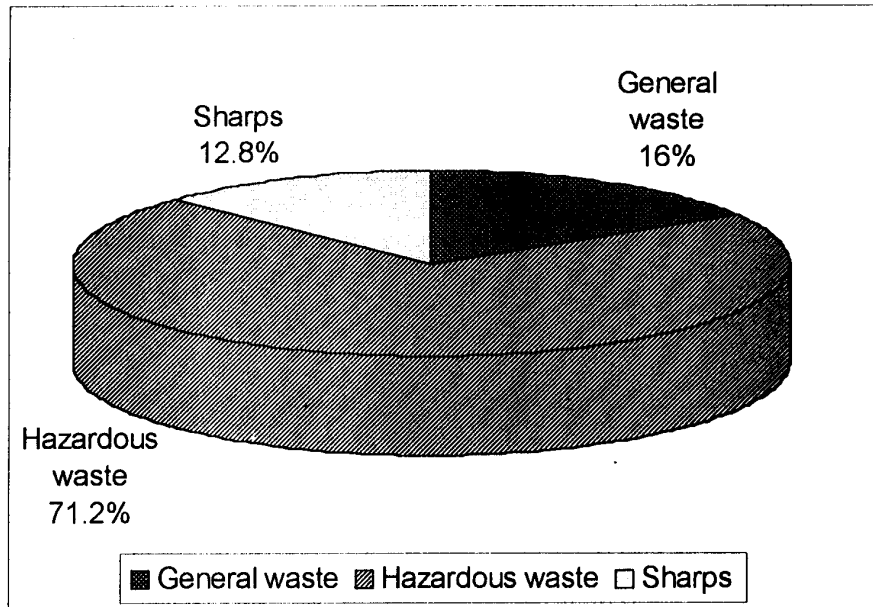
The main work of this laboratory is to provide investigative and diagnostic functions from collected samples. First the samples are collected in a collection counter and according to the need and purpose, the samples are send to respective laboratories for clinical investigation. The laboratory of Patan hospital is divided into 5 sub laboratories; they are parasitology, blood bank, microbiology, chemistry and haematology. During the process of clinical investigation various tools and techniques are applied which generate wastes mainly of infectious type. Since samples and regents used are of hazardous type, they need special treatment and disposal practices. The analysis of generated waste was done once daily in terms of weight only and continued for a month. The segregation procedure of waste according to type is described in table (4.b.) The following is the data obtained from the study.

**Table 5. c. Daily Waste generation from the laboratory**

Data	General waste	Hazardous waste	Sharps
059-11-9	0.42	3.45	1.25
0.59-11-10	4.0	6.7	0.9
0.59-11-11	4.52	4.77	2.5
0.59-11-12	1.5	10.5	1.25
0.59-11-13	2.25	5.46	3.75
0.59-11-14	0.5	6.0	0.8
0.59-11-15	1.2	3.6	1.4
059-11-16	3.5	7.0	1.6
0.59-11-17	3.75	18.75	2.25
0.59-11-18	1.8	9.4	1.2
0.59-11-19	3.0	7.5	1.0
0.59-11-20	2.25	13.86	1.25
0.59-11-21	2.0	9.56	1.5
0.59-11-22	1.75	6.67	1.8
0.59-11-23	2.2	8.6	1.25
0.59-11-24	2.5	11.75	1.5
0.59-11-25	2.0	9.8	1.75
0.59-11-26	1.5	7.21	2.0
0.59-11-27	2.0	13.5	1.5
0.59-11-28	1.5	16.75	1.25
0.59-11-29	1.25	10.5	1.9
0.59-11-30	1.0	7.5	1.0
0.59-12-1	1.75	12.25	1.5
0.59-12-2	1.0	11.0	1.5
0.59-12-3	3.75	8.5	1.25
0.59-12-4	2.0	6.5	1.9
0.59-12-5	1.0	11.9	1.25
0.59-12-6	1.25	4.5	2.5
0.59-12-7	1.2	9.5	1.75
0.59-12-8	2.6	6.0	1.5
0.59-12-9	1.0	6.75	1.75
<b>Total</b>	<b>61.9</b>	<b>275.8</b>	<b>49.5</b>

**Table 5. d. Monthly waste generation from the laboratory**

Study period	Measurement	General waste	Hazardous waste	Sharps	Total waste
March to April 2003	In kg.	61.9	275.8	49.5	387.2
	Weight %	16%	71.2%	12.8%	100%
	Average waste per day in kg	1.99	8.89	1.59	12.47



**Chart 4: Biomedical waste composition (by weight) from the laboratory**

A month study from the laboratory revealed that major generated wastes are of infectious nature. It is observed that 71.2% of the total waste is of hazardous type, 12.8% is sharp and only 16% is of general type. Thus the type of waste produced from the laboratory is different from other hospitals departments. Since the majority of waste from the laboratory is of hazardous type including infections waste and sharps, special precaution should be taken while handling, segregating and disposing such wastes. Some of the materials used in microbiology and chemistry lab are reused such as glass bottle and test tube. Since glass bottles and test tubes contain media for microbial growth and are used for culturing microorganism, they are taken as hazardous wastes.

### **Bio medical waste composition from**

#### **5.1.3 Neuro- Science Ward of T.U. Teaching Hospital**

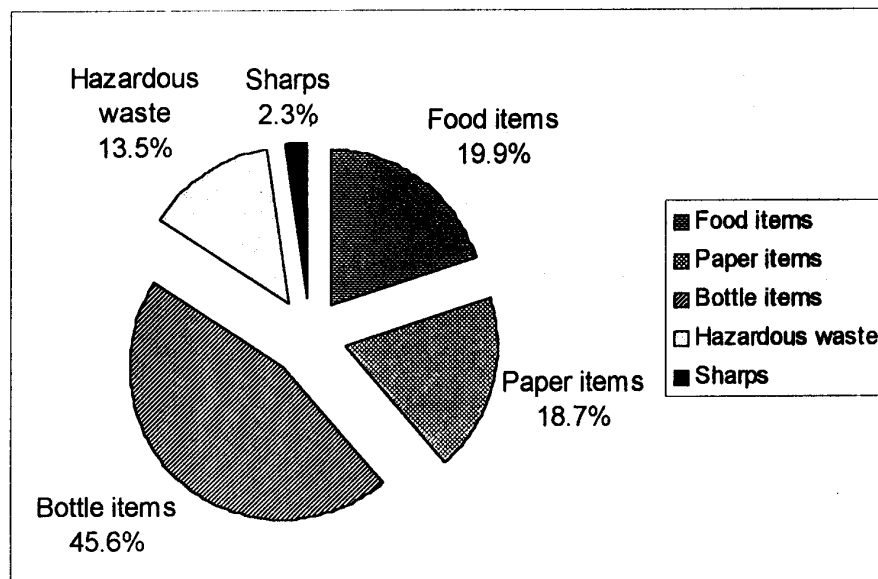
In depth analysis of generated waste on the basis of weight measurement was performed in this ward for a month. This ward contains 12 beds with highly hygienic environment maintained. The ward has provision for segregating wastes into 5 types. General wastes are divided into 3 subtypes i.e, food items, paper items and bottle items. Hazardous waste by the name of used treatment things and sharps are collected separately. Sharps container require long time to fill so it is kept inside the nursing room where as other four types of waste collecting buckets are kept inside the bathroom. The following is the data obtained during the study period.

**Table 5. e. Daily waste generation from Neuro science ward**

Date	General waste			Hazardous waste	
	Food items	Paper items	Bottle items	Used treatment things	Sharps
060-1-1	1.0	1.2	4.0	1.0	
060-1-2	2.0	1.5	5.6	0.5	
060-1-3	1.8	1.2	4.8	1.2	
060-1-4	1.5	0.5	2.9	1.1	
060-1-5	2.2	1.8	4.5	0.9	
060-1-6	3.5	2.0	5.5	1.5	
060-1-7	2.0	1.5	1.8	1.0	
060-1-8	2.5	2.7	4.0	1.8	
060-1-9	3.3	1.1	2.6	2.8	
060-1-10	3.3	1.3	10.3	0.8	
060-1-11	2.6	2.3	7.7	2.1	
060-1-12	3.4	3.1	5.8	3.0	
060-1-13	1.5	2.0	4.5	0.7	
060-1-14	2.2	3.4	5.7	0.0	
060-1-15	3.2	1.5	9.7	1.2	
060-1-16	4.0	0.5	4.5	3.7	5.75
060-1-17	2.8	3.4	8.0	3.1	
060-1-18	1.5	3.6	12.0	1.0	
060-1-19	1.8	3.7	12.0	0.0	
060-1-20	1.8	7.5	8.1	3.1	
060-1-21	1.0	5.5	8.0	4.0	
060-1-22	1.6	3.5	9.5	4.0	
060-1-23	5.2	3.6	9.0	2.5	
060-1-24	4.5	3.5	10.5	1.7	
060-1-25	6.0	2.5	6.0	2.5	
060-1-26	4.0	4.3	12.0	5.0	
060-1-27	6.0	3.2	3.0	1.5	
060-1-28	3.3	2.0	2.0	1.3	3.25
060-1-29	2.2	3.0	5.5	2.5	
060-1-30	2.5	2.0	6.7	1.6	0.75
<b>Total</b>	<b>84.2</b>	<b>78.9</b>	<b>193.2</b>	<b>57.1</b>	<b>9.75</b>

**Table 5. f. Monthly waste generation from Neuroscience ward**

Study period	Bed occupancy rate	Measurement	General waste			Hazardous waste	Sharps	Total
			Food items	Paper items	Bottle items			
April to May 2003	90%	In Kg	84.2	78.9	193.2	57.1	9.75	423.15
		Weight %	19.9%	18.7%	45.6%	13.5%	2.3%	100%
		Total weight %	84.2			13.5	2.3	100%
		Avr. Waste per day in kg	11.88			1.90	0.32	14.1
		Kg/Person/day	1.09			0.17	0.03	1.29



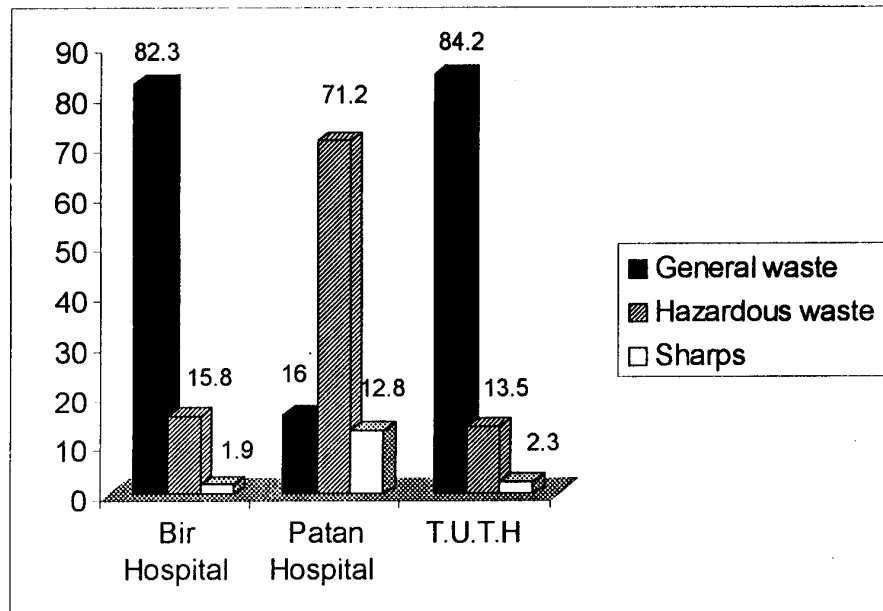
**Chart 5: Biomedical waste Composition (by weight) from Neuroscience ward.**

From the above table it is clear that majority of the waste from Neuro science ward is of general type. The calculated waste percentage resembles with the data obtained from the orthopaedics ward of Bir Hospital with slight variation. Out of the total generated wastes, 84.2% is of general type, 13.5% is of hazardous type and 2.3% is of sharp type. Among the total general waste produced, food items amounts to 19.9%, paper items 18.7% and bottle items 45.6%. The major portion of general waste is reusable. The disposable plastics and bottle items are collected

and sold to recycling agencies. Since majority of the cases are surgical, they get saline water and the collection of such bottles is high in this ward.

#### 5.1.4 Comparative analysis of biomedical waste from three departments

Because of the nature and specialization of departments, the observed composition of waste is different in different department. The two wards selected from Bir hospital and T.U. teaching hospital have almost similar results where as waste from the laboratory of Patan hospital is entirely different in terms of general waste, hazardous waste and sharps. The following graph depicts the variation in data obtained from the studied departments.



**Chart 5: Comparative analysis of bio medical wastes from three departments**

#### 5.2 Findings from the Survey Questionnaire

A total of 75 waste cleaners were contacted for this survey. A lot of information was gathered which are tabulated below.

## Survey Questionnaire for hospital waste management

Focus: Sweeper and cleaners	Patan	TUTH	Bir	Total
Respondents	25	25	25	
<b><u>To test knowledge, attitude and practice</u></b>				
1) Which waste do you think need more care while handling?				
a. General waste	-	-	12%	4%
b. Hazardous waste	32%	20%	24%	25.3%
c. Sharps	44%	28%	20%	30.7%
d. Both b and c	20%	48%	28%	32%
e. Don't Know	4%	4%	16%	8%
2) Do you segregate waste into different types, according to your hospital policy?				
a. Yes	100%	92%	32%	74.7%
b. No	-	4%	48%	17.3%
c. Have no idea about segregation	-	4%	20%	8%
3) Is it good practice to collect general waste, hazardous waste and sharps into the same bucket?				
a) Yes	4%	8%	20%	10.7%
b) No	84%	80%	8%	57.3%
c) Don't know	12%	12%	72%	32%
4) Do you know to segregate waste according to the colour system of the bucket?				
a) Yes	100%	100%	16%	72%
b) No	-	-	84%	28%
5) Do you know how these different types of waste are disposed?				
a) Yes	96%	92%	80%	89.3%
b) No	4%	8%	20%	10.7%
6) What do you think about the cleanness of this hospital?				
a) Very clean	56%	20%	-	25.3%
b) Clean	40%	64%	44%	49.4%
c) Dirty	4%	12%	24%	13.3%
d) Very Dirty	-	4%	32%	12.0%
<b><u>Safety Measures</u></b>				
7) Do you wash your hands after handling waste?				
7.1 a) Yes	100%	100%	100%	100%
b) No				
7.2 How often				
a) Many times	92%	84%	80%	85.3%
b) Some times	8%	16%	12%	12%
c) Only few times				2.7%
7.3 By a) soap	88%	92%	100%	93.3%
b) Special chemical (vircol, et.c)	12%	8%	-	6.7%
8) Which substance do you wear while handling waste?				
a) Gloves only	84%	74%	68%	76%
b) Masks only	-	-	4%	1.3%
c) Both a and b	12%	8%	8%	9.3%
d) None	4%	16%	20%	13.4%
9) Have you accidentally injured your body parts while handling waste				
a) Yes	88%	92%	88%	89.3%
b) No	12%	8%	12%	10.7%

9.1 Which parts of the body				
a) Hand fingers	80%	76%	<b>88%</b>	81.3%
b) Leg fingers	-	-	-	-
c) Both	20%	24%	12%	18.7%
9.2 How many times you were injured?				
a) More than 10 times	12%	16%	<b>24%</b>	17.3%
b) 5 to 10 times	28%	8%	<b>48%</b>	28%
c) 1 to 5 times	60%	76%	<b>28%</b>	54.7
9.3 Which object made the injury				
a) Needles and pins	72%	80%	<b>84%</b>	78.7%
b) scratched glass	12%	8%	12%	10.7%
c) both	16%	12%	<b>4%</b>	10.6%
10) In your service to this hospital have you acquired any of the following diseases in the past				
a) Diarrhoea	-	8%	12%	6.7%
b) Typhoid fever	16%	12%	<b>16%</b>	14.7%
c) Fever only	20%	24%	12%	18.7%
d) Skin disease (allergy etc)	16%	20%	<b>20%</b>	18.6%
e) None	48%	36%	<b>40%</b>	41.3%
<b><u>Hospital policy</u></b>				
11) Are you vaccinated against hepatitis?				
a) Yes	100%	100%	<b>76%</b>	92%
b) No	-	-	<b>24%</b>	8%
12) Do you have taken any in-service training related to hospital waste management?				
a) Yes	96%	88%	<b>80%</b>	88%
b) No	4%	12%	<b>20%</b>	12%
13) Do this hospital provide you sufficient gloves, mask or other needed materials on requirement?				
a) Yes	100%	92%	<b>92%</b>	94.7%
b) No	-	8%	<b>8%</b>	5.3%
14) It is said that nurses and doctors do not strictly follow to collect different types of waste in different container. Is this true ?				
a) Yes	20%	28%	<b>56%</b>	34.7%
b) No	48%	60%	<b>24%</b>	44%
c) Don't know	32%	12%	<b>20%</b>	21.3%
14.1 The solution to this problem is				
a) Doctor's and nurse should be more co-operative to sweepers and cleaners.	36%	40%	<b>72%</b>	49.3%
b) Train new coming doctors and nurses about the waste management system	64%	60%	<b>28%</b>	50.6%
15) Who is responsible for the waste management in this hospital?				
a) All staffs, patient and visitors	80%	80%	<b>88%</b>	82.7%
b) All staffs of the hospital	8%	16%	<b>12%</b>	12%
c) All the sweeper and cleaners of house keeping department.	12%	4%	-	5.3%
16) What is required for improving the present status of waste management in this hospital?				
a) Increase the number of sweeping staffs	20%	12%	<b>8%</b>	13.3%
b) Train staffs and sweepers about the hospital waste management	8%	24%	<b>48%</b>	13.3%
c) Increase awareness to visitors, patients and new coming doctors and nurses.	72%	64%	<b>84%</b>	73.4%



## **CHAPTER SIX**

### **CURRENT WASTE HANDLING PRACTICES**

#### **6.1 Waste Generation, Collection and Segregation**

In Bir Hospital all of the generated wastes are collected in the same municipal container, hence segregation practices if any may be useless at the generation point. Sharps are poorly segregated in special sharp container tins and many cleaners don't know about the location of sharps burner, which is at the top of the hospital. Many in- turn doctors and nurses handle hazardous and sharps material most often, but they do not take care to collect waste in separate bins. When the sharps container is full, cleaners dispose them into the municipal container. The wastes are collected in the municipal container 2 or 3 times a day when the waste bucket is full. The situation of waste from laboratory is highly unmanaged and very hazardous wastes like blood spill, T.B. Patient sputum etc. are collected in the municipal containers. Thus the situation is very grave in Bir Hospital.

Waste generation, collection and segregation practices are well managed in Patan and T.U. Teaching Hospital. In T.U.T.H. It has been observed that both general and hazardous waste are mixed most often which are later segregated at the disposal point. In wards, there is a chance of bucket replacement, which is responsible for mixing of general and hazardous waste. Sometime patient's visitors knowingly or unknowingly throw waste into different container which may cause problem. The followings are the segregation system adopted by the hospitals.

- Bir hospital has yellow tin for sharp collection. It also has yellow bucket for hazardous waste collection but both general and hazardous types of wastes are collected in the yellow bucket.
- In T.U.T.H., bucket with red colour is used for hazardous waste, Green colour for only bottles, blue colour for general waste and yellow colour for paper and plastics.
- Similarly in Patan Hospital yellow colour bucket is for sharps, red colour for infectious waste, blue for paper and plastics, green for food stuffs and orange for broken glass. The radiological waste from Patan and Bir Hospital is sold (only fixer).

## **6.2 Storage, Treatment and Disposal Practices**

Bir Hospital does not have proper storage, treatment and Disposal facilities. The generated wastes are immediately disposed in municipality container. The municipality sometimes provide container with holes and sometimes the provided containers are too high to throw waste inside. Thus wastes are seen thrown haphazardly on the ground. There is a sharp drum incinerator at the top of the hospital unfortunately, many staffs do not know about its location. Regular collection and burning of sharps is rarely seen. The condition is in very grave condition.

Patan hospital has 4 dirty utility rooms, where wastes are collected from different wards and are kept for sufficient time in large buckets until they are filled up. The sharps are stored in plastic- sharp container. The hazardous material are burned in old incinerator where as sharps are burned in separate small capacity incinerator.

T.U.T.H has large buckets to collect waste from the wards. The segregated wastes are incinerated in old incinerator. The new incinerator is rarely used.

## **6.3 Housekeeping department and infection control committee**

There is no infection control committee in Bir Hospital at present. The infection control committee was formed in the past but it is non functional now. Blood-borne infection prevention program was formed some years ago which used to give training to nurses and house keeping staffs, but the program is no longer in existence nowadays. Patan Hospital has a functional infection control committee, which works jointly with housekeeping department. It gives training and awareness programmes to the hospital staffs to prevent cross infection. Patan Hospital has manual for infection control produced by infection control committee which has defined procedure for collection, segregation, storage, treatment and disposal of bio-medical wastes. T.U.T.H also has infection prevention committee and works co-jointly with housekeeping department for giving training and increasing awareness to cleaners and sweepers. It does not have detail manual on waste management like that of Patan Hospital.

The cleaners in Bir Hospital have not been properly immunized against Hepatitis B vaccine. Some workers have taken the vaccination while others are incompletely vaccinated. The training programmes are lacking in Bir Hospital about waste management. Other hospitals have provided effective vaccination and have training classes focused to cleaners and sweepers.

From various analysis, Patan Hospital has best waste management practices, where as Bir Hospital has worst waste management practices.

# CHAPTER SEVEN

## THEORETICAL ESTIMATIONS

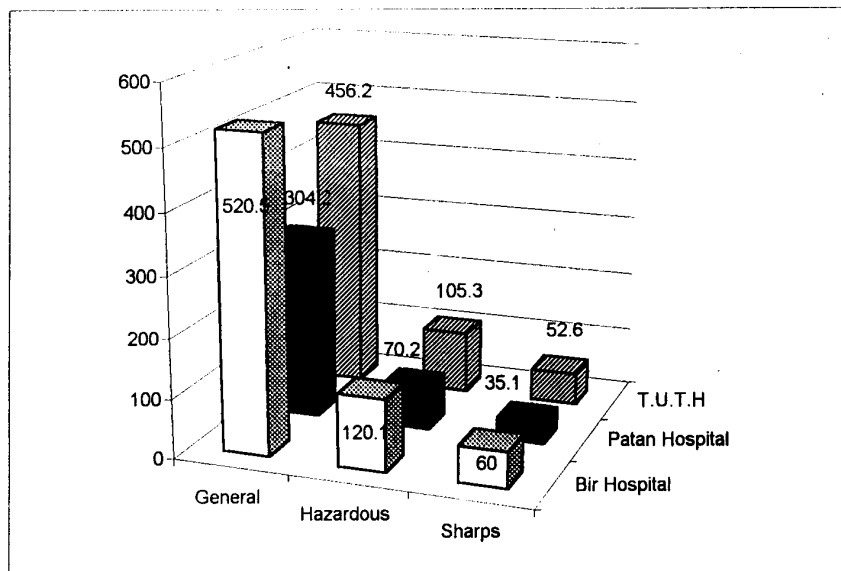
### 7.1 Total waste generation in three hospitals

Theoretical estimations have been calculated in terms of total waste generation in the surveyed hospitals. Figures indicating the average waste quantity generated per day in the hospitals have been aggregated from literature review and probable best approximations. Hospital statistics were obtained from authorized persons of the institutions surveyed. Only three components, namely general waste, hazardous waste and sharps items are included in the calculations. The following are the assumptions made for the final calculation.

- Average general waste/ patient/ day = 1.3 kg
- Average Hazardous waste/ patient/ day = 0.3 kg
- Average sharps waste/ patient/ day = 0.15 kg

**Table 7. a. Estimated total waste generation per day by three hospitals**

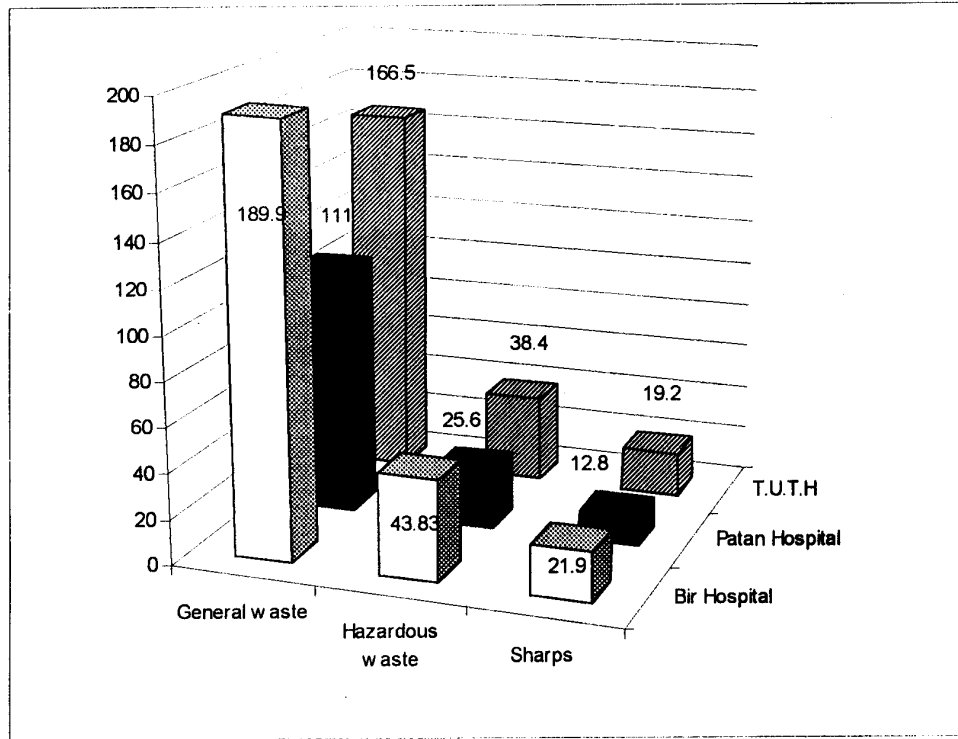
Name of Hospital	Total beds	Beds occupancy rates	Avr. Occupied beds in a day	General (kg)	Hazardous (kg)	Sharps (kg)	Total
Bir Hospital	426	94%	400.4	520.5	120.1	60	700.6
Patan Hospital	289	81%	234	304.2	70.2	35.1	409.5
T.U.T.H	428	82%	350.9	456.2	105.3	52.6	614.1



**Chart 6: Bar Diagram of comparative Analysis of waste produced in a day from three hospitals**

**Table 7. b. Estimated total waste generation in terms of weight (by tons) in the year 2059**

Name of Hospital	Annual average (in tons) for the year 2059			Total
	General waste	Hazardous waste	Sharps	
Bir Hospital	189.9	43.83	21.9	255.6
Patan Hospital	111	25.6	12.8	149.4
T.U.T.H	166.5	38.4	19.2	224.1



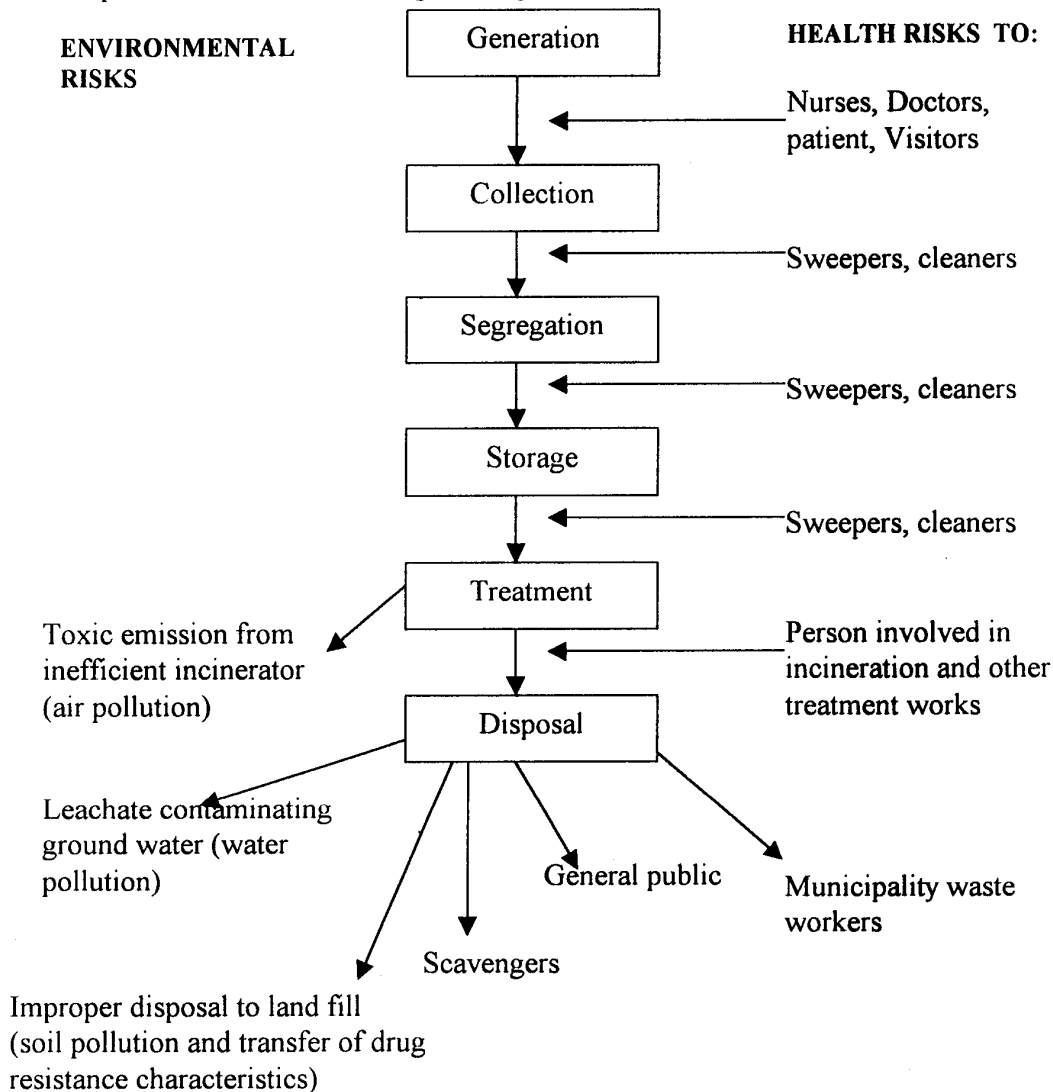
**Chart 7: Bar diagram of comparative Analysis of waste produced in a year from three hospitals (in tons)**

From the above tables, it is clear that a vast amount of hospital waste is generated each day. Since Patan and T.U.T.H have good treatment facilities, hazardous waste do not pose much risks, however Bir Hospital does not have such treatment facilities, so the waste pose great risk to persons who come in contact to such waste.

# CHAPTER EIGHT

## HEALTH AND ENVIRONMENTAL HAZARDS ASSOCIATED WITH HOSPITAL WASTE

Hospital wastes include a large component of general waste and a smaller proportion of hazardous waste. General wastes usually do not pose any health effect or hazard to human health and environment. However, individuals exposed to hazardous waste are potentially at risk of acquiring disease and agents from hazardous waste can contaminate environment. Improper incineration and disposal of hazardous waste can pollute air, water and soil. Thus hazards due to hospital waste can be categorized into two, namely health hazards and environmental hazards. Following is a flow-chart showing health and environment risks posed by hospital waste in different stage of disposal chain.



**Chart 8: Flow chart showing environmental and health risk  
in the process of generation to disposal**

## 8.1 Health risks of hospital waste

People involved in waste management are liable to be exposed to health risks at different stages of the disposal chain of hospital waste. The major point at which such exposure could be encountered is enumerated below.

- At the source of waste generation and during collection of hazardous waste.
- During treatment of hazardous waste including sharps.
- During on-site and off site transportation.
- During storage and final disposal of hazardous waste.

Among the three hospital surveyed, Bir hospital has very poor waste management practices. The waste that is generated in wards, outpatient departments, and laboratory are collected in open buckets without plastic bags covering the buckets. Only buckets from the operation theatre have plastic linings. Segregation is not a routine procedure and sweeper and other staffs of the hospital mix all kinds of wastes into the same bucket. Hence general waste is contaminated by hazardous waste and handling such waste many pose health risks. Only low quantities of sharp materials are segregated. The un-segregated sharp materials are collected in the same bucket where general wastes are collected. This renders whole waste risk to handle. During the study period, one HIV patient was being treated in the orthopaedic department of Bir Hospital. The highly hazardous waste produced from the HIV patient was disposed with other waste into the municipality container. Improper disposal of waste like this is highly hazardous and pose greater health hazard. Though hospital management provide dress and protective equipments, some sweepers do not follow to wear dress and protective things, and hence are probable to acquire disease from the wastes. Some places inside the hospital are kept in dirty condition with wet dump, which can spread vector-borne disease by giving fertile breeding environment to arthropods. All types of wastes are disposed in a container provided by the municipality. The container has easy access to scavengers, rag pickers, rodents, birds, animals and drug addicts. It has been reported that some drug addicts collect and reuse syringes that are disposed in the container. There is also health risk who are responsible for segregating the waste for reuse. The waste container of Bir Hospital is in open condition and waste materials are disposed off outside the container. This even make whole scenery filthy to look. The waste outside the container can be a source of infection to birds, animals, rodents and to humans. Hence health risk associated with hospital waste from Bir Hospital is high.

Other two hospitals have more managed waste management practices. Both the hospitals (Patan and T.U.T.H.) have containers not easily accessible to scavengers, rodents and animals. The container of TUTH is placed in a safe place, which has a roof and external boundaries. Patan Hospital has openly placed container inside the hospital premises where only general wastes are disposed.

Though different principles are adopted by the hospitals to minimise health risks due to exposure of hazardous wastes, a significant number of waste handlers are infected from infectious diseases. From the questionnaire survey it has been revealed that of the total waste handlers, 6.7% contacted diarrhoea, 14.7% were infected with typhoid fever, 18.7% had got fever, and 18.6% have got skin diseases.

## **8.2 Environmental Risks of Hospital Waste**

Open collection and disposal of hazardous waste may cause air-borne contamination and hence increase air-borne infection. A defective and inefficient incinerator may produce toxic emissions and cause air pollution. Similarly improperly treated waste into the landfill or river system can be serious because it can affect both food chain and water chain system. Disposal of sewage and radiological waste from hospitals into water system can damage aquatic life and spread water-borne infection like cholera, typhoid, hepatitis, etc. The infectious waste coming from hospital patient is sometime multiple drug resistant. Disposal of such waste into the virgin soil may transfer drug resistant characteristic into the normal bacteria. The normal bacteria in turn could become more pathogenic and multiple drug resistant and hence may help in the emergence of new profile of bacteria.

Thus the major components of the environment namely air, water and soil become damaged by improper waste treatment and disposal practices.

Only two hospitals (Patan and TUTH) have well managed incinerators. Both the hospital use old incinerators with improper ignition at low temperature. This causes high emission of particulate matter and pollution of air. Burning at low temperature would not destroy all micro organisms and this will favour in the spread of disease by air contamination. In fact both the hospital incinerators have leakage and emit smoke not only from the chimney but from other parts as well.

Bir Hospital has irregularly managed drum incinerator for the purpose of burning sharps material. The waste container of Bir Hospital is placed in Hap-hazard condition without proper boundaries. It doesn't have roofs and wastes are sometimes open-burned. During the monsoon period water washes hazardous waste and forms spills around the ground and the road. Thus the place is highly risk from health and environment point of view.

Municipality disposes the wastes from these hospitals into the landfill in Kirtipur near by the bank of Bagmati river. Both river and land system may get contaminated from such wastes.

## CHAPTER NINE

### CONCLUSIONS AND RECOMMENDATIONS

#### 9.1 Conclusions

- a. The outcomes of investigation carried out in the present study have been revealing in many ways. The two of the three hospitals namely Patan hospital and T.U. teaching hospital have integrated approach of waste management while Bir Hospital has poor hospital waste management. Till now there is no central authority to watch and monitor the management practises of hospital waste, so hospital authorities are treating waste carelessly.
- b. The waste generated from orthopaedic ward of Bir Hospital contains general waste 82.3%, hazardous waste 15.8% and sharps 1.9% by weight. It is observed that 16% of the total waste generated from the laboratory of Patan Hospital is of general type, 71.2% is hazardous in nature and 12.8% of the total waste is sharp. Similarly results obtained from neuroscience ward has similar results as compared to orthopaedics ward of Bir Hospital. It contains 84.2% general waste, 13.5% hazardous wastes and 2.3% sharps. The laboratory of Patan hospital has high recording of hazardous and sharp wastes as compared to other departments.
- c. Both hazardous and general wastes are collected in the same bucket in Bir Hospital. Bir hospital requires hygienic system approach in handling, storage, transport, treatment, and disposal of hospital wastes. Among the three hospitals only Patan hospital has auditing and recording system of generated waste done by the house-keeping department. None of the other hospital keeps records of produced waste.
- d. Investigations showed that a high proportion of waste handlers are exposed to the risks associated with medical waste handling. Significant number of staffs from Bir hospital do not wear protective clothing and equipment in the process of waste management. Staffs involved in waste management are highly unaware of risk associated with health care waste.
- e. Patan and TUTH hospital have working infection control committee. Bir hospital lacks such committee at present. From field observation and through questionnaires it has been seen that among three hospitals Patan hospital has best waste management practices where as Bir Hospital has worst waste management practices.
- f. Public awareness through mass media, proper hygienic education to scavengers, compulsory staff training for waste management, and legislation to regulate hospital waste management system will change the problem encountered with current practices of hospital waste management.



## 9.2 Recommendations

Improvements in medical waste management involve a number of activities, which can be undertaken as a series of small steps. The following general and specific recommendations are hereby made toward the improvement of hospital waste management.

### General

- a. The government should formulate and implement laws, regulations policies and guidelines for the handling and disposal of hazardous waste.
- b. Courses on hospital waste management should be integrated in all undergraduate and graduate levels focusing to Nursing, Medical and Paramedical students.
- c. Education and training to the staffs and directions to patients and visitors about hospital waste will lead to improved waste management practices and reduce savings.
- d. Since hospital wastes are a public health concern, the population should be adequately educated on the risks involved in haphazard handling of the wastes. Moreover, staffs from the housekeeping department need an intensive and regular in-service training related to hospital wastes.
- e. Hospital policy makers should establish their own standard regarding waste management plan. They should establish infection control committee with integrated approach for collection, treatment and disposal of hospital wastes.
- f. The hospitals management should minimize hazardous and infectious wastes at the sources; and give priority to the recycling and resources recovery of wastes.
- g. Most of the health-care institutions do not have on site treatment facilities, thus any responsible government agencies can establish a central treatment technology by taking certain charges from the hospitals. "Polluters pays principle" can also be established. Another option could be to contract out to private sectors for offside treatment and disposal of hospital waste.
- h. Coloured posters, and information relating to hospital policies on waste management and infection control should be sufficiently placed inside wards, corridor and hospital premises.
- i. Proper management of Health care waste require integrated and systemic approach. The Ministry of Health and ministry or environment should play a leading role in policy formulation, program and strategy development for the implementation of health care waste.

## I. Specific

- a. Bir Hospital should establish its waste management policies. The segregation of sharps should be made mandatory. Though the sharps are segregated, they are not collected in a drum incinerator. In-service training should be given regularly to the cleaners. Co-operation between different departments should be established. The final disposal place should be managed properly to avoid unauthorized access and if possible boundaries with roof be made. Separate buckets for general and hazardous waste should be provisioned. Vaccination should be given to sweepers and cleaners.
- b. The Teaching Hospital should give more care while collecting and segregating waste generated at source. Levels should be printed in the surface of buckets for different categories of wastes. New incinerator that is more efficient than the old one should be used.
- c. The Patan Hospital's incinerator is very old so it should be replaced with modern one. Information regarding awareness about hospital waste should be placed at frequent places.
- d. The Kathmandu metropolitan city has incinerator designed to burn hazardous wastes collected from health care institutions of Kathmandu city. It is not in workable condition now. Maintenance should be done as soon as possible to incinerate hazardous wastes. The municipality must be punctual to collect and transport containers from respective, hospitals. Some waste containers are in very poor conditions so they should be replaced.
- e. It is a giant step initiated by NHRC by publishing a training manual on health-care waste management. However, the manual has not been implemented by any hospitals so far. More emphasis should be given to implement such guidelines and training manual. It possible a booklet in Nepali language should be developed so that general people including waste cleaners could understand the content easily. An awareness poster can also be developed to place in hospital premises. NHRC can also integrate with other hospitals to train hospital personals at central level.

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### Survey Questionnaire for hospital waste management

Name of the hospital:

Ward Designation:

Work Designation:

Age and Sex of Respondent:

Duration of Service:

Education Level:

Focus: Sweeper and cleaners	Patan	TUTH	Bir	Total
<p>Respondents</p> <p>Range of period of employment</p> <p>Range of educational level</p> <p><b>To test knowledge, attitude and practice</b></p> <p>1) Which waste do you think need more care while handling?</p> <p style="padding-left: 40px;">a. General waste</p> <p style="padding-left: 40px;">b. Hazardous waste</p> <p style="padding-left: 40px;">c. Sharps</p> <p style="padding-left: 40px;">d. Both b and c</p> <p style="padding-left: 40px;">e. Don't Know</p> <p>2) Do you segregate waste into different types, according to your hospital policy?</p> <p style="padding-left: 40px;">a. Yes</p> <p style="padding-left: 40px;">b. No</p> <p style="padding-left: 40px;">c. Have no idea about segregation</p> <p>3) Is it good practice to collect general waste, hazardous waste and sharps into the same bucket?</p> <p style="padding-left: 40px;">a) Yes</p> <p style="padding-left: 40px;">b) No</p> <p style="padding-left: 40px;">c) Don't know</p> <p>4) Do you know to segregate waste according to the colour system of the bucket?</p> <p style="padding-left: 40px;">a) Yes</p> <p style="padding-left: 40px;">b) No</p> <p>5) Do you know how these different types of waste are disposed?</p> <p style="padding-left: 40px;">a) Yes</p> <p style="padding-left: 40px;">b) No</p> <p>6) What do you think about the cleanness of this hospital?</p> <p style="padding-left: 40px;">a) Very clean</p> <p style="padding-left: 40px;">b) Clean</p> <p style="padding-left: 40px;">c) Dirty</p> <p style="padding-left: 40px;">d) Very Dirty</p> <p><b>Safety Measures</b></p> <p>7) Do you wash your hands after handling waste?</p> <p style="padding-left: 20px;">7.1 a) Yes</p> <p style="padding-left: 20px;">b) No</p> <p style="padding-left: 20px;">7.2 How often</p> <p style="padding-left: 40px;">a) Many times</p> <p style="padding-left: 40px;">b) Some times</p> <p style="padding-left: 40px;">c) Only few times</p> <p style="padding-left: 20px;">7.3 By a) soap</p> <p style="padding-left: 40px;">b) Special chemical (vircol, et.c)</p> <p>8) Which substance do you wear while handling waste?</p> <p style="padding-left: 40px;">a) Gloves only</p> <p style="padding-left: 40px;">b) Masks only</p> <p style="padding-left: 40px;">c) Both a and b</p> <p style="padding-left: 40px;">d) None</p>				

<p>9) Have you accidentally injured your body parts while handling waste</p> <p>a) Yes b) No</p> <p>9.1 Which parts of the body</p> <p>a) Hand fingers b) Leg fingers c) Both</p> <p>9.2 How many times you were injured?</p> <p>a) More than 10 times b) 5 to 10 times c) 1 to 5 times</p> <p>9.3 Which object made the injury</p> <p>a) Needles and pins b) scratched glass c) both</p> <p>10) In your service to this hospital have you acquired any of the following diseases in the past</p> <p>a) Diarrhoea b) Typhoid fever c) Fever only d) Skin disease (allergy etc) e) None</p> <p><b><u>Hospital policy</u></b></p> <p>11) Are you vaccinated against hepatitis?</p> <p>a) Yes b) No</p> <p>12) Do you have taken any in-service training related to hospital waste management?</p> <p>a) Yes b) No</p> <p>13) Do this hospital provide you sufficient gloves, mask or other needed materials on requirement?</p> <p>a) Yes b) No</p> <p>14) It is said that nurses and doctors do not strictly follow to collect different types of waste in different container. Is this true ?</p> <p>a) Yes b) No c) Don't know</p> <p>14.1 The solution to this problem is</p> <p>a) Doctor's and nurse should be more co-operative to sweepers and cleaners. b. Train new coming doctors and nurses about the waste management system</p> <p>15) Who is responsible for the waste management in this hospital?</p> <p>a. All staffs, patient and visitors b. All staffs of the hospital c. All the sweeper and cleaners of house keeping department.</p> <p>16) What is required for improving the present status of waste management in this hospital?</p> <p>a. Increase the number of sweeping staffs b. Train staffs and sweepers about the hospital waste management c. Increase awareness to visitors, patients and new coming doctors and nurses.</p>				
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**SURVEY QUESTIONNAIRE FOR HOSPITAL WASTE MANAGEMENT**  
( Modified from WHO survey questionnaire)

Name of the hospital :

Contact Person :

Designation :

Total No. of Beds :

No of Outpatients / Day :

No of Patients per month / year :

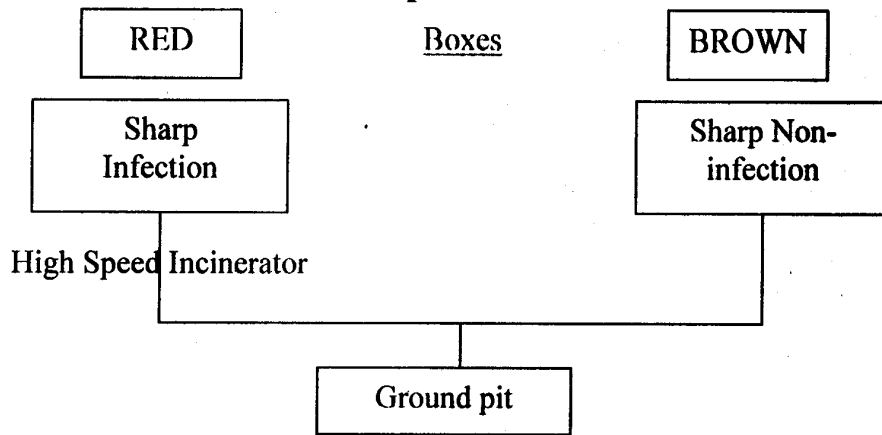
Bed Occupancy Rate :

1. Total number of persons involved in collection, handling, and storage of hospital waste .....
2. Designation of Person(s) responsible for organization and management of waste collection, handling , storage and disposal at the hospital administration level.  
.....  
.....
3. Has he/she received any training on hospital waste Management? Yes.....No.....  
If yes, What type of training and of what duration ? .....  
Workshops.....Meetings.....Pamphlets/other.....
4. Do the waste management have job description detailing their work ?  
Yes .....No.....
5. Are instruction/ training given to the newly hired waste management staff  
Yes.....No.....
6. Is there a manual or guideline document on management of hospital waste available in Nepal ? Yes.....No.....  
If yes, Give the title of the document.....
7. Does your hospital has its own written document regarding hospital waste management ? Yes.....No.....  
If yes, Give the title of the document.....
8. Are there clearly defined procedures for collection and handling of wastes from Specified units in the hospital ? Yes.....No.....
9. Does your hospital have a waste management plan ? Yes.....No.....  
If yes, please attach a copy.....

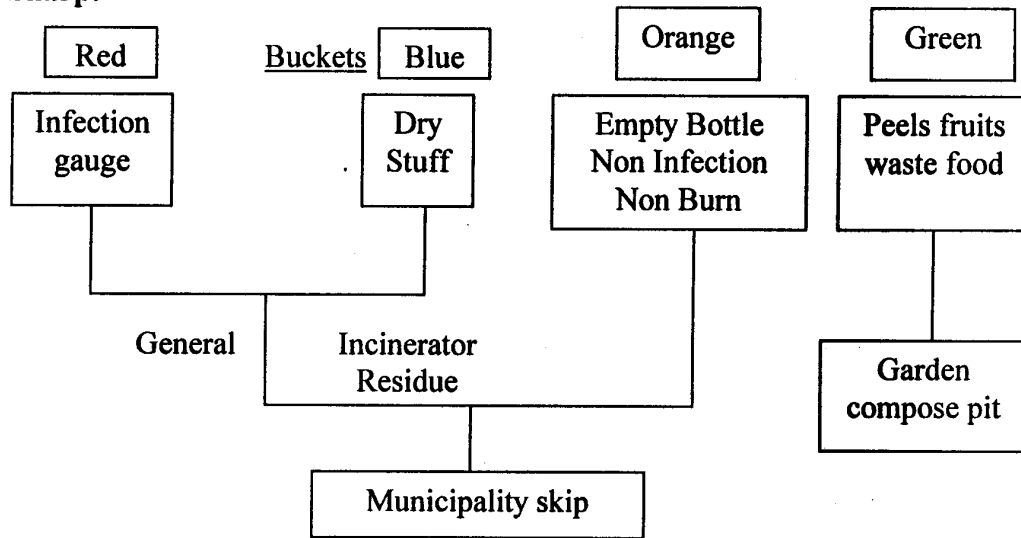
10. Does your hospital have a waste management team (or teams) ? Yes.....No.....  
If yes, please list the members by designation:  
Team leader..... Team members..... Waste handling  
staff..... Others.....
11. Is there a separate environmental service in your hospital ? Yes.....No....
12. Provision of waste collection:     a. Plastic bins.....  
  b. Metal bins...  
  c. Covered..... Yes..... No...
13. Total budget invested on hospital waste management.....?
14. Any vaccination given to the person involved in collection, handling, storage, and disposal of hospital waste ?.....
15. Present methodology of waste disposal:  
    a. General waste.....  
    b. Hazardous waste.....  
    c. Sharps: .....  
    d. Radio active waste.....  
    e. Liquid waste- sewage.....  
    f. Prerssurized containers.....
16. Where is the segregation taking place ( i.e., operating rooms, Laboratory or Disposal point) ?  
.....
17. What type of containers / bags are used to segregate waste( bags, cardboards, plastic containers, metal container etc)  
.....
18. What type of labeling, color-coding ( if any ) is used for marking segregated waste?  
.....  
.....
19. Describe briefly the final disposal of segregated waste (taken to municipal landfill, buried on hospital grounds, incinerated, open burned etc ?  
.....
20. Describe your hospital's material and waste management plans as it applies to the handling of infection waste ?  
.....  
.....  
.....  
.....

**Patan Hospital  
Hospital Solid waste**

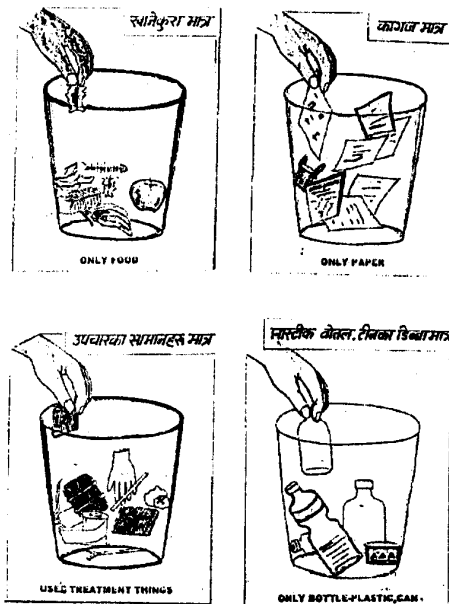
**A. Sharp:**



**B. Non-Sharp:**



**3. Flow chart for solid waste management in Patan hospital**



**4. Waste collection methodology in T.U. Teaching Hospital**



## Department of Orthopaedics

## 1. Basic Design of orthopaedics department

Clothes collection	Corridor	Windows	
Toilet			
Store		Female ward (8 beds)	
Male ward (12 beds)		Male ward (7 beds)	
Sister office store and dressing room		Children ward (4 beds)	
Office of orthopaedics Department of			

## 2. Strategy adopted by Patan Hospital to segregate hospital waste

CLINICAL (INFECTIOUS)		NON-CLINICAL (NON-INFECTIOUS)			
Sharps	Non-sharps	Sharps		Non-sharps	
Used Needles, Used IV Cannulas, Used Blades ↓	Dirty Dressings, Body Tissues, Disposable Tubes, Foley Catheters ↓	Broken ampoules ↓	Other broken glass ↓	Paper, plastics & plastic Bottles, tins ↓	Food scraps fruit and Vegetable peelings ↓
	Red Bucket ↓	Brown Bucket ↓	Orange Bucket ↓	Blue Bucket ↓	Green Bucket ↓
Place at the bedside when procedure is being done. ↓	Seal waste in plastic bag before putting in tin. ↓	Collected in a separate bin and taken outside. ↓		↓	↓
Burn in high temperature Needle incinerator. ↓	Burn in general incinerator ↓	↓	↓	Burn in general incinerator ↓	↓
Dump in pit.	Dump in yellow rubbish skip.	Dump in pit.		Dump in yellow rubbish skip.	Dump in pit to compost



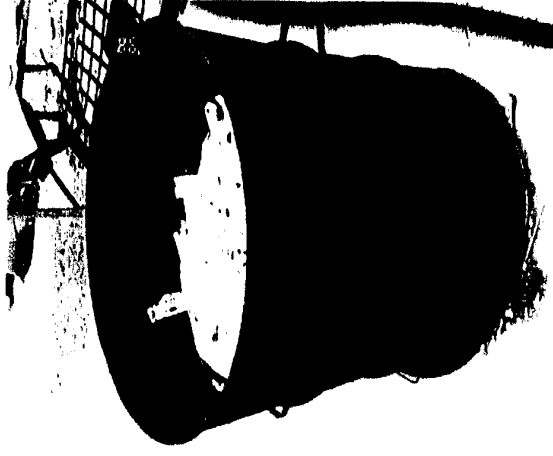
Open Burning of hospital wastes



waste accumulated around water pipe



Hap-hazard collection of hospital wastes



Sharp incinerator of Bir Hospital



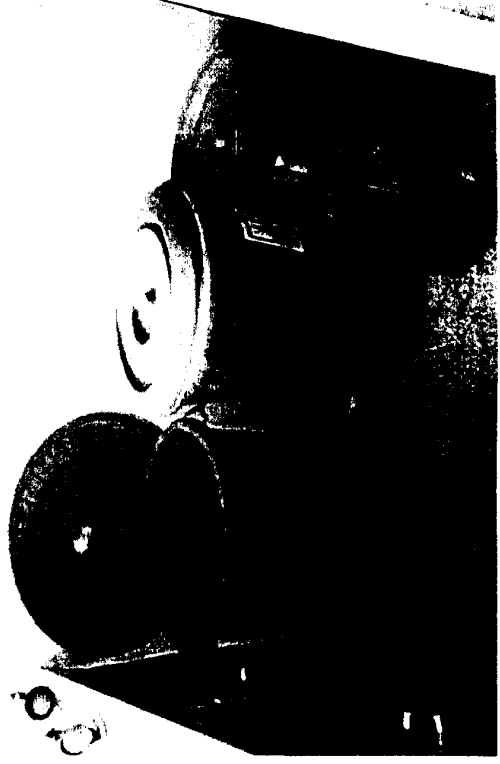
Non infectious sharps disposed at waste pit



Sharps collector



Location of two incinerators



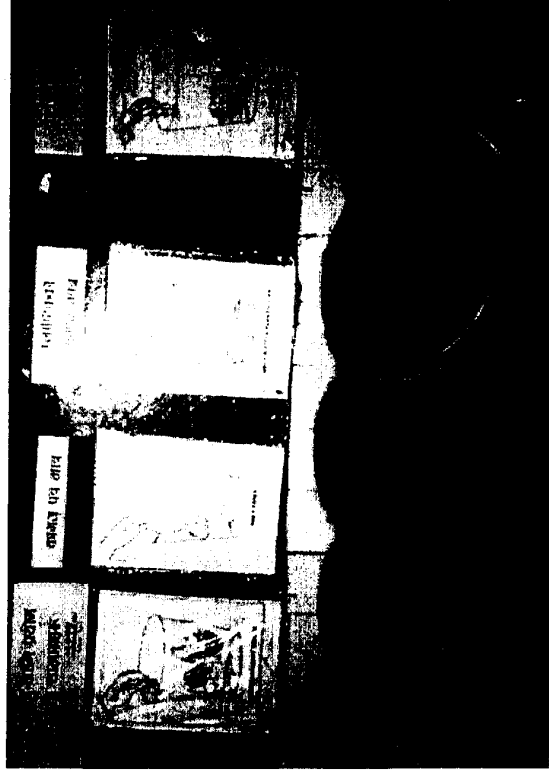
Waste collection at dirty utility room



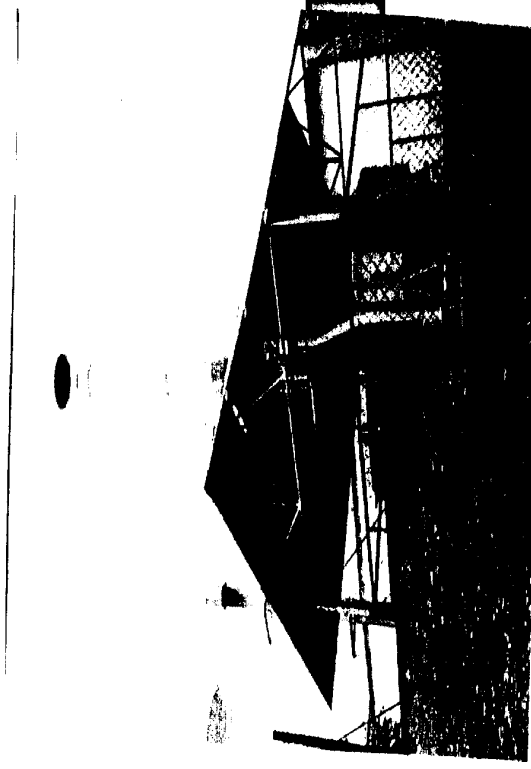
Disposal of collected Waste in Municipal Container



Burning Hazardous waste in old incinerator



Method of waste collection



New incinerator



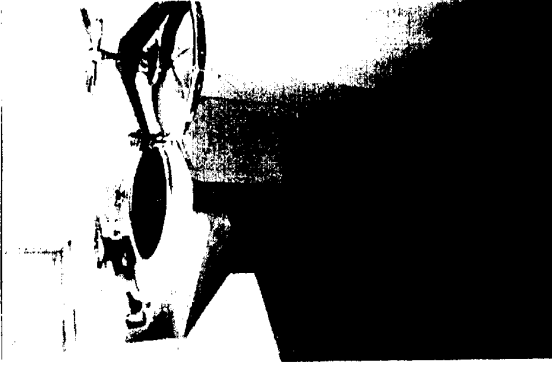
Waste segregation at Teku



Operation Theatre of Bir Hospital



Hazardous waste collector of Patan Hospital



Vertical autoclave to dispose hazardous waste in Patan Hospital