

# Hospital Waste Management in Pakistan

*Case Study Report*  
**Special Waste Fractions: Hospital Waste**

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## PREFACE

This study has been done in the framework of UWEP, the Urban Waste Expertise Programme, a six-year programme - 1995-2001 - of research and project execution in the field of urban waste management in the south. UWEP aims at:

- ♦ generating knowledge on community and small and micro enterprise involvement in waste management
- ♦ developing and mobilizing south expertise on urban waste issues

The Urban Waste Expertise Programme covers a range of topics related to waste management in the context of the urban environment in the south - solid waste collection and transfer, waste minimization, recycling of various waste fractions, resource recovery and liquid waste treatment.

Waste management and its various stakeholders now form a rapidly growing area of interest. The role played by small and micro-enterprises and communities, however, is still much neglected. UWEP aims to generate, analyse, document and customize the information that is gathered during research and pilot projects, in order to enhance the expertise of the UWEP target groups, ultimately aiming at an improved integrated sustainable waste management system. This will in the long run lead to an improved environment, create more employment and offer improved urban services for everyone.

One of the UWEP research topics was hospital waste and the possibilities of responsible re-use by involving small enterprises. This report, "Hospital Waste Management in Pakistan", reflects the results of a case-study research done by Rehan Ahmed commissioned by WASTE, the executing agency of the UWEP programme. Similar researches on the topic of hospital waste management were undertaken in Colombia, the Philippines and Vietnam. By publishing these case-study reports, we explicitly aim at divulging the data gathered during the researches. UWEP sees this report as one of the ways of focusing attention on small and micro-enterprises, community involvement and their invaluable role in urban waste management.

Hopefully this publication helps you to form a picture of the role the various stakeholders play in urban waste management. More information and an overview of the other UWEP reports and books can be obtained from WASTE.

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Gouda, April 1998*



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## ABBREVIATIONS

ADB	Asian Development Bank
AKUH	Aga Khan University Hospital
AKUMC	Aga Khan University Medical Centre
ASH	Abbasi Shaheed Hospital
BHU	Basic Health Center
BMSI	Basic Medical Science Institute
CHK	Civil Hospital Karachi
DMC	District Municipal Corporation
ENT	Ear, Nose and Throat
EPA	Environmental Protection Agency
ICU	Intensive Care Unit
JPMC	Jinnah Post Graduate Medical Center
KMC	Karachi Metropolitan Corporation
KWSB	Karachi Water and Sewerage Board
LNH	Liaquat National Hospital
MCH	Mother and Child Health
NESPAK	National Engineering Services Pakistan (Pvt.) Ltd.
NEQs	National Environmental Quality Standards
OMI	Orthopaedic Medical Institute
OPD	Out Patient Department
PEPA	Pakistan Environmental Act
PEPC	Pakistan Environmental Protection Council
PEPO	Pakistan Environmental Protection Ordinance
PMA	Pakistan Medical Association
RMO	Resident Medical Officer
SITE	Sindh Industrial Trading Estate
SKAA	Sindh Karachi Abadi Authority
SLGO	Sindh Local Government Ordinance
SME	Small and Medium Enterprise
SRS	Sarfraz Rafique Shaheed Hospital
SWM	Solid Waste Management
TBA	Traditional Birth Attendants
UWEP	Urban Waste Expertise Programme
WHO	World Health Organization



# CHAPTER 1 INTRODUCTION

## 1.1 Background

One of the activities that Urban Waste Expertise Programme (UWEP) focus is on special waste including Health Care waste and batteries.

Health Care waste is special type of waste that is generated in relatively small quantities as compared to the domestic, institutional and commercial waste. In spite of being hazardous and containing infectious components, this waste is not properly being taken care of by the generators and disposal authorities/agencies. In developing countries and especially in the major urban centres, Health Care waste often do not get proper attention in terms of storage, segregation, collection, transportation, treatment and disposal. Health Care waste is a problem both inside as well as outside the hospital and health care concerns. Health Care waste is often disposed of along with other municipal waste components and is being handled by the municipal and local government without giving proper attention to its varied components and constituents. Recycling of health care waste is flourishing and many useful components are retrieved, segregated and recycled by the informal sector and actors. SMEs are involved in this business. The absence of information and awareness is causing greater problems of pollution generation directly affecting the human beings involved as well as those who come in contact with this recycled waste stream. Due to the prevailing approach the health care waste has become a great threat to the environment.

The UWEP 10 study focus on action based research on health care waste along with batteries. This report describes the research on health care waste only and is done for the city of Karachi, Pakistan. Through this research many case studies in major urban centres in developing countries are undertaken to assess the existing health care waste management practices as well as to assess the role and extent of the SMEs.

## 1.2 Objectives

The objective of the research was to examine, analyse and document the existing health care waste management system in the city of Karachi, Pakistan. The basic aim was to provide information regarding the actual establishment of an economic and environmental sound basis for small enterprises to participate in the handling of health care waste. There are many reason for this assumption as:

- ◆ health care establishments are places where special waste are generated in a relatively confined area
- ◆ the health care waste produced is heterogeneous in nature, composition and constituents. Each family in the hospital and health care facility is producing different quantity and composition of waste.
- ◆ the economic value of the health care waste components is relatively high as compared to other type of waste involving items like used medicines, cotton, syringes, plastics, bottles, glass, drips etc. The items produces as health care waste offers good opportunity for income generation and employment provided it is done in an environmental friendly way.

Based on these aims and objectives, the overall UWEP 10 research covers the research studies in major urban centres of the Developing Countries. This research is conducted in the city of Karachi which is the largest urban centre of Pakistan with over 12 million people having a wide variety of health care facilities and informal recycling enterprises.

The study aims at analysing the prevailing health care waste management system and emphasise the role of informal sector and SMEs. Together these studies will give a clear picture of how the informal sector and SMEs are participating and are involved in Health Care waste and recycling. In addition, the studies and research will further define the scope and extent of pilot projects.

### **1.3 Area Description**

The study area consist of the entire city of Karachi consisting of municipal and cantonment area and area under the control of other administrative agencies, organizations and departments.

Karachi is the largest centre of Pakistan with an area of 3365 sq.km. housing over 12 million people. Karachi is growing at a tremendous growth rate of about 6 percent, which is twice the average national growth rate. Half of the population growth is attributed towards the natural growth and the remaining half is due to mass influx of people from upcountry and neighbouring countries like India, Bangladesh, Sri Lanka, Burma and Afghanistan. Phenomenal increase in population has taken place in Karachi during the recent years. The fact can be confirmed from the figures that before independence in 1947, Karachi was a small city with a population of less than half a million and was considered to be the most cleanest city of the Indo-Pak sub-continent. In terms of growth, Karachi has grown 75 times in 100 years and 18 times in 40 years. The population density greatly varies in the city but in central urban area it is around 2800 persons/sq.km. while the overall urban density is about 1524 persons/sq.km.

Culturally the population of Karachi is heterogeneous in nature consisting of the ethnic groups from all the four provinces in Pakistan and Kashmir. Approximately 1.5 million people in Karachi are illegal migrants from the neighbouring countries. In terms of religion 97% of the population of Karachi is Muslim, besides a small percentage of minorities includes 2% Christians, 1% Hindus and from other religions. Karachi is a conglomeration of various ethnic groups and backgrounds and can be rightly termed as a cosmopolitan city or a mini Pakistan that is the meeting point of all provincial cultures.

Karachi like other major cities of the country can broadly be divided into three types of localities i.e. high, middle and low income based on the general socio-economic status. Due to shortage of the housing stock for lower income group and mass migration taking place from upcountry and neighbouring countries, innumerable slums and squatter settlements have emerged in Karachi which houses about 40% of the city's population. It is expected that by the end of this century approx. 50% of the total city's inhabitants will be living in these squatter settlements. In 1980 there were 362 identified slum settlements or 'Katchi abadis'. In 1996 there were more than 532 regularizable slums (regularizable means the slums which existed before March 23, 1985 with more than forty houses on land which will be spared by the Owner/Government Department/Organization for the slum up gradation and the competent authority either KMC or SKAA has decided to legalize it). Almost all slums and

katchi abadies are low-income settlements. For a long time the Government has not recognized the informal system of low income housing and slums and attempted to remove these illegal settlements by bulldozing them and settling the squatters in official colonies like Landhi and Korangi. With the passage of time the number of slums assumed enormous proportions and the capacity of local authority dwindled. Moreover the katchi abadies acquired political prestige on account of their number. The Government thus bowed to the doctrine of necessity and adopted the international approach of upgrading/ regularization and legalization of slums.

The 1980 housing survey revealed that 76% of the housing units in Karachi are small with one or two rooms. On an average 7 persons per household is witnessed with an occupancy of 3 persons per room. The survey further revealed that 64% of the population in urban areas live in their own houses. The development and provision of basic infra-structure facilities and utilities like water supply, sewerage, solid waste management, electricity etc. have not kept pace the population growth and urbanization and are seriously deficient in quality and quantity.

The health care waste facilities in Karachi were studied by the Consultant. The data and useful information has been collected from the various Health Care facilities in Karachi depending on UWEP aims, objectives scope, time and available resources. To assess the health care waste situation in Karachi following facilities were visited.

- ◆ Aga Khan University Hospital
- ◆ Jinnah Post Graduate Health Care Center
- ◆ Civil Hospital
- ◆ Liaquat National Hospital
- ◆ National Institute of Child Care
- ◆ Cardiovascular Hospital
- ◆ Abbasi Shaheed Hospital
- ◆ Pathological Laboratories
- ◆ X-Ray Clinics/Radiological Labs
- ◆ Dentists
- ◆ Clinics
- ◆ Dispensaries
- ◆ Consulting Clinics
- ◆ Basic Health Centers
- ◆ Maternity Homes
- ◆ Blood Banks
- ◆ Communal Storage/Bins at Health Care facilities
- ◆ Middle Dealers of Recycling Material
- ◆ Main Dealers of Recycling Material
- ◆ Recyclers of Health Care Waste

#### **1.4 SWM Situation in Karachi**

In Karachi around twenty different agencies and organizations are working for Solid Waste Management (SWM) including five District Municipal Corporation (DMC), which were established by the Karachi Metropolitan Corporation (KMC) for administrative purposes only in the municipal area, seven Cantonment Boards, Karachi Port Trust, Pakistan Steel, Port

Qasim, Civil Aviation Authority, Sind Industrial Trading Estate, Pakistan Railways etc. However around 80% of the total city area is being managed by Karachi Metropolitan Corporation through five DMCs (East, West, South, Central and Malir). The Health Department in DMCs and SWM Department at KMC manages the overall solid waste management in the metropolitan area through a staff strength over 12,000. The municipal refuse collection vehicles include open and covered refuse vans, compactors, multi loaders and arm roll containers. The municipality collect the solid waste from the communal bins and dispose it to the dumping site. There are many informal dumping sites in Karachi, which are spread over in all the districts. KMC spends around Rs.354 million per annum on waste collection and disposal out of which only Rs.70 million or twenty percent is recovered as part of the conservancy bill charged by the Karachi Water and Sewerage Board (KWSB) and levied on the consumers as 'sanitation tax'. In spite of these high expenditures, the existing level of sanitation is far below the acceptable minimum standards.

The per capita solid waste generation rate was calculated by NESPAK Consultant in 1984 covering low, middle and high-income areas and was found to be 0.26 kg/capita.day. The same was calculated again in 1991 by NESPAK and was found to be 0.34 kg/capita.day. The total solid waste generation in Karachi is about 5588 tons per day. Recent studies have revealed that approx. 4528 tons/day (81%) of the solid waste generated is from residential areas while 522 tons/day (9%) is generated from commercial centres and industries, 359 tons/day (6%) is from street cleaning and 179 tons/day (4%) is misc. waste.

The primary collection of waste is done from the households and generating sources to the communal bins and was assessed to have a collection frequency of 90%, while 10% remains to be collected from the municipal area. This assessment was done by the Solid Waste Management Advisor engaged by KMC under ADB funded project in 1995. The total waste storage capacity at the secondary storage is around 4200 tons/day. The waste recovered from the secondary storage is assessed to be around 700 tons/day or 17% of the total waste stored. The quantities of waste remained at the secondary storage site is around 3500 tons/day. The municipal vehicles manage to pick up only 1800 tons/day (51%) while uncollected waste is around 1700 tons/day (49%) of the net stored waste.

## **1.5 Recycling of Solid Waste in Karachi**

Out of the total solid waste generated in Karachi, 925 tons per day or 17% is being retained by the households and users. Approx. 89.9% of this waste is reusable, recyclable or compostable. Recyclable waste is sold by the households and generators to the street hawkers or 'peddlers' who roam on the streets shouting for buying of recyclables. These street hawkers in turn sell the collected recyclables to the middle dealers who deal in almost all waste items. These middle dealers supply separated waste material to the main dealers, who maintain a continuous supply to the recycling industries. The Consultant has estimated that around 300,000 people are directly or indirectly involved in recycling of solid waste in Karachi including street hawkers, scavengers, middle dealer, main dealers, recyclers, selling agents, brokers, shop keepers etc. It is assessed that annually around 44,500 tons of bread, 41,000 tons of bones, 20,000 tons of glass, 3300 tons of metals 245,000 tons of paper, 116,500 tons of plastic, 23,000 tons of textile, 1600 tons of wood and 994,000 tons of organic waste is produced in Karachi out of which over 50% is collected and recycled.

## **1.6 Scope of the Study**

The scope of work for this research study includes the following main aspects:

- i. Review and analyses of existing data on health care waste management system including generation, storage, collection, transportation, treatment, disposal and recycling.
- ii. Collection, tabulation and analysis of data regarding health care waste management covering those aspects, which are not covered/available with the existing studies.
- iii. Assessment of the flow of health care waste along with generation of waste component and quantification of volumes.
- iv. Reviewing the performance of health care waste management authorities and assessment of deficiencies and shortcomings.
- v. Review of national, provincial and municipal laws and regulations regarding health care waste management.
- vi. Overview of the formal and informal actors, SMEs, involved in health care waste management with their tasks, responsibilities and activities.
- vii. Assessment of the major public health and environmental impacts connected with the flow, collection and recycling of health care waste.
- viii. Suggestive mitigation measures for adverse impacts of health care waste system.
- ix. Assessment of needs of the SMEs involved in health care waste recycling.
- x. Opportunities for improvement of SMEs.
- xi. Social analysis of health care waste management system.
- xii. To assess the community involvement in health care waste management system.

## **1.7 Work Methodology**

To undertake the tasks mentioned in the scope of work, the local Consultant who is an Environmental and Public Health Engineer by profession, constituted a professional team comprising of an environmental engineer, sociologist and a surveyor to undertake the assignment under the leadership of Environmental & Public Health Engineer.

The work methodology adopted to undertake the tasks is mentioned as follows:

- i. Collection and review of data, information and reports.
- ii. Meetings with the professionals involved in health care Waste Management.
- iii. Site visits to health care waste management facilities as described in Section 1.3, collection of data from the official and unofficial sources.
- iv. Informal interviews of personnel related with health care waste management system, recyclers, middle and main dealers, municipality etc.
- v. Technical, financial, environmental and social analysis of the data and information obtained.
- vi. Preparation of a draft report.
- vii. Incorporating the comments and finalizing the draft report.



## **CHAPTER 2 CATEGORIZATION OF HEALTH CARE WASTE**

### **2.1 General**

The US EPA defines hazardous wastes as "Solid Waste or combination of solid wastes, which, because of its quantity, concentration, or physical, chemical or infectious characteristics may:

- ◆ Cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible, illness or
- ◆ Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed off, or otherwise managed. Thus infectious waste is a subset of hazardous wastes.

According to WHO, Health care waste can be classified into eight main categories i.e. general waste, pathological waste, radioactive waste, chemical waste, infectious and potentially infectious waste, sharps, pharmaceutical waste and pressurized containers. Each category is briefly described as under for the scope of this study.

### **2.2 General Waste**

It includes domestic waste, packing material, non-infectious animal waste, bedding, wastewater from laundries and other substances that do not pose a special handling problem or hazard to human health or the environment.

### **2.3 Pathological Waste**

It consists of tissues, organs, body parts, human foetuses, animal carcasses, blood and body fluids.

### **2.4 Radioactive Waste**

It includes solid, liquid and gaseous waste contaminated with radio nuclides generated from in vitro analysis of body tissues and fluid, in vivo body organ imaging, tumour localization and therapeutic procedures.

### **2.5 Chemical Waste**

It comprises discarded solid, liquid and gaseous chemicals, for example generating from diagnostic and experimental work, cleaning, housekeeping and disinfecting procedures. Chemical waste may be hazardous or non hazardous. For the purpose of choosing the most appropriate waste handling method, hazardous chemical waste is considered to be the waste that is:

- ◆ Toxic;
- ◆ Corrosive (acid of pH < 2.0 and bases of pH > 12.0);
- ◆ Reactive (explosive, water reactive, shock sensitive);

- ◆ Geotaxis (carcinogenic, mutagenic, teratogenic or otherwise capable of altering genetic material); for example, cytotoxic drugs.

Non-hazardous chemical waste consists of chemicals other than those described above, such as sugars, amino acids, and certain organic and inorganic salts.

## **2.6 Infectious Waste**

It contains pathogens in sufficient concentration or quantity and exposure that could result in diseases. This category includes cultures and stocks of infectious agents from laboratory work, waste from surgery and autopsies with infectious diseases, waste from infected patients in isolation wards, waste that has been in contact with infected patients undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable towels, gowns, aprons, gloves and laboratory coats) and waste that has been in contact with animals inoculated with an infectious agent or suffering from an infectious disease.

## **2.7 Sharps**

It includes needles, syringes, scalpels, blades, saws, glass, nails and any other item that could cause a cut or puncture.

## **2.8 Pharmaceutical Waste**

It includes pharmaceutical products, drugs and chemicals that have been returned from wards, have been spilled or outdated or contaminated, or are to be discarded because they are no longer required.

## **2.9 Pressurized Containers**

It includes those containers used for demonstration or instructional purposes, containing innocuous or inert gas and aerosol cans that may explode if incinerated or accidentally punctured.

Categories of waste that may be produced by particular types of health care services are mentioned in Table 1.

## **2.10 Waste Included in the Research**

The type of waste that is included in the research is based on general and miscellaneous waste, plastic waste, infectious waste and sharps. The miscellaneous waste includes food/organics, plastic and polythene, plaster, laboratory chemicals and fluids, paper metals and others. The sharps include syringes and glassware, plastic waste includes plastic bags and accessories, urine bags. The injections and waste include blood, pus, limbs, swabs, dressings, placenta, and culture media.

**Table 1: Categories of waste produced by various types of health care services**

SOURCE	WASTE CATEGORY							
	General	Pathological	Radio active	Chemical	Infectious	Sharps	Pharmaceutical	Pressurized Containers
<u>PATIENT SERVICES</u>								
Medical	X	X <sup>a</sup>		X	X	X	X	X
Surgical	X	X		X	X	X	X	X
Operating Theatre	X	X		X	X	X	X	X
Recover & Intensive Care	X	X <sup>a</sup>		X	X	X	X	X
Isolation Ward	X	X <sup>a</sup>		X	X	X	X	X
Dialysis Unit	X	X <sup>a</sup>		X	X	X	X	
Oncology Unit	X	X <sup>a</sup>		X	X	X	X	X
Emergency	X	X		X	X	X	X	
Out Patient Clinic	X	X <sup>a</sup>		X	X	X	X	
Autopsy Room	X	X		X	X	X		
Radiology	X	X <sup>a</sup>		X	X	X		
<u>LABORATORIES</u>								
Biochemistry	X	X <sup>a</sup>	X	X	X	X		
Microbiology	X	X <sup>a</sup>	X	X	X	X	X	
Haematology	X	X <sup>a</sup>	X	X	X	X		
Research	X	X	X	X	X	X		
Pathology	X	X	X	X	X	X		
Nuclear Medicine	X	X <sup>a</sup>	X	X	X	X		
<u>SUPPORT SERVICES</u>								
Blood Bank	X	X <sup>a</sup>		X	X	X		
Pharmacy	X			X				
Central Sterile Supply	X			X				
Laundry	X			X		X		
Kitchen	X							
Engineering	X			X		X		
Administration	X							
Public Areas	X							
<u>LONG TERM HEALTH CARE ESTABLISH</u>	X			X	X	X	X	

X<sup>a</sup> = Blood and body fluids.



## CHAPTER 3 SOURCES OF HEALTH CARE WASTE IN KARACHI

### 3.1 General

All the categories of health care waste are present in Karachi. The types of waste included in the UWEP research have been further explored in the Karachi city. Pakistan Health Care Association (PMA) was contacted to provide the list of the registered Health Care institutions in Karachi with respect to the following facilities.

#### 3.1.1 *Municipal Health Care Practices*

The municipality is maintaining a Health Care Department, which supervises, manage and monitor the major hospitals in Karachi run under KMC. The list of KMC Medical Health Care Facilities is mentioned in Annexure-A. The Sanctioned Strength of Medical Institutions in KMC is given in Annexure-B. The Bed Strength of Medical Institutions in KMC is given in Annexure 'C'. The District wise Detail of Medical Institutions Managed by KMC as per 1995 figures is given in Annexure 'D'. The statistics of services provided to the general public by Medical Institutions of KMC is reported in Annexure 'E',

#### 3.1.2 *Health Care Facilities of Agencies*

Various other agencies are managing the Health Care Health Care facilities for their employees like Pakistan Steel, Port Qasim Authority, Karachi Port Trust, Karachi Dock Labour Board, Pakistan Navy, Pakistan Railways, Civil Aviation Authority etc. The facilities available by these agencies were not assessed in detail due to constraints of manpower, time and financial resources, however their number and waste generated has been assessed based on the analysis and configuration of health care facilities analysed for this study.

#### 3.1.3 *Private Health Care Facilities*

The health care facilities are thriving in private sector. These private facilities are not being managed by entrepreneurs/individual/ groups but through a board or charitable institution/trust to get relaxation in taxes as and duties.

The sources of health care waste and their number in Karachi are assessed and elaborated in the following sections.

### 3.2 Clinics and Dispensaries

The clinics and dispensaries include the rooms and area where patients are being diagnosed and treated. It includes general physician rooms with a dispenser and dressing room. The room is also used for giving injections/ drips to the patients. Dentist, dialysis centre, drug and alcohol treatment centre, ear, nose and throat clinics, dermatologist and thrombosis clinics are not included in this category. Typically clinics have one to four doctors (general physicians or specialized doctors) with/without receptionist and dispensers. These clinics and dispensaries are present in almost all areas/localities in Karachi including high, middle and low-income areas.

The assessment regarding number of clinics and dispensaries in Karachi was carried out by conducting interviews with the related agency/department and consulting published data. In

absence of any data, fair assumption was made in consultation with the concerned professional medical officers. The data revealed the following status:

i.	Government clinics	:	22
ii.	KMC/DMC managed	:	62
iii.	Department/Organizations	:	80
iv.	Privately registered clinics	:	403
v.	Local Bodies	:	120
vi.	Privately non-registered clinics/dispensaries	:	500
			-----
Total			1087

The clinics mentioned in (i) represent the clinics/dispensaries operated and managed by the Federal Government and other Federal Government Institute. Clinics mentioned in (ii) also includes 'Unani Dawakhana' or herbal/eastern medicines centres. Clinics mentioned in (iii) represent the clinics/dispensaries of semi govt. agencies, departments and organizations that are providing Health Care facilities to their employees and their families. Clinics mentioned in (iv) are listed with Pakistan Medical Association (PMA) and also include specialized clinics and maternity homes. The number mentioned in (v) represents the clinics/dispensaries operated by the local bodies besides KMC. The clinics/dispensaries mentioned in (vi) are those clinics dispensaries, which are being managed privately and are not registered with PMA. It includes clinics/dispensaries where Health Care practitioners examines the patients and provide medication/dispensing and bandages etc.

### 3.3 Basic Health Units

Basic Health Units (BHU) are mostly established in low-income areas, slums and rural communities in Karachi. It includes Mother and Child Health Care (MCH) facilities with doctors (female and male), compounder/ pharmacist, "Daies", TBA (Traditional Birth Attendant).

The BHUs are basically managed by Union Council and Town Committees in rural/urban communities but is also being managed by charitable organizations and agencies. The estimated number of BHU in urban Karachi is assessed to be 50.

### 3.4 Consulting Clinics

The Specialist doctors and Health Care practitioners are operating their private clinics in a number of locations in Karachi apart from the hospitals. In most of the cases the consulting is not restricted to advice and physical checkups only but includes treatment, and medication also. These consulting clinics are not registered with PMA. Based on the site visits and informal interviews with the local Health Care personnel, the number of consulting clinics is assessed to be 200. The areas of these clinics vary from one room in a residential/commercial building to an office building.

### 3.5 Health Care Establishments

It includes nursing homes, house for physically and mentally handicapped, deaf, dumb and destitute.

The Health Care establishments were assessed by the Consultant in consultation with medical officer of hospitals visited and are mentioned below:

-	Nursing homes	:	25
-	Home for physically and handicapped dumb, deaf and destitute	:	15
			-----
	Total		40

### 3.6 Support Services

It includes Blood Bank, pharmacy, Health Care and teaching centres, mortuary, central sterile supply and laundry.

The estimated number of support service in Karachi based on the informal interviews with the medical officers of hospitals visited is:

-	Blood Bank	:	30 No.
-	Pharmacy	:	1000 No.

Other facilities like Health Care and teaching centres, central sterile supply and laundry also are included in the hospitals.

### 3.7 Technical Services

It includes clinical, pathological, haematological, chemical, research (veterinary and genetic) laboratories X-Ray and radiological laboratories.

The assessment of their number is mentioned as follows:

-	Pathological laboratories	:	100
-	Radiological laboratory/X-ray/Ultra sound	:	150
-	Vecternaty and genetic laboratory	:	5
-	Others	:	10

### 3.8 Hospitals

It includes general and special hospitals, TB sanatorium etc. The hospital include various department like paedric, oncology, rehabilitation, ear, nose and throat, psychiatric, burns and trauma, orthopaedic, diseases haemophilia, surgical, casualty etc. The registered cardiac hospitals, ENT hospitals, Eye hospitals, General hospitals, Kidney hospitals are mentioned in Annexure-G.

The hospitals are not categorically separated in terms of service provision. The list as maintained by PMA is updated and assessment being made since it was not possible to gather

the data from so many agencies. The number of hospitals in Karachi is mentioned in Table 2. Other refers to hospitals of agencies and other institutions. The assessment is given below:

**Table 2: number of hospitals in Karachi**

S.No	Category	Govt.	Municipal	Others	Private
1	Cardiac Hospitals	-	-	-	6
2	ENT Hospitals	-	-	-	7
3	Eye Hospitals	1	-	-	31
4	General Hospitals	2	7	15	266
5	Kidney Hospitals	-	-	-	3
6	Orthopaedic Hospitals	-	-	-	10
7	Paediatric Hospitals	-	-	-	16
8	Plastic Surgery Hospitals	-	-	-	1
9	Psychiatric Hospitals	-	-	-	8
10	Skin Hospitals	-	-	-	2
	Total	3	7	15	350

It is to be noted that the private hospitals refers to the registered hospitals with PMA. In total small, medium and large size hospitals range to 375 in number. The number of beds individually cannot be calculated for these hospitals due to non-availability of proper record. The official figures in December 1992 refer to 10,400 that are estimated to be 17,000 in December 1996. The same was confirmed by the PMA representative and Medical Superintendent of Civil Hospital, Karachi.

### 3.9 Maternity Homes

Maternity homes are places where gynaecological cases are done. It includes labour room, recovery room, and beds for patients, pharmacy, child nursery. The list of registered maternity homes with PMA is mentioned in Annexure-H.

Maternity homes also operate under govt. hospitals. These maternity homes are operated separately by KMC through its Health Care department. Four maternity homes are operated by Aga Khan Health Services. The assessment and number of maternity homes is given in

Table 3 below:

**Table 3: Number of Maternity Homes and Total Beds**

S.No.		<u>No.</u>	<u>Total Beds</u>
i.	Maternity homes managed by KMC	25	600
ii.	Privately registered maternity home	142	2080
iii.	Maternity homes operated by agencies	10	200
iv.	Private maternity homes (unregistered)	40	450
		-----	-----
	Total	217	3330

The data on number of beds were not available except for KMC. However fair assessment has been made based on site visits and informal interviews with the PMA officials.

## CHAPTER 4 LEGISLATION REGARDING HEALTH CARE WASTE

### 4.1 General

The legislation regarding Healthcare waste is covered under Pakistan Environmental Protection Ordinance (PEPO), 1983, PEPO 1997, provincial legislation and local laws and regulations of KMC. The National Environmental Quality Standards (NEQs) govern the discharges and emissions into the environment, restricting the pollution and causing adverse impacts on human beings, flora, fauna and ecology.

### 4.2 Legislative Framework

The legislation to control the environmental pollution in Pakistan was promulgated in the form of Pakistan Environmental Protection Ordinance (PEPO), which was prepared and publicized in August 1983 and implemented in December 1983. Under the Ordinance Pakistan Environmental Protection Agency (PEPA) was established under section 5 and provincial EPAs were established in all the four provinces of Pakistan i.e. Sindh, Baluchistan, Punjab and North West Frontier Province. Under PEPA, Pakistan Environmental Protection Council (PEPC) was also established. The functions of the Council are to:

- ◆ Ensure enforcement of PEPO 1983.
- ◆ Establish comprehensive national environmental policy
- ◆ Give appropriate direction to conserve the renewable and expandable resources
- ◆ Ensure that the environmental considerations are interweaved into national development plans and policies.
- ◆ Ensure enforcement of the National Environmental Quality Standards (News) and
- ◆ Give directions to any Government agency, a Body or a person requiring it or him to take measures to control pollution being caused by such agency, body or person or to refrain from carrying out any particular activity prejudicial to public interest on the purposes of the Ordinance.

The PEPC is required by the Government to direct the PEPA to prepare, submit and promote projects for the prevention of environmental pollution and to undertake research in any specified aspect of environment. The functions of the PEPA is to:

- ◆ Administer the PEPO and the rules and regulations
- ◆ Prepare national environmental policy for approval of the Council
- ◆ Publish an annual report on the state of the environment
- ◆ Establish National Environmental Quality Standards (NEQs) with the approval by the Council.
- ◆ Revise the NEQs as and when deemed necessary.
- ◆ Coordinate environmental policies and programmes nationally and internationally.
- ◆ Establish system for surveys, surveillance, monitoring, measurement, examination and inspection to combat environmental pollution
- ◆ Provide information and education to the public on environmental matters.
- ◆ Coordinate and consolidate implementation of measures to control pollution with Provincial Governments and other Government Agencies.

The National Environmental Quality standards (NEQs) were prepared and published through Gazette Notification of Pakistan, Extra Part II dated 29th August 1993. The NEQs cover the municipal and liquid industrial effluent, industrial gases emissions, motor vehicle exhaust and noise. The NEQs were implemented on 1st July 1996. The NEQs highlight that pollution from any sources including health care waste if entering the air, water or land should not exceed these limits. However the NEQs does not specifically mention the subject of health care waste.

In 1995 Environment and Urban Affairs Division, Government of Pakistan prepared the Pakistan Environmental Protection Act (PEPA) Act 1995 which was widely circulated to the government and non government agencies for comments and suggestions. The PEPA was amended by the Government in January 1997 as PEPO, 1997, which supersedes PEPO 1983. PEPO 1997 covers waste disposal and handling of hazardous waste along with other environmental parameters. PEPO 1997 prohibits the discharges and emissions in excess of the NEQs. These NEQs does not govern the solid/Healthcare waste collection and disposal in general but the liquid and gaseous emissions are covered in the NEQs.

PEPO 1997 has prohibited handling of hazardous substances, which can only be dealt under the license. Under the PEPO 1997 the Environmental Tribunals have been constituted with exclusive jurisdiction to try serious offences. PEPO 1997 mentions the penalties for different offences. The tribunals are authorized to recover the monetary benefits from the offenders. Chapter 1, item 2 (xxi) describes the definition of hospital waste as waste from medical supplies and materials of all kinds, as well as waste blood, tissues, organs and other parts of the human body from hospitals, clinics and laboratories.

Item 14 deals with the handling of hazardous substances except:

- (a) Under a licence issued by the Federal Agency and in such a manner as may be prescribed; or
- (b) In accordance with provisions of any other law for the time being enforced, or of any international treaty, convention, protocol, code, standard, agreement or other instrument to which Pakistan is a party

The PEPO 1997 has replaced the PEPO, 1983. This new law is more comprehensive than the PEPO 1983 and effectively seeks to protect, conserve, rehabilitate, improve the environment and promote sustainable development through a partnership approach. PEPO 1997 gives more powers to the Federal and Provincial EPA, to issue Environmental Protection Order where it is deemed necessary to control pollution within specified time. PEPO 1997 enables EPAs to levy pollution charges to violators of NEQs.

Pakistan Penal Code 1960 includes toxic and hazardous waste handling. According to the code, handling and negligent conduct with respect to poisonous, toxic and hazardous waste is an offence. The code is to be monitored by the provincial government.

No national, local and municipal authority has laws regarding favouring of recycling activities and utilization of waste items. Thus no legislation is favouring or restricting the recyclers in their work.

### **4.3 Agencies Responsible for Solid Waste in Karachi**

In Karachi over twenty agencies are managing, monitoring and dealing with Solid Waste, which also includes hazardous and health care waste. The main agency is Karachi Metropolitan Corporation (KMC), which manages approximately 80% of the Karachi urban area. KMC manages the solid waste through its SWM Department, which is responsible for planning, designing, management and monitoring of the solid waste and five DMCs (District Municipal Corporations). These DMCs include East, West, South, Central and Malir.

The other agencies working in the urban area of Karachi include Seven Cantonment Boards (Karachi, Manora, Drigh, Clifton, Malir etc.), Karachi Port Trust (Karachi port and harbour area), Civil Aviation Authority (Civil and International airport) Port Qasim Authority (Port Qasim), Pakistan Defence Officers Housing Authority (Defence Housing Authority Area), Pakistan Steel (Steel Mills Area) etc.

No coordination exists between these agencies for planning, designing, implementation, treatment and disposal of solid and health care waste. The waste storage, collection, transport and transfer facilities are being managed by these agencies while the disposal is done mostly on municipal land or water bodies like river and waste water channels.

Within the municipal area, KMC Health Bye Laws are governing. In Clifton Cantonment Board Area, relevant CCB regulations are applied. In KPT area, KPT rules govern. Waste collection and disposal has been emphasized in the rules, regulations and byelaws but are not elaborated and publicized. The marine pollution due to discharge by ballast/rubbish to the port is prohibited as per the Ports Act 1908.

The solid waste management and its governing law has been described in Sind Local Government Ordinance 1979 popularly known as SLGO 1979. This SLGO has been amended during these years to accommodate the changes made by the provincial govt. (Govt. of Sindh).

As per the SLGO, 1979, the compulsory functions performed by the Karachi Metropolitan Corporation is given in Annex 'J'.



## CHAPTER 5 HEALTH CARE WASTE MANAGEMENT IN KARACHI

### 5.1 General

The description of health care waste generation facilities and sources has been described in chapter 3.

This chapter presents the assessment and evaluation of existing health care waste management system at various health care facilities in Karachi. The hospital waste management is described separately in Chapter 6 due to information, data and material obtained and as a major source of health care waste generation.

A broad classification of solid waste has been made with respect to general and infectious waste. General waste include kitchen waste, food leftovers, garden waste, debris, sweepings of the premises, paper, packing, cardboard, tins, glass, X-ray sheets, plastic bags, caps etc. Infectious waste include disposable syringes glucose/dextrose bags, plastic bottles, glass bottles, glass culets, urine bags, bloods bags, infusion sets, bandages, dressings, blood, pus, tissues, organs, empty glass vials/ampoules/needles, expired and unused medicines etc.

The general recyclable waste includes disposable syringes, drips, catheter, plastic piping, connectors, infusion tubes, plastic accessories, urine bags, blood bags, organic waste, paper waste etc. The non-recyclable waste includes urine, infected dressings, blood/pus stained dressings, sputum, biopsy material, laundry waste, amputations, floor/street sweepings etc.

The waste management at health care facilities are described in detail in the forthcoming sections.

### 5.2 Waste Management at Clinics and Dispensaries

The status and assessment of waste management at clinics and dispensaries is elaborated as follows:

- (i) **System:** The clinics and dispensaries are established all over the city manned by the general Health Care practitioner(s) with a compounder (who gives the medicines to the patients, administer injections, put bandages/dressings and give external infusion). The compounder is not qualified but is usually experienced in treating patients. Medicines, mixtures and syrups are given to the patients along with injections/infusion/dressing/ bandages as required by the patients. The doctors examine the patients and also prescribe medicines from the pharmacy/chemist when required.
- (ii) **Types of Waste Generated:** The types of waste generated include packing of medicines, tins, containers (used to store the medicines), soiled and infected bandages, paper waste etc.
- (iii) **SWM System:** There exists no separate SWM system for Clinics and Dispensaries. Usually the waste is stored in plastic buckets/used containers at the premises. Sweeper(s) are employed to collect this waste from these clinics on monthly payment basis. A private clinic in a medium income area pays Rs.100 (US\$ 2.5) per month for this service, which also include sweeping of the floor area.

The sweepers in turn collect and dispose the waste at domestic communal bins or identified heaps. The waste is collected from the communal bin by the KMC/DMC or the agency responsible for the waste management of the area.

- (iv) **Quantities of Solid Waste Generated:** No actual measurement and analysis is done of this type of waste. Site visits and visual examination done by the Consultant revealed that on an average 50 patients are treated per day/clinic generating 75 gms./patient. day  
 $= 75 \text{ gms./patient.day} \times 50 \text{ patients/day} \times 1087 \text{ clinics} = 4076 \text{ kg/day.}$
- (v) **Composition of Waste:** The composition of waste estimated by the Consultant based on visual examination is as follows:
- |   |                |       |         |
|---|----------------|-------|---------|
| - | General Waste  | (20%) | 816 kg  |
| - | Infected Waste | (80%) | 3260 kg |
- (vi) **Recycling Status:** In terms of recyclability of waste, the status assessed by the Consultant based on visual examination and informal interviews with the medical staff is as follows:
- |   |                            |       |         |
|---|----------------------------|-------|---------|
| - | Potential recyclable waste | (40%) | 1630 kg |
| - | Non Recyclable Waste       | (60%) | 2446 kg |
- The empty bottles, tins and containers are reused by the compounder/Health Care assistant who work at the clinics/dispensary without sterilizing them.  
 The next stage of sorting is done by the sweeper who separates the syringes, glucose bags etc. without realizing the potential hazards caused by the infectious waste. Other potential items are also retrieved by the sweeper and then by the street scavengers.
- (vii) **Comments:** No record of waste generated is recorded. The doctors/para Health Care staff/patients do not dispose the infectious waste appropriately.

### 5.3 Waste Management at Basic Health Units

The status and assessment of waste management at Basic Health Units (BHU) is elaborated as follows:

- (i) **System:** BHUs are similar to the clinics and dispensaries in terms of functions and services provided with the addition of treating women and especially pregnant women. The 'daies'/ Traditional Birth Attendants (TBAs) are experienced but uneducated elderly females who carry out duties of a gynaecologist in rural and semi urban poor areas are also available at BHU.
- (ii) **Types of Waste Generated:** The types of waste generated are similar to the waste generated at clinics/dispensaries.
- (iii) **SWM System:** The system is similar to the one as mentioned in earlier section.
- (iv) **Quantities of Solid Waste Generated:** No actual measurement and analysis is done of this waste. Site visits and physical examination revealed that on an average 25 patients are treated per day per BHU generating about 40 gms/patients/day.  
 $= 40 \text{ grms / patient day} \times 25 \text{ patients} \times 50 \text{ BHUs} = 50 \text{ kg / day}$
- (v) **Composition of Waste:** The composition of waste is estimated by the Consultant based on visual examination and informal discussions with the medical staff are as follows:

- General Waste (20%) 10 kg
- Infected Waste (80%) 40 kg

(vi) **Recycling Status:**

In terms of recyclability of waste, the status assessed by the Consultant based on visual examination and informal interviews with the medical staff is as follows:

- Potential recyclable waste (40%) 20 kg
- Non recyclable waste (60%) 30 kg

The status is similar to that of clinic/dispensaries mentioned in Section 5.2. The empty bottles, tins and containers are reused by the compounder/medical assistant. The sorting is done first by the Sweepers and then the Scavengers at the communal bin or garbage heaps of the BHU.

(vii) **Comments:** No record of waste generated is recorded. The infectious waste is not segregated and handled appropriately.

#### 5.4 Waste Management at Consulting Clinics

The status and assessment of waste management at consulting clinics is elaborated below:

- (i) **System:** The consulting clinics are located in commercial buildings that are used by the Consultants/Health Care practitioners. The clinics usually have a doctor's room, examination room and reception facilities.
- (ii) **Type of Waste Generated:** The waste generated is general and usually no medicines are dealt/disposed in the clinics. The composition consist mainly of paper, cardboard, bottles, plastic, organics and packing material.
- (iii) **SWM System:** Usually the sweeper of the building, service the clinic taking a monthly charge of Rs.500 (US\$ 12.5) for collection and disposal of the waste. The workers disposed the collected waste at the municipal communal bins or waste heap from where it is lifted by the area-collecting agency.
- (iv) **Quantities of Solid Waste Generated:** No actual measurement and analysis is done of this waste. Site visits and physical examination revealed that on an average, 20 patients visit the clinic per day. Taking into consideration three clinic staff members per clinic. The total waste generated is assessed as:  

$$= 25 \text{ grams/patient day} \times 23 \text{ persons} \times 200 \text{ clinics} = 115 \text{ kg/day}$$
 which is negligible in the waste stream in terms of quantity, composition and utilization.
- (v) **Composition of Waste:** The composition of waste is assessed by the Consultant based on the visual examination and informal discussions with the medical officers is as follows:
  - General Waste (90%) 103.5 kg
  - Infected Waste (10%) 11.5 kg
- (vi) **Recycling Status:** The status is similar to that of clinic/dispensaries. In terms of recyclability of waste the status assessed by the Consultant based on visual examination and informal interviews with the medical staff is as follows:
  - Potential recyclable waste (70%) 80.5 kg
  - Non recyclable waste (30%) 34.5 kg

- (vii) **Comments:** The waste is insignificant and do not contribute much to the Health Care waste stream.

## 5.5 Waste Management at Health Care Establishments

The status and assessment of waste management at Health Care Establishment at elaborated below:

- (i) **System:** The nursing homes are usually located with big hospitals like Aga Khan University Hospital, Civil Hospital, Jinnah Hospital, Abbasi Shaheed Hospital, Liaquat National Hospital etc. The home for physically handicapped children also comes under this area which are separately located in the city.
- (ii) **Type of Waste Generated:** The types of waste generated is general household/institutional waste similar to domestic waste.
- (iii) **SWM System:** The SWM system consist of waste storage facilities at the premises. The sanitation staff service the individual area and collect the waste to a dedicated place in the premises. The waste is disposed to communal bins/identified garbage heaps and is collected by the area servicing agency together with domestic waste.
- (iv) **Quantities of Solid Waste Generated:** The quantity of waste generated depends on the number of persons per facility. Assuming an average figure of 100 persons per facility, the users are assessed to be 4000. The average waste generation rate of 0.30 kg gives a waste generation figure of 1200 kg/day.  
 $= 300 \text{ gms./person} \times 100 \text{ persons} \times 40 \text{ establishment} = 1200 \text{ kg/day}$
- (v) **Composition of Waste:** The composition of waste is assessed by the Consultant based on the visual examination and informal discussions with the medical staff is estimated to be 100% general waste.
- (vi) **Recycling Status:** In terms of recyclability of waste the status is assessed by the Consultant based on visual examination and informal interviews with the medical staff is as follows.
- |                              |              |
|------------------------------|--------------|
| - Potential recyclable waste | (65%) 780 kg |
| - Non recyclable waste       | (35%) 420 kg |
- (vii) **Comments:** This waste is part of waste generated at Health Care facilities and consist of general/domestic waste. The waste quantities are insignificant and do not contain any hazardous substances requiring special treatment.

## 5.6 Waste Management at Support Services

The status and assessment of waste management from support services is elaborated below:

- (i) **System:** It includes the Blood Bank, Pharmacy, Health Care and teaching centres, mortuary, central sterile supply and laundry. With respect to waste generation, disposal and recycling, blood banks are mentioned. These Blood Banks are separately located like at Fatmid which is the largest blood bank in Karachi also providing blood transfusion facilities to lot of patients and especially young children who are facing from the diseases of Haemophilus. (Refer photographs) Blood banks exist at all major hospitals supplying blood from donors to patients.

- (ii) **Type of Waste Generated:** The waste generated contains blood bags, plastic syringes tissue papers, gloves, plastic connectors and piping.
- (iii) **SWM System:** The SWM system consist of waste storage at the premises, laboratory and at the patients rooms/halls. The bags are segregated from other waste and sold to the street hawkers or directly to the middle dealers. The collections, storage and disposal procedures are highly unsanitary and unhygienic and can become a source of infection to the handlers.

Only in two hospitals these blood bags are burned including Aga Khan and OMI (Orthopaedic Health Care Institute).

- (iv) **Quantities of Solid Waste Generated:** The exact quantities of solid waste generated is not recorded. No data on generation and composition has been maintained by any hospital/agency/ institution. The assessment of waste generation is made based on the informal interviews with the sanitation staff of the Blood Bank, administrative staff and based on ten site visit made by the Consultant and his staff at different blood banks in the city.

It is estimated that each blood bank generates about 25 kg. of waste per-facility. Thus the total waste generated is approximately 30 No. x 25 = 750 kg.

- (v) **Composition of Waste:** The composition of solid waste is assessed by the Consultant based on the visual examination and informal interviews with the medical staff and consist of 65% of plastic waste (plastic cannulas, connectors, syringes, bags) 15% (paper, card board boxes, etc.) 20% consist of glass bottles, organics, wrappings and other miscellaneous waste.
- (vi) **Recycling Status:** In terms of recyclability of waste, the status is assessed by the Consultant based on the visual examination and informal interviews with the medical staff is as follows:

- Potential recyclable waste	(60%) 450 kg
- Non recyclable waste	(40%) 300 kg

- (vii) **Comments:** The used blood bags are handled inappropriately and unhygienic. The non-awareness among the sanitation staff causes chances of pollution and may become source of epidemic and contagious diseases. There has been many incidence of disease transmission among the workers and sanitation staff but the facts have never been recorded and publicised.

## 5.7 Waste Management at Technical Services

It includes waste generated from pathological laboratories, radiological/X-Ray facilities, veterinary and genetic laboratories etc. The earlier two facilities were investigated by the Consultant.

### 5.7.1 Pathological Laboratories

Pathological laboratories are present in almost all big hospitals and separately as well. Well known pathological laboratories and their branches all over the city are providing this services like Sind Lab, The Lab., Dr. Ehsanullah Lab, Aga Khan Lab, Karachi Lab, etc.

- (i) **System:** The pathological laboratories were visited by the Consultant staff. More than ten pathological laboratories were visited by the Consultant and his staff on several occasions. The visits revealed that no data and information on waste generation was

available and the administration of these labs. were not helpful in providing any information due to being afraid of publicity through newspapers and media. The routine laboratory tests performed at the laboratory are mentioned in Annexure E. The no discount laboratory tests are mentioned in Annexure 'K'and 'L'.

- (ii) **Types of Waste Generated:** The type of waste generated at these facilities include both liquid and solid waste which needs prior treatment before disposal. The liquid waste contains specimen of bloods, pus, sputum, urine, stool, biopsy material and other body fluids. The solid waste contains plastic, glass, organics, dressings, cotton, area sweepings, packing, wrapping, empty glass vials etc.
- (ii) **SWM System:** The laboratories located in the hospitals are being services by the sanitation staff of the hospital. The waste stored in the dustbins are emptied into bigger drums, trolleys and is carried outside the hospital to a communal bins varying from 5-7 cu.m. capacity heap. The waste is mixed with other hospital waste and is not being segregated.
- (iii) The laboratories located separately and independently have their own sanitation staff who collect and dispose the urine, stools and other body fluids in the sanitary sewage system as well as collect and dispose solid waste. Sweeping of the premises is also their duty. Usually 4-10, number of sanitation staff is employed by an average laboratory.
- (iv) **Quantities of Solid Waste Generated:** The quantities of solid waste generated depends on the number of patients, type of tests performed, the number of tests and staff employed. In absence of any relevant data, fair assessment has been made as per informal interviews with the staff and over ten site visit of Consultants staff to five laboratories.

Per laboratory solid waste generation is assessed to be 50 kg. (Based on 2000 persons/laboratory generating 25 gms). The total solid waste generation from pathological laboratories:

$$= 25 \text{ gram/person} \times 2000 \text{ persons} \times 100 \text{ labs.} = 5,000 \text{ kg/day}$$

- (v) **Composition of Waste:** The composition of waste is assessed by the Consultant based on visual examination and informal interviews with the medical staff and is estimated to be:

-	General Waste	(20%)	1000 kg
-	Infected Waste	(80%)	4000 kg

- (vi) **Recycling Status:** In terms of recyclability of waste the status is assessed by the Consultant based on visual examination and informal interviews with the medical staff is as follows:

-	Potential recyclable waste	(85%)	4250 kg
-	Non recyclable waste	(15%)	750 kg

The potential recyclable waste items include disposal syringes, plastic bags, paper waste etc.

- (vii) **Comments:** A major problem at these pathological laboratories is the disposal of liquid waste containing urine, blood, stool, biopsy material, puss, chemicals body fluids etc. which are disposed through the sanitary sewerage system. This waste is dangerous and can cause severe epidemics if not treated properly. only two laboratories in Karachi have a pre-treatment system while others dispose this effluent without any treatment.

The solid waste is often collected by the sanitation staff and segregated before disposal into the communal bins. The potential recyclable material is retained which often contains infected material also. Proper awareness and training is required for efficient separation and utilizing protective gears by the sanitation staff.

### 5.7.2 Radiological Laboratories

Radiological laboratories, X-Ray and ultrasound facilities are available in almost all big hospitals, but they exist independently also in separate buildings. Almost all big pathological laboratories as mentioned in section 5.7.1. have their radiological section also which provide radiological examination and testing facilities for patients.

- (i) **System:** No data/information is available with any agency, institution and hospital regarding the solid waste generated, stored, disposed and recycled. The consultant's staff visited several radiological laboratories to obtain the data and information.
- Ultrasound is now a common test being performed in pregnancies. There has been a mushroom growth of these clinics in Karachi in the last decade.
- Radiological examination and tests include a wide variety. The main tests include chest X-ray and X-ray for broken bones and body parts.
- (ii) **Types of Waste Generated:** The type of waste generated at these facilities include both liquid and solid. The liquid waste include processing liquid of X-Ray film which is collected, sold and recycled. This subject is not addressed in this report. The solid waste contain paper waste, organic, sweepings, X-Ray films, ultrasound viscous gel tubes, wrapping, glass etc.
- (iii) **SWM System:** The radiological laboratories located in the hospitals are serviced by the sanitation staff of the hospitals. The waste is stored in the dust bin and are emptied into bigger drums, trolleys and is carried outside the hospital to a communal bin/heap. The waste is segregated for its recyclable parts and the remaining waste is mixed with the general waste from where it is lifted by the municipal staff or the servicing agency of the area/locality.
- The laboratories located separately and independently have their own sanitation staff who collect and dispose the waste. Sweeping of the premises is also done. Usually 4-10 number of sanitation staff per facility is employed on an average.
- (iv) **Quantities of Solid Waste Generated:** The quantities of solid waste generated depends on the number of patients, type of tests performed, number of tests and staff employed. In absence of any relevant data, fair assessment has been made as per informal interviews with the staff and site visits of the Consultants professionals.
- Per laboratory solid waste generation = 10 kg (Based on 50 persons/laboratory generating 200 grams).
- Total solid waste generated from radiological laboratories:  
 = 200 grams/person x 50 persons x 150 labs. = 1500 kg/day
- (v) **Composition of Waste:** The composition of waste is assessed by the Consultant based on visual examination and informal interviews with the medical staff and is estimated to be:
- |   |                |       |         |
|---|----------------|-------|---------|
| - | General Waste  | (85%) | 1275 kg |
| - | Infected Waste | (15%) | 225 kg  |

- (vi) **Recycling Status:** In terms of recyclability of waste the status is assessed by the Consultant based on the visual examination and informal interviews with the medical staff is as follows:
- |                              |       |         |
|------------------------------|-------|---------|
| - Potential recyclable waste | (75%) | 1125 kg |
| - Non recyclable waste       | (25%) | 375 kg  |
- (vii) **Comments:** One of the major problem is non awareness of the para Health Care staff against the dangers of radioactive material and X-Ray. Only few good private hospitals provide appropriate protective gears and protection equipment to employees. Others are using outdated body coverings. Proper awareness and training is required by the staff of these facilities.

## 5.8 Waste Management at Maternity Homes

The status and assessment of waste management at maternity homes is elaborates as follows:

- (i) **System:** Maternity homes/clinics are places where gynaecological cases are dealt. The waste include general and infectious waste. The waste is generated by the patients, attendant of the patients, maternity homes staff (doctors, nurses, para Health Care and administrative) The facilities which produces most of the waste is the labor room operation theater. The maternity homes are of small, medium and large size depending on the number of beds facilities, equipment, resources and staff. It also include the formal (registered) and informal (unregistered - mostly operating in slum and low income areas).
- (ii) **Types of Waste Generated:** The waste generated contain the general waste infected waste and organic waste (human tissues, placentas, ovaries, tubes etc.).
- (iii) **SWM System:** Generally in-house sanitation staff is employed by these maternity homes. One dust bin is provided at each bed. The staff collect it and dispose it at the municipal facilities (communal bins, containers, heaps) often it is temporarily stored/collected in the premises for 8-10 hours before disposal. This waste at the communal bin is often picked up by rodents, cats, dogs, vultures etc. Sanitation staff is paid a monthly charges of Rs.1200 (US\$ 30) per month.
- (iv) **Quantities of Solid Waste Generated:** No actual measurement and analysis is done of this waste. Site visits and visual examination was carried out in ten maternity homes at different occasions which revealed that on an average 18 beds/maternity home is available with an average occupancy of 80%. Thus total beds contributing the waste is assessed to be 3330 beds. The quantity of waste generated is included in Chapter 6 along with hospitals.

The quantity of waste generated is estimated to be:

$$= 4.1 \text{ kg/bed/day} \times 3330 \text{ No. of beds} = 13,653 \text{ kg.}$$

- (v) **Composition of Waste:** The composition of waste is assessed by the Consultant based on the visual examination and informal interviews with the medical staff is estimated as follows:
- |                  |       |         |
|------------------|-------|---------|
| - General Waste  | (30%) | 4096 kg |
| - Infected Waste | (70%) | 9557 kg |

(vi) **Recycling Status:** In terms of recyclability of waste the status is assessed by the Consultant based on the visual examination and informal interviews with the medical staff is as follows:

- Potential recyclable waste	(70%)	9557 kg
- Non recyclable waste	(30%)	4096 kg

The potential recyclable items are retained/sorted out by the sweeper/sanitation staff of the facilities. He/she manages their own premises. Usually an unused room, space behind the hospital or area under the staircases are used for storing this recycling waste. This accumulated waste is then segregated for its type by the sanitation staff and sold to the street hawker often twice a week depending on the quantity. This waste storage system goes unchecked and unnoticed by the administrative and management staff. The interviews with the sanitation staff at five maternity homes revealed that around Rs.30 (US\$ 0.75) is earned by each sanitation staff per day.

(vii) **Comments:** A private company situated in Karachi organise the collection of human placentas from the registered maternity homes. This company negotiate with the administration of the Health Care facility and provide a fridge/deep freezer for storing the placentas. The collection is done regularly on schedule dates. No charges are paid for this service. The company has approval from the Ministry of Health and organizes the collection from Karachi, Lahore and other major cities also. The placentas collected are stored, packed and exported to France. In case of no electricity or break down, the maternity home authorities calls the company which organizes immediate pickup of placentas to avoid decomposition of placentas.

The interview with the Administrator of Aga Khan Maternity Home (5 in No.) were held. Aga Khan Maternity Home also has this placenta collection facility and the company has satisfied them with the ultimate use/export of this stuff which is used in making of drugs from human chronic gonadotroplins and used for research.

The company was also contacted by the Consultant on many occasions both directly and through other sources but they avoided to give the quantity/number of placentas collected/day or exported.



## CHAPTER 6 HOSPITAL WASTE MANAGEMENT IN KARACHI

### 6.1 General

This chapter presents the assessment and evaluation of existing hospital waste management system at various hospitals in Karachi. The data is further compared with the data from other major cities in Pakistan obtained by the Consultant during conducting research on hospital waste generation at various hospitals in Punjab province (Reference 11) Three visits each were made in the five major hospitals mentioned in Section 6.4.1. To assess the number and facilities at the hospital, the Consultant contacted Pakistan Medical Association (PMA) as almost all the hospitals in Karachi are registered with PMA. The number and category of hospitals has been elaborated in chapter 3.

This chapter presents the data and information of various hospitals collected for this research.

### 6.2 Hospital Waste Generation Rate

A study conducted in the city of Sheikhpura, Punjab Province on the solid waste generation collection and disposal by Scott and Purphy and NESPAK Consultant has revealed that the generation of hospital and institutional waste is around 0.01 kg/cap./day which represents around 0.2% of the total waste.

Karachi has now become a mega city i.e. city with over ten million people. Based on the average generation rate of 0.01/kg/cap./day, the city alone generates over 100 tons of hospital waste/day.

**Table 4: Hospital waste generation in different cities of Pakistan**

S. No	City	No. of hospitals surveyed	Total No. of beds	Generation Rate in Kgs/bed/day
1.	Karachi	5	3,500	1.20
2.	Lahore	6	4,188	1.05
3.	Rawalpindi	9	1,552	0.99
4.	Multan	4	1,235	1.46
5.	Faisalabad	9	1,546	1.00
6.	Gujranwala	9	1,037	0.98
7.	Sargoda	6	435	0.71
		48		(av.) 1.06

The other method to assess the waste generation in hospitals is based on sampling and assessment of waste generation in kg/bed/day. Sample surveys carried out in 48 hospitals of seven cities by the Scott and Purphy and NESPAK Consultant revealed that average waste generation in hospitals is in the order of 30 tons per day and averages 1.06 kg/bed/day. Table

4 shows the quantities and composition of hospital waste generated in different cities in Pakistan including Karachi.

Based on the assessment of number of total beds of hospitals in Karachi, it is assessed that around 18,020 kg of hospital waste is produced in Karachi (17,000 beds x 1.06 kg/bed/day). Adding the figures of maternity homes also (3330 beds x 1.06 kg/bed/day). The total waste generation becomes 21,550 kg.

Another survey, sampling and analysis done in 1995 depicts that the generation rate of hospital waste from government hospitals in Karachi ranged between 1.63 kg/bed/day and 3.69 kg/bed/day with an average generation rate of 3.02 kg/bed/day. The generation rate at private hospital in Karachi was assessed to be 5.13 kg/bed/day. Based on these results the hospital waste generation from private, government and other hospitals in Karachi is assessed to be:

$$\begin{aligned} \text{Government hospital} &= 3.02 \text{ kg/bed/day} \times 45.33 \text{ beds} \times 25 \text{ No.} \\ &= 3,422 \text{ kg/day} \end{aligned}$$

$$\begin{aligned} \text{Private hospital} &= 5.13 \text{ kg/bed/day} \times 45.33 \text{ beds} \times 350 \text{ No.} \\ &= 81,396 \text{ kg/day} \end{aligned}$$

$$\begin{aligned} \text{Maternity homes} &= 4.1 \text{ kg/bed/day} \times 3330 \text{ beds} \\ &= 13,653 \text{ kg/day} \end{aligned}$$

Total hospital waste generation = 98,471 kg/day or 98.57 ton/day this figure is comparable with the figure of 100 tons/day. Thus a total figure of 100 tons per day is adopted for this report.

Indoor-patients treated	=	596,791
Average waste generation	=	2.06 kg/bed/day
Total waste generated daily	=	3,368 kg
		3.4 tonnes/day
Outdoor patients treated	=	10,958,962
Average waste generated by a patient	=	64 gram/O.P.D/day
Total waste generated by all patients	=	1,922 kg
		1.9 tonnes/day
Total waste generated in Karachi Division	=	5.3 tonnrday

The waste generation is also estimated from the in-patients and out-patients data using the medical facilities. The data with respect to patients treated in Karachi Division during 1991 is given in Table 5. Karachi division includes the urban and rural areas of Karachi city. The urban area consist of municipal area, Cantonment area and area managed by other agencies/departments/organizations.

### 6.3 Density of Hospital Waste

The density of solid waste generated in the government hospitals is found to be 353 kg/cu.m. This assessment is based on sampling and actual field measurement at the hospital premises without any compaction. The high density shows that the waste collected from different wards has high value of moisture content and less plastic contents.

**Table 5: Patients treated in Karachi Division during 1991**

No.	Health facility	Indoor patients	Outdoor patients
1.	<b>Hospital</b>		
	Government	65,807	2,082,815
	Private	360,011	1,410,795
	Local bodies	11,618	289,653
	Other Government Departments	38,493	1,114,360
2.	<b>Dispensaries</b>		
	Government	--	327,289
	Private	--	157,392
	Local bodies	--	1,404,283
	Other Government Departments	--	2,539,083
3.	<b>Mother Care Health Centres</b>		
	Government	3,899	103,173
	Private	--	--
	Local bodies	9,330	319,310
	Other Government Departments	2,010	21,4973
4.	<b>T.B. Clinics</b>		
	Government	--	53,539
	Private	--	57,114
	Local bodies	--	--
	Other Government Departments	--	7,352
5.	Rural Health Centres	4,541	52,130
6.	Basic Health Units	1,082	827,881
		596791	10958962

### 6.4 Hospital Waste Management in Selected Hospitals in Karachi

#### 6.4.1 General

To assess the existing hospital waste management practices in the different type of hospitals in Karachi, a survey and study was conducted in Government hospitals (with medical college) and without teaching facilities as well as private hospitals. The selected general hospitals included the following:

- A. Government Hospital (with medical college):
  - i. Civil Hospital Karachi (CHK)
  - ii. Jinnah Post Graduate Health Care Centre (JPMC)
- B. Government/Municipal Hospitals (without teaching facilities):
  - i. Abbasi Shaheed Hospital (ASH)
  - ii. Liaquat National Hospital (LNH)
- C. Private Hospitals:
  - i. The Aga Khan University Hospital (AKUH)

The description of the above hospitals is mentioned in the following sections:

#### 6.4.2 Civil Hospital Karachi (CHK)

##### General

Civil hospital is a general, government and teaching hospital attached with Dow Health Care College, having 1342 beds with an average of 844 in-patients per day. Wardwise bed strength, bed occupancy and other details are shown in Table 6. These details are for the year 1992. Now some departments have expanded with increased number of beds.

**Table 6: In-patients data at Civil Hospital Karachi (1992)**

No.	Ward/Unit	Bed Strength	Waste/ Day (Kg)	Gen.Rate Kg/Bed/Day
1.	Medical Unit I	48	150	3125
2.	Medical Unit II	50	152	3040
3.	Medical Unit III	53	157	3962
4.	Medical Unit IV	46	150	3261
5.	Medical Unit V	36	143	3927
	<b>All Medical Units</b>	<b>233</b>	<b>752</b>	<b>3228</b>
6.	Surgical Unit I	50	170	3400
7.	Surgical Unit II	44	152	3455
8.	Surgical Unit III	48	158	3292
9.	Surgical Unit IV	50	163	3260
10.	Surgical Unit V	50	163	3260
11.	Surgical Unit VI	50	171	3240
	<b>All Surgical Units</b>	<b>292</b>	<b>977</b>	<b>5346</b>
12.	Gynaecology Unit I	50	153	3060
13.	Gynaecology Unit II	51	153	3000
14.	Gynaecology Unit III	45	146	3244
15.	Labour Room	12	150	12500
	<b>All Gynaecology Units</b>	<b>152</b>	<b>602</b>	<b>3961</b>
16.	Orthopaedic Unit I	62	190	3065
17.	Orthopaedic Unit II	42	168	4000
	<b>All Orthopaedic Units</b>	<b>104</b>	<b>358</b>	<b>3442</b>

No.	Ward/Unit	Bed Strength	Waste/ Day (Kg)	Gen.Rate Kg/Bed/Day
18.	Cardiac	35	122	3486
19.	C.C.U	10	55	5500
20.	Neurology	25	65	2600
21.	Orology	44	155	3523
22.	E.N.T.	50	170	3400
23.	Eye	50	135	2700
24.	Paediatric Unit I	50	145	2900
25.	Paediatric Unit II	50	151	2746
	<b>All Paediatric Units</b>	<b>105</b>	<b>296</b>	<b>2819</b>
26.	Paeds Surgery	31	125	4032
27.	Neuro Surgery	22	75	3409
28.	Va scui ar Surgery	32	105	3281
29.	Plastic Surgrey	35	130	3714
30.	Burns	25	170	6800
31.	Psychology	40	110	2750
32.	Skin	30	105	3500
33.	Isolation	25	65	3095
34.	Paeds Treatment Room		40	
35.	Surgical I.C.U.		45	
	<b>TOTAL</b>	<b>1342</b>	<b>4657</b>	<b>3470</b>

Besides wards, Civil hospital also has other services for in-patients which includes operation theaters, X-ray units, laboratories, blood bank, casualty, Out patient Department (OPD), emergency, administration, kitchen, cafeteria, maintenance, stores and laundry. There are also residences for staff in the hospital premises as well as outside the premises. OPD patients data for the year 1992 is shown in Table 7.

Total number of staff sanctioned for civil hospital is 2001 whereas the number of employees on January 1st 1993 were only 1918. The major shortfall is in new doctors (46 less) and nursing/sisters (27 less). Other useful statistics is given in Table 8.

### **Waste Management System**

The existing waste collection and disposal system at Civil hospital is manually-operated based on three shifts. All staff is employed by the hospital administration including 331 sweepers for hospital cleaning purpose.

The waste generated by patients and their visitors is kept into small baskets and pots which are placed under each bed of the hospital. The waste is collected by the sweepers (sanitary staff) at the end of each shift in drums (capacity 100 litres) provided in each ward which is being transported to the on-site disposal area located outside but adjacent to the hospital by the help of manual-driven trolleys or small drums/containers on shoulders or is often carried on heads of the sweepers. The waste generated in corridors and pathways are collected by the sweeper separately and then transported to off-site disposal of city waste dumping sites.

The entire system runs in three shifts i.e. morning, evening and night. One supervisor for each shift is responsible for hospital cleaning, waste collection and disposal. The supervisor is

assisted by his assistants and shift operatives (sweepers etc.). All three supervisors are responsible to a steward who is the man behind the waste management system after administration. The sanitation staff takes care of the general hospital cleaning but nobody is aware of the adverse effects of hospital waste on human beings and environment. The hospital lacks basic facilities to manage the waste as per standards of hospital waste disposal practices in developed countries.

**Table 7: OPD waste data of Civil Hospital Karachi (1992)**

No.	O.P.D s.	Male	Female	M/Child	F/Child	Total	Percentage
1	Casualty	54326	44364	39537	31465	169692	25.00
2.	Medical	30656	70317	—	—	100973	15.00
3.	Paeds	—	—	38536	38007	76543	11.00
4.	E.N.T.	19520	19580	6418	5232	50750	7.50
5.	Skin	22932	24396	8343	5870	61541	9.00
6.	Surgical	13182	11656	3388	2087	30313	4.50
7.	Dental	8432	7381	2269	1450	19532	2.90
8.	Orthopaedic	19487	14102	4457	3235	41281	6.00
9.	Gyane & Obstt.	—	32642	—	—	32642	4.80
10.	Physiotherapy	6154	4904	2067	1360	14485	2.00
11.	Eye	10508	8598	2482	1483	23071	3.50
12.	Cardiac	9887	8778	89	34	18788	2.80
13.	Urology	9454	3937	270	222	13883	2.00
14.	Evening	858	1065	417	370	2718	0.41
15.	Psychiatry	3487	2839	725	391	7442	1.00
16.	Neurology	1156	1075	251	120	2602	0.39
17.	Plastic surgery	927	726	220	162	2035	0.30
18.	Vascular surgery	92	782	10	—	184	0.02
19.	Neuro. Surgery	125	108	3	2	238	0.03
20.	Burns	192	176	57	—	435	0.07
	<b>TOTAL Pats Treated</b>	<b>211375</b>	<b>256726</b>	<b>109549</b>	<b>51498</b>	<b>669148</b>	<b>100.00</b>

*Conclusion:*

*Daily Casualty Patients 465*

*Ratio between Casualty and other OPDs (consolidated): 1: 4 (25%: 75%)*

**Table 8: Statistics at Civil Hospital, Karachi (1989-1991)**

Year	New Indoor Patients Treated	Bed* Occupancy	Out Patients Including Casualty	Casualty Patients Treated	Operations Performed	X-Ray Films Used	Lab Tests Done	Deliveries Conducted	Deaths Occurred (Indoor)
1989	21536	315374	757930	148946	21767	173600	215400	3735	1231
1990	22261	303838	706861	171942	24238	185300	287733	3675	1291
1991	21498	301408	666341	155623	24212	148125	307878	3388	1357
Average	21766	306873	710377	158837	23406	169008	270337	3600	1293

*\*BEDS OCCUPANCY: Number of days a patient has remained in hospital and bed is occupied. For example if one patient is admitted in hospital of first day, he will be called as one new patient*

*after wards he will remain in hospital for nine more days t hen it will be called nine o ld patients and bed occupancy will be considered as ten patients s.*

In 1993, an on-site incinerator was installed to burn pathological and infectious waste. The system was run by sweepers, operators and paramedical staff. The lack of technical information on operation, maintenance and training failed the successful operation of the incinerator. The incinerator is of pathological type with two burning chambers. The main chamber where waste is charged is called primary chamber. The temperature in primary chamber is kept around 800°C. The hot gases from primary chamber pass through perforated refractories at the top and again burn in secondary chamber at higher temperature around 900°C. The residue is treated as general waste and disposed off with other hospital waste. The incinerator has not being functioning for a long time.

There are no special techniques for hospital waste handling at civil hospital and staff is treating all solid waste as general waste very carelessly. Municipal vehicle daily collect this waste once a day in the morning for off-site disposal at an open dumping area with other general wastes generated in the city. No collection and disposal of waste is done on Sunday being weekly holiday for the sanitation staff.

### **Waste Generation Rate**

The waste generation rate as assessed by the Consultant with respect to bed strength, solid waste generated and generation rate wardwise is shown in Table 9.

**Table 9: Waste generation and rates at Civil Hospital, Karachi**

No.	Ward/Unit	Bed Strength	Waste/Day (Kg)	Gen. Rate Kg/Bed/Day
1.	Medical Unit I	48	150	3.125
2.	Medical Unit II	50	152	3.040
3.	Medical Unit III	53	157	3.962
4.	Medical Unit IV	46	150	3.261
5.	Medical Unit V	36	143	3.927
	All Medical Units	233	752	3.228
6.	Surgical Unit I	50	170	3.400
7.	Surgical Unit II	44	152	3.455
8.	Surgical Unit III	48	158	3.292
9.	Surgical Unit IV	50	163	3.260
10.	Surgical Unit V	50	163	3.260
11.	Surgical Unit VI	50	171	3.240
	All Surgical Units	292	977	5.346
12.	Gynaecology Unit I	50	153	3.060
13.	Gynaecology Unit II	51	153	3.000
14.	Gynaecology Unit III	45	146	3.244
15.	Labour Room	12	150	12.500
	All Gynaecology Units	152	602	3.961
16.	Orthopaedic Unit I	62	190	3.065
17.	Orthopaedic Unit II	42	168	4.000
	All Orthopaedic Units	104	358	3.442
18.	Cardiac	35	122	3.486
19.	C.C.U	10	55	5.500

No.	Ward/Unit	Bed Strength	Waste/Day (Kg)	Gen. Rate Kg/Bed/Day
20.	Neurology	25	65	2.600
21.	Orology	44	155	3.523
22.	E.N.T.	50	170	3.400
23.	Eye	50	135	2.700
24.	Paediatric Unit I	50	145	2.900
25.	Paediatric Unit II	50	151	2.746
	All Paediatric Units	105	296	2.819
26.	Paeds Surgery	31	125	4.032
27.	Neuro Surgery	22	75	3.409
28.	Vascular Surgery	32	105	3.281
29.	Plastic Surgrey	35	130	3.714
30.	Burns	25	170	6.800
31.	Psychology	40	110	2.750
32.	Skin	30	105	3.500
33.	Isolation	25	65	3.095
34.	Paeds Treatment Room		40	
35.	Surgical I.C.U.		45	
	TOTAL	1342	4657	3.470

The solid waste generation other than hospital wards include employees of the hospital (2001), total patients (844), daily OPD (1860), visitors (3500), open area, nursing mess, support services, casualty etc. generate the waste as follows:

<u>AREA</u>	<u>DAILY WASTE (KGS)</u>
Open areas and compound	165
Nursing mess	70
Casualty and OPDs	60
	----
Total outside wards (i)	295
	-----
Total from wards (ii) refer table 9	4,657
<b>Grand total (i) + (ii)</b>	<b>4,952</b>

Waste generation rate is assessed as follows:

Total waste generated in Civil hospital	4,952 kg/day
Total gross population	8,205
Generation Rate (kg/gross pop./Day)	0.604

Generation rate as total is determined as:

Total waste generated daily	4,952 kgs
Total beds in Civil hospital	1,342
Generation rate (kg/bed/day)	3.69

Waste generation rate from casualty and other OPDs is determined below:

Daily waste from casualty and OPDs	60 Kgs
Casualties and OPDs (during 1992)	669,148
Generation rate	33 gms/OPD/day

All the waste generated from hospital is collected together and disposed of indiscriminately with the city waste.

**Table 10: Annual floor census at JPMC, Karachi (1992)**

Wards	Departments	Beds	Admissions	Dis-charged	Deaths	Pats./ D	Ave.P/D	Beds Occ. rate (%)
1	Special Ward	38	647	546	33	8224	22.53	59.29
3	Surgical Unit I	48	941	752	82	11436	31.33	65.27
2	Surgical Unit II	48	913	768	77	11642	31.90	66.45
26	Surgical Unit III	22	564	422	66	7058	19.34	87.90
4	Radiotherapy	48	522	363	140	6687	18.32	38.17
5	Medical Unit I	48	1213	977	150	14394	39.44	82.16
6	Medical Unit II	48	852	667	139	12440	34.08	71.00
7	Medical Unit III	48	1144	923	159	13132	35.98	74.95
8	Gynae. & Obst. Unit I							
9	Gynae. & Obst. Unit II	135	9339	8960	28	55782	152.68	113.10
10	Cardiology	30	399	276	18	4912	13.46	44.86
11	Ophthalmology	73	1391	1250	00	12851	35.21	48.23
12	Thoracic Medicine Unit I	21	651	460	90	7632	20.91	48.63
13	Thoracic Medicine Unit II	22						
14	Orthopaedic	32	559	422	9	8550	234.42	73.20
15	E.N.T.	28	635	492	9	9211	25.24	90.13
16	Neuro Surgery	40	1168	932	201	19220	52.66	131.64
17	Accidental	32	632	468	5	8923	24.45	76.40
20	Psychiatry	22	341	232	62	6349	17.39	79.07
21	Thoracic Surgery	25	316	224	9	5034	13.79	55.17
22	Nephrology	20	482	377	76	4695	12.86	64.32
23	I. C . U .	20	855	667	118	8044	22.04	110.19
24	Plastic Surgery	30	351	237	00	6944	19.02	63.42
25	Dermatology	10	183	115	00	2958	8.10	81.04
2S	Neurology	22	391	233	49	5623	15.41	70.02
	<b>TOTAL</b>	<b>910</b>	<b>24489</b>	<b>20768</b>	<b>1583</b>	<b>1583</b>	<b>25168</b>	<b>75.78</b>

### Waste Composition

The waste composition was assessed by the Consultant based on informal interviews with the hospital staff in terms of general waste and infectious waste (as described in earlier sections). The results shows that 39% of general waste and 61% of infectious waste is generated at Civil Hospital Karachi.

#### 6.4.3 Jinnah Post Graduate Health Care Centre (JPMC)

##### General

JPMC is a federal government general hospital. Sindh Medical College is attached with JPMC. It has a bed strength of 910 but in some wards occasionally more than 100% occupancy occurred and is mentioned in Table 12. During emergency, additional beds are

placed even in hospital corridors, hence statistical department count JPMC of approximately 1100 beds facility.

Details about departments, wards, bed strength, bed occupancy etc. for the year 1992 is shown in the above mentioned table. The hospital is normally occupied approximately 76% on an average i.e. 690 beds are occupied out of 910 beds daily. Like Civil hospital, JPMC also have operation theatres, X-ray units, laboratories, blood bank, casualty, OPDs, emergency, pharmacy, administration, kitchen and cafeteria, maintenance and stores and laundry. Detail of OPD is shown in Table 11.

**Table 11: O.P.Ds. Statistics department-wise at JPMC (1992) Karachi**

S .No.	O. P.Ds	Number of Patients
1	Casualty	94212
2	Surgical	42156
3	Cancer	59232
4	Medical	126552
5	Thoraci c Medicine (Chest, T.B)	15468
6	Gynae & Obst.	46992
7	Orthopaedic	33276
8	Neurosurgery	6540
9	Dental	28200
10	Neurology	48936
11	Psychiatry	20784
12	Physiotherapy	35676
13	E.N.T	60600
14	Eye	41964
15	Chest Surgery	840
16	Plastic Surgery	1920
17	Staff Clinic	17088
18	Kidney	14220
19	Dermatology	25416
20	Cardiology	7600
	TOTAL	727672

*Source: JPMC Statistic Department*

### **Waste Management System**

There are staff residences within the boundary of JPMC which includes residences for doctors, nurses and other staff making a permanent population of approximately 6500 personnel in JPMC. There is a colony for senior doctors living with families, having approximately 1000 personnel. A mess for RMOs (also family accommodation) have 200 flats, a mess for junior and house doctors having capacity for single persons is 300 in number, a nursing mess for 600 personnel, a physiotherapy hostel for 60 students and a hostel of Basic Health Care Science Institute (BMSI) for 400 students.

The sanctioned sanitary staff is approximately 420 out of which only 319 sanitary workers are employed by the administration for cleaning purpose. A superintendent is the key man managing the entire waste management system assisted by sanitary inspectors, supervisors and hawaldars (sanitary inspectors) in three shifts operation. The administration also engage

the sanitary staff for other jobs like tree cutting, loading and unloading and other general hospital works making the crises of staff crucial. Besides cleaning, the sweepers deputed in the wards are also involved in activities other than cleaning affecting the general sanitary condition of the hospital.

### Waste Generation Rate

The waste generation rate with respect to bed strength, solid waste generated and generation rate wardwise is shown in Table 12. The waste generation rate in kg/population/day is estimated by the Consultant based on the available data and informal discussions with the medical staff and is shown in Table 13. Thus the waste generation is worked out to be:

Total gross population	6,500
Total waste generated daily	1801 kg.
GENERATION RATE KG/GROSS POP/DAY	0.277

Waste generation rate as total is determined as follow

Total waste generated daily	1801 kg.
Average beds occupied daily	910
GENERATION RATE (KG/BED/DAY)	1.98

Waste generation rate of casualty patients is determined as follows:

Casualties during 1992	94,212
Daily casualty waste	110 kg.
GENERATION RATE (KG/CASUALTY/DAY)	0.387

Another study conducted by an NGO in 1993 (Reference 10) revealed that 1160 bedded JPMC is generation 1328 kg of solid waste daily or 1.15 kg/bed/day

**Table 12: Ward wise waste generation at JPMC, Karachi**

S.No	Wards/Departments	Beds Strength	Waste Kg/Day	Rates /Kg/ Bed/Day
1.	Special Ward	38	50	1.32
2.	Surgical Unit I	48	50	1.04
3.	Surgical Unit II	48	50	1.04
4.	Surgical Unit III	22	50	2.27
	<b>Total Surgical Units</b>	<b>118</b>	<b>150</b>	<b>1.27</b>
5.	Radiotherapy + OPD	48	60	1.25
6.	Medical Unit I	48	70	1.46
7.	Medical Unit II	48	70	1.46
8.	Medical Unit III	48	50	1.04
	<b>Total Medical Units</b>	<b>144</b>	<b>190</b>	<b>1.32</b>
9.	Gynae & Obst. Unit I + OPD			
10.	Gynae & Obst. Unit II			
	<b>Total Gynae Obst. Unit</b>	<b>--</b>	<b>--</b>	<b>--</b>

S.No	Wards/Departments	Beds Strength	Waste Kg/Day	Rates /Kg/ Bed/Day
11.	Dermatology	30	25	0.83
12.	Ophthalmology (Eye + O.T)	73	31	0.43
13.	Thoracic Medical Unit I	21	25	1.19
14.	Thoracic Medical Unit II	22	37	1.68
	<b>Total Thoracic Medical Units</b>	<b>43</b>	<b>62</b>	<b>1.44</b>
15.	Orthopaedic	32	50	1.56
16.	E.N.T. + OPD	28	65	2.32
17.	Neurosurgery	40	110	2.75
18.	Accidental (Orthopaedic)	32	50	1.56
19.	Psychiatry + OPD	22	15	0.68
20.	Thoracic Surgery	25	50	2.00
21.	Nephrology + OPD	20	65	3.25
22.	I.C.U.	20	37	1.85
23.	Plastic Surgery	30	50	1.67
24.	Neurology + Department	32	60	2.73
	<b>TOTAL</b>	<b>910</b>	<b>1360</b>	<b>1.51</b>

### Waste Composition

The waste composition was assessed in terms of General Waste and Infectious Waste. The result shows that 35% of General Waste and 65% infected waste is generated at JPMC.

### Waste Composition

The waste composition was assessed in terms of general waste and infectious waste. The assessment made by the Consultant based on informal interviews with the medical staff shows that 35% of general waste and 65% infected waste is generated at JPMC.

**Table 13: Waste generation in Jinnah Hospital (outside wards)**

AREA	DAILY WASTE (KGS)
Dental OPD	6
Casualty	100
Main Theatre	40
Doctor Mess I	30
Doctor Mess 96	50
Doctors colony	50
Nursing mess & school	10
Physiotherapy hostel	15
Library	10
Medical Store	10
Open areas & roads	120
<b>TOTAL</b>	<b>441</b>

#### 6.4.4 Abbasi Shaheed Hospital (ASH)

##### General

Abbasi Shaheed Hospital (KMC) is a metropolitan government and general hospital having a nursing school for teaching and training. ASH has all basic facilities of a general hospital including OPDs, casualty, operation theatres, laboratory, pharmacy, workshop, canteen etc. There are residences for doctors and nurses in the hospital premises. The hospital bed strength is shown in Table 14.

**Table 14: medical and para-medical staff in Karachi division (1992)**

No.	Description	Government	Other Government	Private	Local Bodies	Total
1.	Doctors	2259	634	822	561	4276
2.	Nurses	461	319	869	489	2138
3.	L.H.V.	74	13	48	94	229
4.	Radiographer	4	4	42	8	58
5.	Health Technician	27	--	--	5	32
6.	Dispensers	259	571	193	311	1334
7.	X-Ray Assistants	46	23	108	22	199
8.	Lab. Assistants	130	47	210	51	438
9.	O.T. Assistants	75	23	186	36	320
10.	Mid Wives	50	53	233	135	471
11.	Dais	164	155	381	159	859
TOTAL EMPLOYEES		3613	1874	3107	1904	10503

Some important data about OPDs, In-patient Department, operations, deaths and births, casualty cases and medico legal cases from 1986 to 1992 is shown in Table 15.

**Table 15: Statistics at Abbasi Shaheed Hospital, (KMC) Karachi (1986 - 1992)**

YEAR	O.P.Ds	I.P.Ds	OPERATIONS			BIRTHS	DEATHS	CASUALTY CASES	MEDICO LEGAL CASES
			MAJOR	MINOR	TOTAL				
1986	450826	13237	5461	6407	11868	1381	1150	68932	10610
1987	481871	13806	6592	5907	12499	1534	1182	60775	11396
1988	496288	14294	7178	6564	13742	1894	1181	77432	5836
1989	590689	15837	7626	6737	14363	2140	1359	97355	6114
1990	675167	17218	7630	7178	14808	2245	1408	124387	5492
1991	700229	19347	8470	5977	14447	2621	1444	104935	5271
1992	763085	21629	8169	5755	13924	2163	1647	101161	4950

##### Waste Management System

In Abbasi Shaheed Hospital, the sanitary staff first collect waste from ward beds and then from the whole ward. The waste from each ward is transported to an on-site disposal area where plastic drums are placed. Normally, baskets with carrying capacity of 10 kgs or manually driven trolleys are being used by the sanitary staff for waste transportation. Each

plastic drum may have 60 kgs waste load depending upon the density of the waste and around 15 drums are filled daily.

The cleaning system is operated in three shifts like Civil hospital and JPMC in Karachi. Every morning KMC vehicle transports the waste from on-site storage to an off-site final disposal area where other city wastes are being dumped indiscriminately. Sunday being a holiday for KMC staff, the waste remains in the hospital and for the whole day it affects people, patients and visitors coming into the hospital. The bad odour is spread in the atmosphere and people residing nearby the hospital always complain about this matter. An incinerator was installed in the recent past to burn the infectious waste daily. Unfortunately, it did not work and the problem still persist.

### Waste Generation Rate

The waste generation rate with respect to bed strength, solid waste generated and generation rate wardwise is shown in Table 16. The waste generation at the Abbasi Shaheed Hospital other than ward is given as follows:

<u>AREA</u>	<u>DAILY WASTE (KGS)</u>
Computer section, workshop, open area, nursing area, nurses and doctors residences	100
OPDs	200
Main office	10
	----
TOTAL	310

The generation rate as total in kg/bed/day is determined as:

Total waste generated	1484 kg daily
Total beds	579
Generation Rate	2.56 kg/bed/day

Waste generation rate per OPD is calculated as follows:

Waste from OPDs	200 kg daily
Working days	300 per year
OPD patients during 1992	759,495
Generation Rate	79 gms/OPD/day

**Table 16: Ward-wise waste generation and rates at Abbasi Shaheed Hospital, Karachi**

No.	Wards/Departments	Bed Strength	Waste (Kg/Day)	Generation Rate (Kg/Bed/D)
1.	Orthopaedic	61	117	1.92
2.	Gynaecology	60	60	
3.	Labour Room		135	3.25

No.	Wards/Departments	Bed Strength	Waste (Kg/Day)	Generation Rate (Kg/Bed/D)
4.	Surgical I & II	63	107	1.70
5.	Surgical III	24	30	1.25
6.	Neurology	36	44	1.22
7.	Nephrology	31	40	1.29
8.	Burns	21	40	1.91
9.	K.M.C.	31	54	1.74
10.	Medical	42	120	2.86
11.	Paediatric	56	77	1.38
12.	Eye	34	40	1.18
13.	E.N.T.	34	50	1.47
14.	Surgical I.C.U.	8	30	3.75
15.	C.C.U.	12	30	2.50
16.	Cardiology	19	30	1.58
17.	Nursery	23	30	1.30
18.	Casualty	24	60	2.50
19.	Operation Theatre		40	
20.	Laboratory		40	
	TOTAL	579	1174	2.03

### **Waste Composition**

The waste composition was assessed by the Consultant based on informal interviews with the medical staff in terms of general waste and infectious waste. The result shows that 30% of general waste and 70% of infected waste is generated at the Abbasi Shaheed Hospital.

#### *6.4.5 Liaquat National Hospital (LNH)*

##### **General**

Liaquat National Hospital (LNH) was started in 1958 on a modest scale serving only for outdoor patients in the beginning. It however started taking in-patients from the beginning of 1959. LNH has made phenomenal progress over the years. Today LNH has 560 beds in general, semi-private and special wards, including general and semi-private beds (419) private rooms (85) special care for Intensive Care Unit ICU (23) Special Care for Coronary Care (16) Special Care for Paediatrics (17).

LNH has well equipped pathological laboratories, blood bank, radiology department, operation theaters and recovery room, 24 hours dialysis service, physiotherapy, teaching and training school, pharmacy and special care departments with facilities for E.N.T. & Echocardiography.

LNH offers the fellowship and residency programme to the junior medical staff for one, two or three years depending on the specialty. The Hospital also provides paramedical training and teaching in allied health since its inception. It provides training in General Nursing, Midwifery, Physiotherapy, Laboratory, X-Rays, Operation theaters and like.

### **Waste Management System**

Like other hospitals in Karachi, LNH is doing same practice for waste disposal. The Hospital has an on-site dumping yard where all the waste generated is being dumped by the house keeping (sanitary) staff. The waste generated by individual patient is first collected in a drum of approximately 100 litres capacity placed in each ward. The drum is emptied daily at an on-site dumping yard either at the end of each shift or when it is filled.

### **Waste Generation Rate**

The waste generation rate with respect to bed strength, solid waste generated and generation rate wardwise is shown in Table 17. The waste generation at the LNH other than ward is given in

Table 18

**Table 17: Ward-wise waste generation and rates at Liaquat national hospital, Karachi**

No.	Wards/Departments	BedStrength	Waste(Kg/Da y)	Rate(Kg/Bed/D )
1.	Special I	18	25	1.39
2.	Special II	25	30	1.20
3.	Special III	29	40	1.38
4.	Special IV	13	20	1.54
5.	C.C.U.	16	25	1.56
6.	Cardiac I.C.U.	4	10	2.50
7.	Special I.C.U.	8	12	1.50
8.	Male I.C.U.	4	10	2.50
9.	N/I.C.U.	4	10	2.50
10.	Chest I.C.U.	7	15	2.14
11.	Male Surgical	69	70	1.02
12.	Female Surgical	22	35	1.59
13.	Male Medical	35	40	1.14
14.	Female Medical	41	35	0.88
15.	Cardiac Ward	24	35	1.46
16.	Gynae & Obst.	39	60	1.54
17.	Orthopaedic	65	70	1.08
18.	Chest	40	50	2.25
19.	Children	44	60	1.36
20.	Nursery	17	30	1.77
21.	Psychiatry	28	30	1.07
	TOTAL	556	712	1.28

**Table 18: Waste generation at Liaquat National Hospital (other than wards)**

AREA	DAILY WASTE (KGS)
<u>Infectious Waste</u>	
Operation theatre	25
Labour room	80
Laboratory	20
Total infectious waste	120
<u>General Waste</u>	
Main office	20
open area	50
Total general waste	70
<b>TOTAL</b>	<b>195</b>

The waste generation rate assessed by the Consultant based on the informal interviews with the medical staff for infectious and total waste are determined below:

Total infectious waste	837 kgs
Total beds	556
Generation Rate (infectious waste)	1.51 kg/bed/day
Total waste (infectious & general)	907 kgs
Generation rate (total)	1.63 kg/bed/day

### **Waste Composition**

The waste composition was assessed by the Consultant in terms of general waste and infectious waste. The result shows that 35% of general waste and 65% of infectious waste is generated at the hospital.

#### *6.4.6 The Aga Khan University Hospital (AKUH)*

##### **General**

The Aga Khan University's faculty of health sciences and the university hospital are collectively known as The Aga Khan University Health Care Centre (AKUMC). Besides serving the nation on medical and health grounds, The Faculty of Health Sciences responded to the Government request for assistance in the formulation of its health policies, and collaborated with the Government of Sindh in assisting two World Bank sponsored programmes - The Family Health Project and The School Nutrition Programme.

The Aga Khan University Hospital is a private and teaching hospital. It has a bed strength of 432. The details of wards/departments with their bed strength are shown in

Table 19.

**Table 19: Details of wards/departments with bed strength at the Aga Khan University Hospital (Akuh), Karachi**

No.	Wards	Departments			
1.	PW1-Private I	Surgical			
2.	PW2-Private II	Medical			
3.	Pw3-Private III	Executive			
4.	A2	Obst. & Gynae			
	TOTAL PRIVATE BEDS		84		
			General	Semi-Private	Total
5.	B1	Surgical	44	14	58
6.	C1	Med. Surgical	44	14	58
7.	C2	Medicine	44	14	58
8.	B2	Obst. & Gynae	39	12	51
9.		Paeds	40	14	54
10.		Paeds Diarea	20		20
11.		Psychiatry	10	2	12
12.	D2	Oncology	10	4	14
13.		N/I.C.U.	10		10
14.		I.C.U.	8	1	9
15.		C.C.U	4		4
	Total Beds in General & Semi-private Wards				348
	TOTAL BEDS				432

The AKUH has latest medical facilities and services for both in and out patients. For in-patient department AKUH has the following facilities:

- i. A 14 bed day-care Oncology service for Chemotherapy:
- ii. Equipment and expertise in Orthoscopic and Laporscopic surgery. This technique involves minimal surgery and is less costly for patients.
- iii. To reduce pressure on the main Intensive Care Unit, and to provide care to patients in appropriate settings, a 5 bed special care "step down" unit was established in the departments of Medicines and Paediatrics.
- iv. The installation of cardiac monitors on the medical floor of the private wing now enables physicians to extend timely care to critically ill patients in that area.

On the out patient side, the facilities include Endoscopy suite, Day Care Surgery, Psychiatric Day Care Centre, Audiometry and Speech Therapy.

### **Waste Management System**

Initially, AKUH acquired the services of M/s. SERVICE MASTER INC., USA, the experienced company in hospital waste management world wide. Almost 500 hospitals all over the world have acquired the services of Service Master Inc., In AKUH, initial contract was for two years. Management and training of local staff which was extended for the third year. Since 1986, the local staff is managing all the waste in AKUH properly and as per the developed standards.

Waste generated in the wards is separated in two categories i.e. infectious and general waste. General waste is filled in green bags and stored at an on-site storage area for further transportation to off-site disposal.

Infectious waste is kept in red colour bags which includes sharp containers, tissues, animal carcasses, blood, body fluid, cotton, bandages, expired medicines and other hazardous items. The red bags are carried by a special team of personnel with appropriate personal protection gears, equipment and trolleys for collection of special/infectious waste. These red bags are kept in a cold storage adjacent to an on-site incinerator.

The waste from isolation unit are more infectious and hazardous and is put into a bag, sealed and again put into another bag of red colour. The gloves, masks, clothes etc. used by the staff in isolation unit are autoclave and sterilized before reuse or disposal. Some important data with respect to sizes and quantity of waste collection bags utilized per month at AKUH is given in Table 20.

**Table 20: Sizes and quantity of waste collection bags utilized per month at Aga Khan University Hospital, Karachi**

NO.	COLOURS	SIZES (INCHES)	QUANTITY
1.	Red	12 X 10 X 22 15 X 13 X 40 22 X 20 X 48	54852650100
2.	Green	5 x 5 x 22	8910
3.	Dark Green	15 x 30 x 40	4581
4.	Black	22 x 9 x 45	650

*Small Sharp Containers*                      450 per month average  
*Large Sharp Containers*                    210 per month average  
*Syringes*    99,975 per month average  
*Salines*    21,160 per month average

The infectious waste packaged in red colour bags are carried out by the housekeeping staff from wards, laboratory and other places to the on-site incinerator for closed burning. Incinerator is operated three days a week alternatively on Sunday, Tuesday and Thursday. The waste collected in other working days (Friday, Saturday, Monday and Wednesday) are stored in a refrigerated room. The cold storage is designed for waste storage capacity for 2-3 days. The incinerator is of enough capacity to handle all the infectious waste generated in the hospital.

The incinerator is operated, charged, discharged and maintained only by one person who is the sole responsible for all incinerator operations. Till today the incinerator is well maintained and is operating efficiently as per standards of flue gases set by the hospital authorities.

Incinerator is of pathological type suitable for infectious hospital waste burning. It consists of two chambers, the primary one (main firing chamber) and the secondary one (the high temperature burning chamber). The waste is loaded through charging door manually in front of main burner in the primary chamber where temperature is maintained around 800°C. The temperature is increased slowly giving enough time to the waste for complete burning. The hot exhaust gases go upward into the secondary chamber, and passes through holes in the refractory linings at the top of the primary chamber. The gases are also burnt in the secondary chamber where a secondary burner further increase the temperature upto 900°C. The temperature in the secondary chamber is almost 100°C higher than that of the temperature in the primary chamber. From secondary chamber the hot, clean and nonhazardous flue gases are exhausted through a stack/chimney.

The hot gases from secondary chamber are recycled in primary chamber through a closed-circuit minimizing the fuel (natural gas) consumption. Initially, the fuel gas is consumed to raise the chamber temperature and after certain time and temperature achievement, the fuel gas is less required as the hot air from secondary chamber is recycled with fresh air.

The confidential documents are also being incinerated at AKUH. A rough estimate shows that approximately 5% remaining waste is achieved in the form of ashes.

The incinerator operator and room are well equipped with safety measures. Gloves, masks, long boots etc. are provided to the operator. For cleaning the chemicals, detergents, disinfectants and high pressure water with suitable floor drain and wipers are available.

The green bags containing general wastes are further transported to dispose of at a city disposal area at North Karachi. A contractor is hired for these services who is also collecting other recyclable items like empty tins of ghee/oil, packing cartons, newspapers etc. The ash from incinerator and kitchen waste collected in black bags are also disposed of with general waste. In the evening the suzuki van transport the waste from AKUH to North Karachi dumping ground. A visit to the area revealed that all the general waste is mixed, segregated as per recyclable items and the non recyclable waste items are burned by potters (people making earthen pots like water container, flower pots etc) at the location. Around 20 sorters/scavengers do this job in the evening hours.

The Aga Khan University Hospital has an underground tank with Calcium Hydro-oxide lining connected with the main sewerage line. The infectious liquid waste from pathological laboratories and other facilities pass through this tank and then into the main sewerage system.

### **Waste Generation Rate**

The waste at AKUH is divided into three categories i.e. general (non-infectious), infectious and kitchen wastes. All these three wastes are packed in their respective colour bags as per standards of the hospital management. The sharps generated at the hospital are first placed into a puncture proof container and then packed into red bags with other infectious wastes. All the sharps are burnt in the incinerator.

The waste management in the AKUH is different from other government, semi government and private hospitals. The waste generated is properly packed in their respective colour-coded bags according to the category and is disposed as per colour of the bags.

**Table 21: Daily waste generation at Aga Khan Hospital**

	General Waste	Infectious Waste	Kitchen Waste
No. of bags	120	70	7
Weight/Bag	10 KG	12 KG	25 KG
Total	1200 KG	840 KG	175 KG
<b>TOTAL DAILY WASTE GENERATED AT AKUH 2215 KG</b>			

The daily waste generation at AKUH is mentioned in Table 21. The waste generated at Aga Khan hospital was disposed of collectively so ward-wise generation rate could not be determined. However, the generation rates for infectious and total waste in kg/bed/day and in kg/gross pop./day for infectious, general and total waste were determined with the help of facts and figures mentioned in Table 22.

- |    |   |                        |
|----|---|------------------------|
| 1. | Generation rate (70% bed occupancy) only for infectious waste | 2.78 kg/bed/day        |
| 2. | Generation rate (total)                                       | 5.13 kg/bed/day        |
| 3. | Generation rate (infectious waste)                            | 0.38 kg/gross pop./day |
| 4. | Generation rate (general waste)                               | 0.61 kg/gross pop./day |
| 5. | Generation rate (total waste)                                 | 0.99 kg/gross pop./day |

**Table 22: Total waste generation at Aga Khan Hospital**

PARTICULARS	QUANTITY
In-patients during 1992	20999
Out patients during 1992	249683
Employees and students daily	1500 approx.
Daily gross population	2242
Beds in hospital	432
Daily bed occupancy (70%)	302 kgs
Daily infectious waste	840 kgs
Daily General waste	1375 kgs

### Waste Composition

The waste composition was assessed by the Consultant based on informal interviews with the medical staff in terms of general waste and infectious waste. The assessment shows that 62% general waste and 38% of infectious waste is generated at AKUH.

## 6.5 Comparison of Solid Waste Generation Rate

The data collected by the Consultant is further reviewed for comparison and is mentioned as follows:

### 6.5.1 *Civil Hospital*

The average generation rate ward wise is 3.47 kg/bed/day with slight variation in different wards. The highest generation rate is in Burns Ward i.e. 6.8 kg/bed/day and the least generation rate is in Neurology Department i.e. 2.6 kg/bed/day. The majority of the departments are producing waste with a generation rate of 3.5 kg/bed/day.

Some departments generate little waste like medical, cardiac, E.N.T., eye, psychology departments etc. This is because of the mixing of waste from outside wards and from open areas including corridors and open grounds.

### 6.5.2 *Jinnah Hospital*

The average generation rate ward wise is 1.51 kg/bed/day (total generation rate is 1.98 kg/bed/day) with maximum generation rate in Nephrology Department (3.25 kg/bed/day) and minimum in Eye Ward (0.43 kg/bed/day). Jinnah hospital has 910 beds and normally the departments are producing waste around 1.5 kg/bed/day with exception of some departments.

Some low waste generation departments are showing more waste as the waste from OPD is mixed with the ward waste. In some wards, corridor waste is mixed with ward waste. Like in E.N.T. and Nephrology Departments.

### 6.5.3 *Abbasi Shaheed Hospital*

Abbasi Shaheed Hospital has 579 beds and producing waste at the generation rate of 2.03 kg/bed/day wardwise (total generation rate is 2.56 kg/bed/day) with the highest rate in Surgical I.C.U. (3.75 kg/bed/day) and the least in Eye Department (1.18 kg/bed/day). There is same practice to mix corridor and OPD waste with departmental waste which slightly increases/the generation rate.

### 6.5.4 *Liaquat National Hospital*

The average generation rate is 1.28 kg/bed/day ward wise from 556 beds hospital (total generation rate is 1.63 kg/bed/day) with maximum rate of 2.5 kg/bed/day from Cardiac I.C.U., Male I.C.U. and N.I.C.U. and minimum rate of 0.88 kg/bed/day from Female Health Care Ward.

### 6.5.5 *Aga Khan Hospital*

Ward wise waste collection could not be obtained. However, the maximum generation rate at Aga Khan hospital shows that disposable items are frequently used. Other factors like services provided to patients, its frequency and packing material are also responsible for this high generation rate.

The data gathered from the above hospitals is compared and is given in

Table 23. The generation rate was found varying from 1.63 to 5.13 kg/bed/day.

**Table 23: Ward-wise waste generation in different hospitals in Karachi**

S.No	Wards/Departments	Generation Rates (Kg/Bed/Day)			
		Civil Hospital	JPMC	Abbasi Shaheed Hospital	LNH
1.	Medical	3.228	1.320	2.860	0.990
2.	Surgical	3.346	1.270	1.575	1.150
3.	Gynae & Obstt.	3.810	1.780	3.250	1.540
4.	Orthopaedic	3.442	1.560	1.920	1.080
5.	Cardiac	3.490	--	1.580	1.460
6.	C.C.U.	5.500	--	2.500	1.560
7.	Neurology	2.600	2.730	1.220	--
8.	Urology	3.520	--	--	--
9.	E.N.T.	3.400	2.320	1.470	--
10.	Eye	2.700	0.430	1.180	--
11.	Paediatric	3.096	--	1.380	1.360
12.	Nephrology	--	3.250	1.290	--
13.	Plastic Surgery	3.710	1.670	--	--
14.	Skin	3.500	--	--	--
15.	Burns	6.800	--	1.910	--
16.	Accidental	--	1.560	--	--
17.	Psychiatry/Psychia	2.750	0.680	--	1.070
	TOTAL	3.470	1.510	2.030	1.280

## 6.6 Comparison of Waste Composition

The waste composition as assessed from different hospital is compared. This is mentioned in Table 24. The results are compared with other hospitals in U.S.A.

**Table 24: Waste composition of hospitals in Karachi**

S.No.	Hospitals	General* Waste	Infectious**Waste
		(In Percentage)	
1.	Jinnah Post Graduate Medical Centre	35	65
2.	Abbasi Shaheed Hospital	30	70
3.	Liaquat National Hospital	35	65
4.	Aga Khan Hospital	62	38
5.	Civil Hospital	39	61
	Average in Karachi	40	60
	USA	40-50	50-60

\* General waste consist of kitchen waste un-utilized food from wards, garden waste, debris, corridor dust, newspapers, packing material, X-Ray sheets, plastic bags; caps, tins etc.

\*\* Infectious waste consist of disposable syringes, dust rose bags/bottles, urine bags, blood bags, infusion sets, bandages, dressings, blood, pus, tissues, organs, empty glass vials/ampules, bottles, needles, experied and usual mediciner etc.

In government hospitals of Karachi, there is no separation of general and infectious waste at source and high ratio of infectious waste is determined as 61% to 70%. In Aga Khan hospital,

there is separation at source and they are producing only 38% infectious waste. The range of infectious waste in USA varies from 50% - 60%.

## 6.7 Medical Staff

The medical and paramedical staff in Karachi Division as per data in 1992 is given in Table 25. The data further confirmed that on an average a patient stayed for about 5 days in a hospital.

**Table 25: Medical and para-medical staff in Karachi Division (1992)**

No.	Description	Government	Other Government	Private	Local Bodies	Total
1.	Doctors	2259	634	822	561	4276
2.	Nurses	461	319	869	489	2138
3.	L.H.V.	74	13	48	94	229
4.	Radiographer	4	4	42	8	58
5.	Health Technician	27	--	--	5	32
6.	Dispensers	259	571	193	311	1334
7.	X-Ray Assistants	46	23	108	22	199
8.	Lab. Assistants	130	47	210	51	438
9.	O.T. Assistants	75	23	186	36	320
10.	Mid Wives	50	53	233	135	471
11.	Dais	164	155	381	159	859
	TOTAL EMPLOYEES	3613	1874	3107	1904	10503

## 6.8 Collection of Hospital Waste

As mentioned in earlier sections, the hospital waste is collected by the permanent sanitation staff. The individual or twin sharing bins are provided in the general wards, while semi private (two to four beds/room) and private rooms have one bin per bed. The capacity of the bins vary from 10-25 litres. Bins are also provided in the nursing rooms, doctors rooms, visiting room, recovery room and at other facilities. The capacity of the bin varies from 20-40 litres. The waste is collected by the sweepers in a four wheel trolleys. The waste is taken to a central location in all the hospital (except AKUH) where it is stored and segregated for removing/retaining recyclable items.

## 6.9 Communal Storage of Hospital Waste

All types of waste are collected and stored in the communal facilities as a heap or in container or in cement concrete G.I. bin. The waste is stored/dumped manually by baskets. The site visits at these hospitals (except AKUH) revealed that floor sweepings is not appropriately done and the back lanes/sides of the government hospitals especially pose a very polluted sight (refer photographs).

## 6.10 Disposal of Hospital Waste

The general trends in Pakistan is disposing of bio-medical waste at the local nearby communal bins for which no segregation in collection and disposal is done. The hospital waste can be witnessed in and around the communal bins in all the major urban centres in Pakistan and include operation theatre waste, infectious waste and sharps (scalpels, catheters, syringes etc.), general wastes from the hospital wards and kitchen. Within the hospitals, wastes are collected by untrained staff, and there is generally little segregation of sharps from other waste materials. Incidents occurring due to inappropriate handling of sharps have been informally reported to occur due to which the staff member(s) get infected and have died from such incidents.

The hospital waste is being collected manually by coolies (loaders) through shovel and baskets, loaded on head and dumped into the open refuse vans or compactors. The municipal staff do not wear any protective clothing and gears. Besides the scavengers also search for the recyclable/reusable waste items from the communal bins prior to its collection by the municipal staff. They too are also without protective clothing and gears. The direct manual handling of such hazardous waste can cause infectious diseases. Another survey has revealed that skin diseases and occurrence of fever among municipal sweepers and scavengers are a common incidence which is not reported by them. Some informal interviews of the sweepers were conducted by the Consultant for other research yielded that on an average one out of five worker has/had some sort of skin disease in the shape of rashes, allergies, red/soaring limbs etc. However the workers are used to it and does not specifically complain about it.

Garbage is frequently been burnt in the communal bins causing tremendous air pollution. Burning of hazardous constituents of the waste is dangerous and becomes a threat to the public health of the people living and working around such garbage heaps. The same practices is being adopted at the ultimate garbage disposal site where hospital waste alongwith the municipal waste is being openly dumped and burnt.

## **CHAPTER 7 EXISTING GENERATION AND RECYCLING STATUS OF HEALTH CARE WASTE**

### **7.1 General**

This chapter discuss the existing recycling status and practices of health care waste in Karachi city by the formal and informal sector.

### **7.2 Recyclability of Health Care Waste**

The waste category as distinguished by the Consultant include infectious waste, plastic waste, sharps and miscellaneous waste. The quantities in kilograms of health care waste generated in Karachi is given in Table 7.1. The recyclability status of the waste categories is mentioned in Table 7.2.

### **7.3 Quantities of Recyclable Waste Produced**

The quantities of recyclable waste produced/retrieved by the informal/formal sector from the various health care facilities is mentioned in Table 7.1. This assessment is based on the various site visit of the Consultant to these facilities, informal interviews of the sanitation staff and scavengers available during the visit. The total quantities generated in each waste category cumulatively is also mentioned in the table 7.1.

The recycling status, methodology and process of various waste categories is mentioned as follows:

### **7.4 Generation and Recycling Status of Infectious Waste**

Most of infectious waste produced is not recycled and does not contain much of the recyclable material. The description of each item is mentioned as follows:

#### *7.4.1 Blood*

Blood is generated mainly from the support services like Blood Bank and radiological laboratory where blood specimens are taken for culture, testing and analysis. Similarly the blood is generated from hospital (mainly from operation theatres and surgical wards) and maternity homes (gynaecological cases). The blood from the blood banks are stored in the blood bags which is transported to the users as well as used for in-house health care test before delivery/utilization of blood by the patients. Facilities like Fatmid Foundation also utilizes the blood from donors and provide it to the patients. (Refer photographs). The empty blood bags and plastic tubing contain some quantities of blood which remains sticking with the bag walls. The same is disposed in this condition.

The blood from the pathological laboratories after testing is put into the sanitary sewer system (as 95% of the pathological laboratories are located in the urban areas of Karachi where pipe sewer system is available). Only at AKUH, Karachi is the liquid waste treated. At many hospitals the waste blood is disposed by diluting it with water from the tap.

**Table 26: Quantities in kgs of health care waste generated**

S.No.	Waste Category	Clinics/ Dispensaries	BHUs	Consulting Clinics	Health care Establishments	Support Services	Technical Services		Hospitals & Maternity Homes	Total
							Pathological lab	Radiological Services		
<b>A. INFECTIOUS WASTE</b>										
1	Blood	-	(2.0) 1.0	-	-	(18.0) 135.0	(14.0) 700	-	(4.5) 450.0	1286.0
2	Pus	-	(0.4) 0.2	-	-	-	(0.3) 15.0	-	(0.5) 50.0	65.2
3	Limbs	-	-	-	-	-	(0.3) 15.0	-	(0.3) 30.0	45.0
4	Swabs/Dressings	(47.0) 1916	(48.0) 24.0	(20.0) 23.0	-	(9.0) 67.5	(20.0) 1000	(6.0) 90.0	(45.0) 4500.0	7620.5
5	Placenta	-	-	-	-	-	-	-	(4.0) 400.0	400.0
6	Culture Medic	-	-	-	-	-	(6.0) 300.0	-	(3.0) 300.0	600.0
<b>B PLASTIC WASTE</b>										
1	Plastic bags & accessories	(8.0)326	(8.0) 4.0	(20.0) 2.3	-	(30.0) 225.0	(3.0) 150.0	-	(10.0) 1000	1707.3
2	Urine bags	-	-	-	-	-	-	-	(2.0) 200.0	200.0
<b>C SHARPS</b>										
1	Syringe	(3.0) 122	(4.0) 2.0	(1.5) 1.7	-	(5.0) 37.5	(15.0) 750.	-	(5.0) 500.0	1413.2
2	Glass ware	(8.0) 326	(8.0) 4.0	(4.0) 4.6	-	(6.0) 45.0	(10.0) 500.	(2.0) 30.0	(6.0) 600.0	1509.6
<b>D MISCELLANEOUS</b>										
1	Food/organics	(3.0) 122	(2.0) 1.0	(2.5) 2.9	(20.0) 240.0	(5.0) 37.5	(4.0) 200.0	(3.0) 45.0	(4.0) 400.0	1048.4
2	Plastic & polythene	(8.0) 326	(7.0) 3.5	(15.0)17.3	(11.0) 132.0	(6.0) 45.0	(4.0) 200.0	(38.0) 570.0	(2.0) 200.0	1493.8
3	Plaster	-	-	-	-	-	-	(4.0) 60.0	(2.0) 200.0	260.0
4	Laboratory Chemicals/ fluids	-	-	-	-	(1.0) 7.5	(4.0) 200.0	(10.0) 150.0	(2.0) 200.0	557.5
5	Paper	(7.0) 286	(6.0) 3.0	(20.0) 23.0	(17.0) 204.0	(6.0) 45.0	(8.0) 400.0	(7.0) 105.0	(4.7) 470.0	1536.0
6	Metals	(3.0) 122	(3.0) 1.5	(2.0) 2.2	(3.0) 36.0	(4.0) 30.0	(2.0) 100.0	(4.0) 60.0	(1.0) 100.0	451.7
7	Others	(13.0) 530	(11.6) 5.8	(33.0) 38.0	(49.0) 588.0	(10.0) 75.0	(9.4) 470.0	(26.0) 390.0	(4.0) 400.0	2496.8
	<b>TOTAL</b>	<b>(100)4076</b>	<b>(100) 58</b>	<b>(100) 115</b>	<b>(100) 1200</b>	<b>(100) 750</b>	<b>(100) 5000</b>	<b>(100) 1500</b>	<b>(100) 10000</b>	<b>22699</b>

( ) = Percentage of Total Weight

**Table 27: Existing recycling status of medical waste (in kgs)**

S.No.	Waste Category	Recyclability	Clinics/ Dispensaries	BHUs	Consulting Clinics	Health care Establishments	Support Services	Technical Services		Hospitals & Maternity Homes	Total
								Pathological lab	Radiological Services		
<b>A. INFECTIOUS WASTE</b>											
1	Blood	NR	-	-	-	-	-	-	-	-	-
2	Pus	NR	-	-	-	-	-	-	-	-	-
3	Limbs	NR	-	-	-	-	-	-	-	-	-
4	Swabs/Dressings	NR	(20.0) 3.2	(20.0) 4.8	(15.0) 3.5	-	-	-	(10.0) 9.0	(20.0) 900.0	1300.5
5	Placenta	R	-	-	-	-	-	-	-	(30.0) 120.0	120.0
6	Culture Medic	NR	-	-	-	-	-	-	-	-	-
<b>B PLASTIC WASTE</b>											
1	Plastic bags & accessories	R	(50.0)163.0	(40.0) 1.6	(40.0) 0.9	-	(60.0) 135.0	(50.0) 75.0	-	(80.0) 800.0	1175.5
2	Urine bags	R	-	-	-	-	-	-	-	(40.0) 80.0	80.0
<b>C SHARPS</b>											
1	Syringe	R	(35.0) 43.0	(30.0) 0.6	(30.0) 0.5	-	(30.0) 11.3	(60.0) 375.	-	(40.0) 200.0	630.4
2	Glass ware	R	(20.0) 65.0	(10.0) 0.4	(30.0) 1.4	-	(20.0) 9.0	(30.0) 150	(24.0) 6.0	(30.0) 180.0	411.8
<b>D MISCELLANEOUS</b>											
1	Food/organics	R	-	-	-	-	-	-	-	(10.0) 40.0	40.0
2	Plastic & polythene	R	(25.0) 82.0	(10.0) 0.4	(20.0) 3.5	(60.0) 79.2	(50.0) 22.5	(50.0) 100	(50.0) 285.0	(10.0) 20.0	592.6
3	Plaster	NR	-	-	-	-	-	-	-	-	-
4	Laboratory Chemicals/ fluids	NR	-	-	-	-	-	-	-	-	-
5	Paper	R	(30.) 86.0	(20.0) 0.6	(70.0) 16.1	(70.0) 142.8	(65.0) 29.3	(65.0) 260	(70.0) 73.5	(30.0) 141.0	749.3
6	Metals	R	(20.0) 24.0	(15.0) 0.2	(60.0) 1.3	(60.0) 21.6	(50.0) 15.0	(70.0) 70.0	(65.0) 39.0	(20.0) 20.0	191.1
7	Others	R/NR	-	-	-	-	-	-	-	-	-
	<b>TOTAL</b>										

Legend: R = Recyclable NR = Non Recyclable

( ) = Percentage

The blood generated at the hospitals and maternity homes from operations and maternity cases is collected by putting cotton and gauzes. The soiled cotton is discarded while the thick cotton gauzes are reused/utilized again after washing. In small and medium private hospitals the washing is done manually by the maintenance/sanitation staff. In Govt. hospitals it is sent to the laundry where it is washed, dried, ironed and reused again for the same purposes. In private and expensive hospitals they are separately washed with chemicals and detergents and autoclaved like at OMI hospital.

The table 7.1 depicts that no recycling of the blood is taking place while the blood bags are included in plastic content as item B(1), cotton and gauzes are depicted in item A(1).

#### 7.4.2 *Pus*

Insignificant quantities of pus and allied organic/decomposed matter is generated in all health care facilities. Significant quantities of pus is generated in BHU's, pathological laboratories, hospitals and maternity homes. The pus is collected/swabs in the cotton dressing. The recycling quantities of pus soaked cotton dressing/soak is depicted in item A(4).

#### 7.4.3 *Limbs*

Part of amputated limbs and human parts are disposed in hospitals and maternity homes. The other source is pathological laboratories where such item are sent for testing and analysis and the same is disposed with other general solid waste. This organic content is thrown/disposed of with the other health care waste. This waste is very hazardous and can cause epidemics and communicable diseases. Often the street cats, dogs and goats loiter around the communal bins and eat such waste which is very dangerous. The same waste when collected by the sanitation staff poses great threat to human health and well being. The informal sector is not involved.

#### 7.4.4 *Swabs/Dressings*

It includes all solid material including cotton, gauzes and dressing which are generated due to physical treatment of patients. The survey revealed that this type of waste is generated in almost all health care facilities in minor or major quantities. This waste is generated by treating/dressing of patients in clinics, dispensaries, BHUs, consulting clinics, support services, pathological and radiological laboratories, hospitals and maternity homes. The major quantities are generated in hospitals (operation theater, surgical wards, emergency) and maternity homes.

The sanitation staff segregate this waste manually in terms of soiled and unsoiled cotton, dressing and gauzes. The soiled portions are disposed with the health care waste while the unused/segregated waste is separated, retained and sold. This waste is used as filling material in chairs cushions/sofa covers. The gauzes are washed and reused. The used gauzes are sold at higher price due to its solid content and reuse potential.

#### 7.4.5 *Placenta*

Placentas are generated during child birth which is removed, segregated, retained or thrown. The description of disposal through a private company operating in Karachi has already been elaborated in earlier Section.

In small maternity homes the placentas are disposed of with other health care waste ultimately reaching the communal bins storing domestic solid waste.

#### 7.4.6 *Culture Media*

The culture media consist of human tissues which are generated from the patients in hospitals and maternity homes and sent to the laboratories for testing. Often it is discarded and thrown of with other health care waste. The presence of culture media increase the pathogenicity of health care waste creating health hazardous to the collection staff (sanitary staff and scavengers).

### 7.5 **Generation and Recycling Status of Plastic Waste**

Plastic waste is the main component which is generated in huge quantities at the health care facilities and which is mostly recycled. The description of each item in the waste stream is mentioned as follows:

#### 7.5.1 *Plastic Bags and Accessories*

The plastic bags consist of blood bags, glucose bags and other drips/medication provided via veins. With the bags, the accessories include plastic tubing, control switches, catheters, etc. This sort of waste is produced in all health care facilities except health care establishments and radiological laboratories. Generally this waste is not segregated from other waste and is put in the litter box. The sanitation staff segregates and collect this waste and sell it to the hawkers when accumulated in good quantity.

#### 7.5.2 *Urine Bags*

The urine bags are used in hospitals and to some extent in the maternity homes also. Urine bags are mostly emptied, washed and reused in the health care facilities. The quantity of urine bags was found maximum in urology and surgical ward. Urine bags are also segregated by the sanitation staff and is sold to the hawkers when accumulated in good quantity.

### 7.6 **Generation and Recycling Status of Sharps**

This type of waste is mostly infectious and hazardous and is generated in almost all types of health care facilities except nursing homes, residences of medical personnel and radiological laboratories. Sharps are recyclable and are retrieved from the health care waste streams. The description of each item is mentioned as follows:

#### 7.6.1 *Syringes*

Syringes are now in common use in all health care facilities for injecting the medicines to the patients. In hospitals it is used in almost all wards and especially in operation theaters. The syringes mostly used are of plastic and disposable ones. The syringes are available of different capacities ranging from 1 ml to 1000 ml. It has a plastic body and plastic plunger to which a metallic needle is attached. Syringes are hazardous material and needs to be stored separately. The syringes are to be broken separating needles and plastic part. This exercise is done in only few private hospitals like AKUH and OMI. In most of the health care facilities the syringes are disposed/thrown with other general waste. Syringes also harm the storage container and poses great threat to the sanitation staff and recyclers.

The syringes are manually separated by the sanitation staff of the hospitals and is stored in a carton or a bucket to be sold to the street hawkers when accumulated in sizeable quantities. The street hawkers buy the syringes separately as per the price of plastic and sell it to the

middle dealers. The main dealers separate the needles and plastic by using local tool/plas. (Refer photographs). Labourers are hired for the separation purposes only. The plastic waste is recycled while the metal part is thrown of. The labourers separating the needles from plastic syringes do not realise the health risks involved. The visit to the main dealer waste at Shershah revealed that the metal parts are thrown in the Lyari river.

#### 7.6.2 *Glass Ware*

Various types of glass wares are used in the health care facilities including test tubes, bottles, jars, injection vials, containers, etc. The health care and syrup bottles are usually collected undisturbed from the waste stream. Other thin glass ware is received as culets which are dangerous and pose great threat to the sanitation staff and scavengers. Many scavengers complained of getting cuts and bruises due to the broken glass ware. Glassware is generated in almost all health care facilities. Glassware can be infected by contact with pathological waste when all waste is mixed and can pose a real health risk. The scavengers do not realize the health risks. The empty syrup bottles unused/expired bottles are retained by the sanitation staff and these bottles fetch a good price as they are cleaned, washed and reused. The thin glassware from injection vials are often not collected due to more efforts and less weight.

### 7.7 **Generation and Recycling Status of Miscellaneous Waste**

This category of waste is generated in almost all type of health care facilities. It consist of identified, unidentified and traceable quantities and type of waste. This miscellaneous waste is both recyclable and non recyclable. The description of each item is mentioned as follows:

#### 7.7.1 *Food/Organics*

This component of waste is generated in all the health care facilities due to preparation and utilization of food items. In large hospitals and health care facilities, garden waste is also included in this category. The food/organic waste contains kitchen waste from food preparation facilities, (flour, rice, vegetables, fruit residues etc.), food left over by the staff of the health care facilities, patients and their family members/caretakers/visitors. It includes fruit peeling which is thrown in the waste basket and kept under patient's bed.

The leftover edible food prepared by the hospital kitchen is utilized while the remaining unutilizable food is thrown in the communal bins with other components of health care waste. Only in major hospitals the leftover food is sold informally. The organic waste is not collected by any sanitation staff member or scavengers and is not utilized for making the compost.

#### 7.7.2 *Plastic and Polythene*

This waste component is also generated in almost all the health care facilities. Plastic consist of all other items excluding syringes, tubes, blood/urine/glucose/medicine bags. Polythene has become very common due to packing and carrying material. The patient's attendants bring polythene bags carrying medicine, fruits, food, clothes etc. Plastic containers for medicines, capsules etc. and other waste is generated which is found in the waste stream.

#### 7.7.3 *Plaster*

The quantities of plaster waste was found in hospitals and especially in orthopaedic wards and separate orthopaedic hospitals. The waste contains plaster lumps, stones and plaster particles. This item is non recyclable and cannot be easily segregated and reused.

#### 7.7.4 *Laboratory Chemicals/Fluids*

This waste is generated at support services, pathological and radiological laboratories and hospitals. The chemicals used at X-Ray Laboratory is collected, reused and recycled and is not included here as it is liquid waste. The other chemicals used at the pathological laboratory are disposed of in the sanitary sewerage system.

#### 7.7.5 *Paper*

Paper waste is generated in almost all health care facilities in considerable quantities. The type of paper waste includes newspapers, paper bags, wrapper of medicines, juice boxes, wrappings, include cardboard, prescriptions, computer paper etc. The site visit to the health care facilities revealed that often paper waste is soiled due to dumping of other type of liquid and infectious waste.

The sanitation staff often avoid collection of loose and soiled paper due to low economic value of waste. This waste is dumped at the communal bins with other waste and is collected by the scavenger (often Afghans). The paper has a low economic value being in small pieces but is baled by the middle dealer and sold to the main dealer for onward utilization by the paper recyclers.

#### 7.7.6 *Metals*

The metal waste include syringe needles, metal caps of bottles and metal pieces generated from orthopaedic wards in the form of metal plates, screws, nuts and bolts. The metal waste is generated from all health care facilities. The sanitation staff only collect the main/big metal pieces while the rest is dumped in the communal bins. The price of metal waste being bought by the street hawkers is Rs.5 per kg. (US\$ 0.13).

#### 7.7.7 *Others*

The other waste consist of recyclable and non recyclable parts. It includes elements in small quantities which cannot be separately identified. It also include floor sweepings. However for the purpose of identification of recyclable, no recyclable waste component is included here.



## CHAPTER 8 ACTORS IN HEALTH CARE WASTE MANAGEMENT

### 8.1 General

This chapter discuss the various formal and informal actors responsible in health care waste management. The condition, status, socio-economic condition, financial benefits received through health care waste is elaborated here.

### 8.2 Formal Actors in Health Care Waste Management

The formal actors in health care waste management include the following:

- (i) **Primary Storage:** The primary storage facilities at the health care facilities which is provided by the owner/operator of the facilities.
- (ii) **Primary Collection:** The primary collection of health care waste generated at the facilities is done by the appointed/hired sanitation staff who collect the waste from the identified storage to the disposal point, often a communal bins outside the premises. The in-house sanitation staff is employed by large hospitals, maternity homes and pathological laboratories. The staff hired in rest of the health care facilities are on monthly basis.
- (iii) **Secondary Storage:** The secondary storage is provided by the municipality and the agency servicing the area. In large private hospitals the facility is provided by the hospital itself. Otherwise the waste is disposed by the sanitation staff in the communal storage.
- (iv) **Secondary Collection:** The secondary collection and transportation of health care waste is done along with other domestic and commercial waste by the municipality or the other agency servicing the area.
- (v) **Disposal:** The health care waste is not segregated with other waste and is disposed along with other domestic and commercial waste. The open disposal is often followed by burning which is done by the municipal staff and recyclers to reduce the pathogenicity of waste and to reduce the volume.
- (vi) **Retrieving, Reusing and Recycling:** The waste items are often retrieved by the formal actors. In many health care facilities the waste items are retrieved and reused including bandages, gauzes, plastic bottles, glass bottles and glassware. In small private hospitals the syringes are also collected by the hospital administration and collectively sold after a month directly to the street hawker/middle dealer.

### 8.3 Informal Actors in Health Care Waste Management

The informal actors in health care waste management are described as follows:

The sanitation staff collect the health care waste before disposal at the communal bins and segregate the recyclables. Often the relatives, family member or friend (including watchman) assist the sanitation staff in segregation, storage and selling and thus share the profit. The watchman act as a guard who discourages/restrict the entry of other scavengers/street hawkers into the premises of the health care facilities. The segregated items are stored in cartons (refer photographs) and is kept in an empty room in the premises of the health care facility or under

the staircases. Depending on the quantity of waste retrieved, the waste is sold only to the identified/selected street hawkers.

The scavengers (human beings, mostly Afghan refugees collect/sort out the recyclables from communal bins and waste heaps) are also allowed to visit the communal bins and heaps only when the sanitation staff have retrieved the useful recyclables of good economic value. The scavengers collect the plastic, polythene, paper and metal waste. Thus an informal mafia works in health care waste management.

#### **8.4 Street Hawkers**

Street hawkers are people with four wheel trolley/ cart who roam on roads and streets shouting for buying recyclables from the households and generators. The street hawkers servicing the area also collect the recyclable from health care facilities. Only in case of large hospitals separate/ identified/selected street hawkers with four wheel cart are allowed to collect the recyclables. The hawkers have a balance and weights to weight the waste load. Only in case of bottles the items are numbered. The informal interviews with the sanitation staff of some hospitals revealed that to avoid complexity of situation, the recyclable waste is sold as total load irrespective of individual components instead of item by the item.

#### **8.5 Middle Dealers**

The street hawkers after collecting the recyclables sell the items to the middle dealers located in the nearest residential or commercial area. The middle dealer deals in almost all recyclable items and handle the waste manually. Few selected middle dealers are located near the Government and municipal hospitals including Sarfaraz Rafique Hospital, Civil Hospital, JPMC, Abbasi Shaheed hospitals etc. The middle dealers collect the separated items and store it at the premises till the load collected is good enough for transportation to the main dealers. No processing of waste is done at the middle dealers premises. The middle dealers sell the separated and sorted recyclable items to the main dealers.

#### **8.6 Main Dealers**

The main dealers are mostly located in Shershah, North Karachi, Orangi and Korangi areas.

#### **8.7 Small and Medium Enterprises**

The SME includes middle and main dealers as well as recycling enterprises which are operating on private basis without any formal and informal support of the Government. The identified recycling enterprises utilizing the health care waste include the following:

- (i). **Utilizing of Swabs/Dressings:** The dressing, cotton and gauzes are separated and stored. The gauzes are soaked and washed in a big tub manually, dried and sold for making covers, filling material etc. unused cotton is seldom retained due to its low economical value and use.
- (ii). **Collection and Transportation of Placenta:** The description of the contractor has already been made. The placentas are collected, packed and exported to France. However this service is provided only to few identified maternity homes and hospitals.

- (iii). **Plastic Recyclers:** The plastic bags and accessories are separated and shredded. The 'dana' (bead) obtained is of good quality which is mixed with virgin plastic to make different plastic items of daily utility.
- (iv). **Syringes Recyclers:** In many cases the syringes collected are washed with hot water and reused again for injection purposes. This is often done in rural areas in Karachi. Metallic needles are separated from the syringes and is also used by plastic recyclers for making 'dana' (bead) after shredding.
- (v). **Glass Recycling:** The glass bottles are washed unhygienically and dried. The paper labels are taken out. In case of medicines and chemicals sticking in the bottles, brush is applied for washing/cleaning. The cleaned bottles are sold to the main dealers located in glass lane (Botal-Wali-Gali) near to the city centre. These bottles are reutilised and fetch a good price. The uses of glass bottles vary considerably. Several interviews with the shop/dealers of glass bottles yielded that these bottles are often brought by the approved manufacturer/supplier of glass bottles to industry/ pharmaceutical company. In these cases the bottles are sterilized by the Company. In other cases these bottles are bought by people for other uses who use it for their cottage product with a new paper label stickers. Bathroom cleaners, tooth powder and other items are kept in these bottles depending on sizes and volume.
- (vi). **Plastic Bottles:** The plastic bottles in good condition are washed and reused. The plastic bottles are often reutilised or bought by the small vendors/manufacturers/suppliers who fill their own product with a new sticker/label. The broken or damaged plastic bottles are crushed/shredded and 'dana' (bead) is made.
- (vii). **Paper Recyclers:** The paper waste collected is baled by the middle/main dealers and transported to the recyclers located mostly in the Punjab province where cheap paper and cardboard is made.

## 8.8 Socio-economic Conditions of the Recyclers

The sanitation staff, watchmen, support staff, scavengers etc. are all people from the low socio-economic group. They are unskilled, uneducated and are living in the nearby slum areas. Usually they have a big family to support including an average of four children, wife and two dependents (parents, brother and sisters). They are mostly Hindus and Christian. The sanitation system gives them an incentive of getting recyclables from which they obtain some economic benefit. Working for hospitals give them more economic incentives as compared to dealing with domestic/commercial/ industrial waste. The informal interviews with the permanent sanitation staff revealed that they do not do other private and extra jobs.

## 8.9 Manpower Involved in Health Care Waste Management

The manpower involved in Health Care Waste Management include patients, doctors, paramedical staff, visitors, attendants, staff of health care facilities etc. the sanitation staff of the health care facilities have been assessed and is mentioned in Table 8.1. The hired sanitation staff mentioned does not signify that this manpower is only involved in health care waste collection and disposal. Only dedicated manpower involved in hospitals are restricted to the health care waste only. The approximate number of scavengers involved, is also mentioned in the table. The assessment is based on Consultant's visit and assessment, informal interviews with the sanitation and health care staff. Table 8.1 shows that health care

waste is providing employment opportunities to over 3000 persons. The persons involved as middle dealers, main dealers, recyclers and personal of SMEs are not mentioned here.

### 8.10 Involvement of Females in Health Care Waste Management

The inhouse sanitation staff in the health care facilities consist of both men and women. The female staff are usually working as permanent staff. The status and approximate number of female staff is shown in Table 28. The hired staff consist of less number of females like in clinics, dispensaries, BHUs and consulting clinics. The female staff was found dominant in all maternity homes especially private ones. The interviews revealed that staff here is more comfortable as the salary in private maternity homes is better, working times are less, more opportunities are there for getting recyclable and they receive presents (both in kind and cash) from patients especially if a son is born.

For retrieving the recyclable from the health care waste stream the work is mostly done by the males in which female staff get their due share. The municipality staff consist of male as well as female staff. The females are mostly deputed on sweeping the roads in the morning and they collect the heaps which is removed by the male counter parts. The female staff is not deputed on collection of health care as well domestic waste. The females are also not involved in loading of waste from communal bins to the refuse van and disposal of waste to the disposal site.

**Table 28: Manpower involved in health care waste management**

S.No.	Facilities	No.	No. of sanitation staff	Status	Females	Scavengers
1	Clinics/Dispensaries	108 7	200	T	20	100
2	BHUs	50	40	T	10	10
3	Consulting Clinics	200	30	T	5	10
4	Health Care Establishment	40	80	P	15	10
5	Support Services	30	40	T/P	10	10
6	Technical Services					
6.1	Pathological Lab	100	125	P	40	60
6.2	Radiological Lab	150	50	P	5	50
7.1	Hospitals	375	2000	P	600	400
7.2	Maternity Homes	182	300	P	200	80
	TOTAL		2865		905	790

Legend: T = Temporary P = Permanent

### 8.11 Involvement of Communities in Health Care Waste Management

The sanitation workers in health care facilities as well as in municipality and other local agencies consist of Christians and Hindus. In maternity homes, Muslim women are also found working. The scavengers mostly consist of 'Afghani's. The people working as street hawkers, middle and main dealers and recyclers are of mixed ethnic background consisting of 'Mohajirs' (people settled mostly in Karachi who migrated after 1947 from India) and 'Punjabis' (people from Punjab province mostly speaking 'Punjabi' language).

No identified communities are involved in health care waste management which can be separately identified. The work is restricted to the selected areas of the city including Shershah, North Karachi, Korangi and Landhi.

### **8.12 Organization and Growth of Waste Collection Enterprises**

The organizations of health care waste collection enterprises have been developed with time, need and demand. The sanitation staff of the health care facilities get assistance from the fellow workers or engage assistants in case of more quantities of recyclables are to be handled like in hospitals. The watchmen/guard also get their share as they safeguard the recyclable components and only allow the selected scavengers inside the health care facility/premises. The scavengers often oblige the watchman through cash or the job is allowed purely on friendship basis. As has been earlier mentioned and shown in photographs, a dedicated and remote facility within the health care premises is acquired by the sanitation staff to store the recyclables prior to disposing it in the communal bins for municipal collection. At this location the recyclables are separated and stacked.

With the increase in the number of health care facilities and quantities of waste produced, the number of persons retrieving the utilizable waste components have also been increasing proportionately.

The number of middle and main dealers are not much increasing as they are monopolizing the waste components due to good contacts with the suppliers and working relationship with the recyclers. These dealers increase the number of workers to combat with the increased quantity of waste.

An informal survey and five site visits conducted by the Consultant to the recycling enterprises in Shershah, New Karachi and specified area revealed that few women are involved in recycling sector. The women sort out glass cullets, wash glass and plastic bottles and segregate paper waste according to type and quality. The average age of women was about 55 years. Girls of 8-11 years were also witnessed. The male Afghani scavengers vary in the age limits (13-55 years). All Afghans were found to be Muslims who are socially and ethnically different from the local people and cannot communicate well in 'Urdu' (national language of Pakistan). This physical fitness coupled with job availability has pushed these migrants to labour intensive jobs like collection of recyclable and transportation of goods. These Afghans are mostly bachelors and live in clusters. The families are often at Afghan Camp located at Super Highway where they have settled on illegal land.

### **8.13 Health Problems of the Actors**

The health care waste contains infectious, non infectious and general waste. Due to the absence of segregation and separation practices of health care waste at Karachi, the infectious waste also pollute the general waste. The manual handling, mixing, sorting, retrieving and storing further deteriorate the recyclable component of health care waste that are being handled by the sanitation staff, scavengers, street hawkers, middle dealers and main dealers.

The Consultant assessed the health condition of the various actors during several site visits made to the recycling areas who are involved in health care waste. The aim of the Consultant was to determine the potential problems associated with waste handling and recycling practices. The Consultant's team undertook sample survey of the actors by informally

interviewing the person concerned. No sample size was drawn for this survey and the percentages are indicative only based on the number of actual surveys performed.

The health status was inquired through presence/occurrence of various common diseases in Karachi. The percentage depict getting sick/ill in the month preceding the month of the interview, i.e. September - October 1996. The health status includes the person interviewed, his immediate family including wife/husband and children. The health status is given in Table 8.2 attached. This table is indicative only which shows the general infectious and communicable diseases. This table shows that the individuals and their families are paying a high price for involvement with the health care waste stream. The general complain was fever, skin diseases, itching, nausea, loss of appetite, headache, bruise/cut etc. Aids was not included due to non awareness of the disease by the scavengers. In absence of any earlier health status survey, AIDs was not found to be a common disease even among the truck drivers in the country (an exclusive AIDS testing and monitoring project was conducted by AKUH funded by the World Bank. The study was conducted in Manila and Bangkok also where AIDS was found prevalent. In Karachi AIDS was not found common due to social and religious reasons. The exact data, figures and statistics are not available with the Consultant).

In terms of working days per month and absenteeism from work, the average figure was found to be 3 days of leave by the sanitation staff and 4 days by the scavenger per month.

#### **8.14 Attitude of the Actors Regarding Health Problems**

In spite of high sickness rate among the sanitation staff dealing with health care waste, the awareness regarding the protection of their bodies and manual handling was found to be missing. The common perception is that "every body else is doing the same so there lies no danger in doing it myself". No body was found wearing any protective gears, spectacles, shoes and hand gloves even. These items are considered to be a luxury and was thought to hinder the work. Besides they complained that the same are not provided by their employers like hospital and municipalities. The sanitation staff do understand the relation of waste and diseases but they replied that they have been doing the same for a very long time (ranging from 8-20 years) so they have become immune to many health problems. As a protective measure the municipal collection staff wears a head gear to protect the waste falling on their bodies while loading it in the refuse van. The sanitation staff working in hospital and health care facilities get free medication from their place of work or from the municipal clinics.

The scavengers on the other hand are almost 80% Afghanis (people from Afghanistan speaking Pushto or Persian languages). The scavengers have to earn their livelihood on daily basis and have to walk a long distance for their work thus they prefer to obtain a modest shoes as the first choice. In case of sickness they go to a doctor (in most of the cases compounder only). After receiving injection (often anti-allergic/antihistamine) and medicines they get well and back to work. The interviews revealed that to avoid absenteeism from work and probable sickness due to handling of waste, the scavengers get the injections once a week or a prior dose of medicines (often Avil injection). Some scavengers have even learned how to give inter muscular injections which they administer to their colleagues.

The nasty element in the waste stream has been assessed as broken glass from injection vials which are very fine and syringe needles.

Except for few private hospitals like Aga Khan University Hospital and OMI, no other health care facilities are trying to improve the working conditions of the employees and creating awareness among the staff/workers. Regular courses are offered and organized at AKUH. The staff has the awareness of segregating the injections and hazardous waste from the general waste. The protective gears are also worn and systematic care is taken to avoid manual contact with the hazardous waste. The sanitation staff of these two hospitals are also well trained and do their job hygienically.

### 8.15 Improvement in Working Conditions

The informal interviews with the sanitation staff of the health care facilities revealed that the Administration of the facilities are not fulfilling their duties of creating awareness among the staff on health hazards of toxic and injurious waste. During the year 1996, no courses was organized for para-medical staff and sanitation staff of 98% of the health care facilities which is a clear indication of importance of the subject.

**Table 29: Health status of sanitation staff in a given month**

No	Diseases Personnel	General Fever	Influenza	Dysentery	Bruise/cut	Polio	Measles	chicken pox	Tuberculosis	Skin disease
1	Clinics/Dispensaries	X	0	X	X	X	X	X	X	X
2	BUHs	X	0	X	X	X	X	X	X	X
3	Consulting Clinics	X	0	X	X	X	X	X	X	X
4	Healthcare Establishment	0	X	X	X	X	X	X	X	X
5	Support Services	X	X	0	0	X	0	X	X	0
6	Pathological Labs	X	0	0	0	X	X	X	X	0
7	Radiological Lab	X	X	X	X	X	X	X	X	X
8	Hospital & Maternity Home	0	0	0	0	0	X	X	X	0
9	Municipal Collection staff	0	0	0	0	X	X	X	X	0
10	Scavengers	0	0	0	0	X	X	X	0	0

Legend = 0 = yes x = no.



## CHAPTER 9 SMALL AND MEDIUM ENTERPRISES ON HEALTH CARE WASTE

### 9.1 General

The SMEs have been described in earlier chapter which are solely or partially operating on health care waste. The status of these SMEs with their role is divided as per the collection and utilization of waste components. These SMEs can be broadly classified as Middle Dealers, Main Dealers and Recyclers. The same are described in this chapter with reference to health care waste management.

### 9.2 Middle Dealers

The middle dealers are located in almost all areas in Karachi. They are located on public land and amenity areas and have mostly occupied the premises illegally. Often they pay "Bhatta", (illegal money to police as protection money). They cover a larger area and operate area wise. The middle dealers employ usually 5-15 people depending on the load of waste handled. The scavengers and street hawkers bring the collected waste load to the middle dealers. The middle dealer has a big scale in which the waste load is measured. The dealer buy the material on a profit ranging between 10-20 percent. These dealers deals in any type of material they receive and which has a market/demand. The material according to the category is stored in the polypropylene sacks. Further details are elaborated as follows:

- (i) **Working Area:** The working area of the middle dealers is usually the nearby areas of waste generation. Since the scavengers and street hawkers work by walking with a sack and 'thela' (four wheel trolley) respectively, they tend to sell the collected material at a nearby place.
- (ii) **Location:** The location is often uncovered and partially covered due to the nature of the enterprise and illegal status. The middle dealers of health care waste are found near to the major hospitals and maternity homes.
- (iii) **Formation Procedure:** The entrepreneur first looks for other competitors in the area and then select a space. If an open area hidden from main road, but have good accessibility is obtained, then the space is encroached or hired. If an open land or amenity land is found then the area is encroached gradually with the patronage of local area leaders/influential who also negotiate with the area police for providing protection. In case of hired and enclosed space, the protection from police is nominal.

The entrepreneur then invest in buying the balance and weights, sacks/drums and containers for storing waste and buy the 'Thelas' (four wheel carts). The carts are given to the potential people on daily contract/rent basis. The vendors come in the morning to the entrepreneur and gets the 'thela' including an amount of Rs.200 (US\$ 5) per day for the business, buying the recyclable material from people/shops/enterprises. The street hawkers thus move to the respective areas according to their hypothetical jurisdiction and buy the recyclable material from potential generators. When the load full of cart is obtained or till 4 or 5 pm, they gather the material and return to the middle dealer and sell the recyclable at a profit. The daily rent is deducted from the payment and money is handed over to the hawkers. The entrepreneurs also hire some unskilled labourers for sorting, stacking, baling and loading of waste for transportation to the main dealers. The middle dealers deals in all type of waste items which has a potential financial value.

- (iv) **Leadership Roles:** The middle dealer is the sole proprietor of the enterprise who takes their own decision for expanding the enterprise and marketing of materials collected. The entrepreneur keeps himself abreast of the market trends, prices of items, collection load and requirement of the items by the main dealers.

The main dealers visit the enterprise and negotiate the quantities and prices of items and this verbal contract was later on honoured by both sides. Often some transporters (suzuki van, donkey cart, camel cart and trucks) serve as go between/agent between the middle and main dealers. This gives them the advantage of having a sole proprietary right for transportation of waste material from middle to main dealers. Thus in terms of marketing and decision making the owner/entrepreneur is the sole decision maker and leader of the enterprise.

- (v) **Organizational Structure:** The organizational structure consist of the entrepreneur/owner or his representative/agent (in case of his absence), sorters and hawkers. The entrepreneur manages, supervisors and control all the business dealing and make all decisions regarding the business.

- (vi) **Legal Status:** There is often no legal status for the middle dealers. When occupying an open plot or community area they pay for their existence to the police and area influentials.

In case of shops and covered areas, the rent is paid to the owner of the premises. The legal status of such enterprise is not approved and their status is illegal. They are not paying any tax to the government or municipal authorities.

- (vii) **Motivation for starting the Enterprise:** The informal interviews with the middle dealers depicted that the sole motivation for starting the enterprise has been the employment whereas good profit can be made on receiving and selling the waste material. Due to increase in population and increase of waste quantities the business is expanding.

- (viii) **Growth of the Organization:** The interview with the entrepreneurs revealed that the business has tremendously increased with time. The growth can be witnessed from more quantities of waste handled and increase in number of 'thelas' at the premises. The number of storage sacks/containers have increased with time and so is the number of employees. The transportation of waste is now done almost daily at many enterprises which are centrally located in the city areas.

- (ix) **Problems Encountered:** The main problems encountered by the entrepreneurs with respect to the enterprises are mentioned as follows:
- harassment by the law enforcing agencies
  - increase in transportation charges due to constant increase in prices of fuel and labour charges
  - more payment to labourers due to inflation
  - non segregation/soiled waste
  - pressure from the nearby community (especially when located in a residential area)

- (x) **Equipment and Technology Used:** The middle leaders does not utilize many tools and equipment for waste handling as they receive the material, sort, bale and store it. In terms of health care waste generation the tools used is local baling machines for waste paper.

- (xi) **Occupational and Environmental Health Analysis:** Following occupational and environmental health problems have been witnessed at the middle dealers.
- Crowding of facilities in terms of space. More material is stored in a short space causing dust blowing problem.
  - The ventilation is very poor in enclosed enterprises. No windows, ventilators and proper doors are provided at these enterprises. The fans are often not provided and if provided are of insufficient number and capacities. The working in summer months is a very tedious job.
  - The lighting inside the premises is very poor. However no problem occur in open space.
  - Potable water is often not available at the enterprise. Water is transported from nearby public taps/stored in plastic containers for use.
  - Sanitation system is often not provided. The space is mostly not having sewage connections.
  - No protective gears are being used by the employees/workers. The workers often get bruises and cuts due to waste handling.
  - Long working hours and low pay of the workers.

On an average the workers are absent for almost 4 days a month due to sickness. Coupled with lack of proper food, malnourishment and health care facilities the health of workers are deteriorating. Other observations include:

- The waste handling causes air pollution and dust problems.
- The waste storage of soiled material causes proliferation of vermin and rodents which is a serious health threat to the workers, entrepreneurs as well as nearby population.
- Due to hazardous waste handling, the skin diseases were found to be rampant among the workers. Other health problems are fever, diarrhoea, allergy and influenza.

The entrepreneur has never been interested in taking any step to avoid these occupational and environmental problems. Due to the availability of cheap labour and high unemployment figures, the acquiring of workers has never been a problem.

### 9.3 Main Dealers

The main dealers are mostly located in Shershah, North Karachi, Orangi, New Karachi, Malir, Korangi and Landhi areas. With the passage of time the main dealers have de-centralized due to pressure on space and working environment. Main dealers are usually dealing in one single waste item only. They organize collection of waste material from the middle dealers through personal contact and through transporters. Often when large quantities of waste is involved, middlemen are found operating who connect the middle dealers and waste generators to the main dealers. In many cases these middlemen are operating from the premises and buy the waste material directly from scavengers and sanitation staff of health care facilities, pocketing the profit and saving the transportation costs. Middle dealers are mostly located on owned and hired plots/premises paying monthly rent for facilities, electric power etc. Further details are elaborated as follows:

- (i) **Working Area:** The working area of main dealers has been mentioned. The main center is Shershah area. The greatest advantage which Shershah offers is close proximity to Sindh Industrial Trading Estate (SITE), an industrial area which require raw material from waste, nearness to other end users/Recyclers and ease in

discharging the waste in the Lyari river. These recycling areas are also accessible by public transport and road network.

- (ii) **Location:** The location of main dealers are often covered due to the nature of the enterprise. The shop/place has a legal status. These dealers are not in the close vicinity of major hospitals.
- (iii) **Formation Procedure:** The main dealers are operating in the areas for over 25 years and in many cases 35-50 years. These dealers have settled in the area due to the need as an informal enterprise. They receive the waste from middle dealers and scavengers, physically process it (baling, pressing, sorting, cleaning, stacking, packing) and sell it in bulk quantities to the Recyclers. With the passage of time the Recyclers have also settled in these areas at different locations. The main dealers are mostly paying rent to the owners or are owning the premises on 'Pagari' basis (owing a land and paying a minimum rent. The owner/trust cannot evacuate them. In case the owner wants to leave, he can sell the proprietary right to another person but the rent goes to the actual owner). Due to thriving of vast business in the localities mentioned above the prices of land and property has risen sharply. To meet the demand of other areas and avoid transportation problems, the entrepreneurs have opened up other areas in Orangi, North Karachi and New Karachi as the land in these areas are relatively cheap, affordable and cheap labour is available. The informal interviews revealed that main dealers also pay 'Bhatta' to the law enforcing agencies. During the time the main dealers have settled and their business has acquired sole proprietary rights for a particular waste item on which they specializes. Changing the waste item for business is difficult as the dealer has owned a good reputation with time. In case the owner wants to sell, the total business including the facilities and clients are transferred.
- (iv) **Leadership Roles:** The main dealer is the sole owner/proprietor of the enterprise who takes the own decision for expanding the enterprise and marketing of waste material. The entrepreneur keeps himself abreast of the market trends, prices of items, collection load and requirement of the waste items by the Recyclers.

The Main Dealers often visit the Recyclers and negotiate the quantities and prices of items and this verbal contact is kept and honoured by both parties as this is taken as an official deal. The waste transporters also serves as a middlemen between the middle and main dealers and arrange the quantities of waste items required by the Recyclers.

Thus in terms of marketing and decision making the Owner/entrepreneur is the sole decision maker and leader of the enterprise. He hires/fires the employees, assign the work load to the workers. Keep all the tract (written/verbal) of financial dealings, pay salary to staff, arrange for repair and maintenance of facilities tools and machinery, pay rent of the premises and deals with the 'officials' for safe continuation of their work.
- (v) **Organizational Structure:** The organizational structure consist of the Entrepreneur/owner or his representative/agent (in case of his absence), staff/workers. The entrepreneur manages, supervises and control all the dealing and in decision making.
- (vi) **Legal Status:** The main dealers are operating mostly on legal land but their type of enterprise and work is not registered. The electric connections and load is not sanctioned and often they are illegally obtained via agents. No tax and duties are paid to the provincial government/municipal authorities.

- (vii) **Motivation for Starting the Enterprise:** The informal interviews with the main dealers depicted that the sole motivation for starting the enterprise has been the employment in which the business is thriving and is not affected by time, season or any other factor. The waste quantities are increasing and the market for recycling products are also increasing proportionally. The profits are easy and marketability of material is not a difficult job as compared to other business/enterprises. Often people involve their dear friends and relatives, especially when expanding a business.
- (viii) **Growth of the Organization:** The informal interviews of the main dealers revealed that their business has tremendously increased with time. The growth can be witnessed from the fact that the labourers are increasing in number, more quantities of waste are handled and the suppliers/agents are increasing. The main dealers in Karachi also supply the raw material to Recyclers in upcountry (mostly in Lahore and Faisalabad).
- (ix) **Problem Encountered:** The problems encountered are mostly similar as faced by the middle dealers.
- (x) **Equipment and Technology Used:** The main dealers utilizes the tools and equipment for baling, crushing and packing.

#### 9.4 Recyclers

The Recyclers are also located near to the main dealers in Shershah, North Karachi, Orangi, and Korangi areas in the city. Some Recyclers of waste are located upcountry in Multan, Lahore, Faisalabad and Gujranwala. The waste Recyclers have also decentralized due to extreme pressure on land and working environment in the inner city areas. Recyclers receive the raw materials from main dealers and process them mechanically to transform/change the waste item physically. The physical and chemical properties of the recycled items also differs with the original waste material. Since Recyclers have installed mechanical equipment and utilize electric power thus he is extremely dependent on main dealer for the raw material. To keep his business smoothly running, he stores the waste in considerable quantities to meet the emergency demand and feed the machines with raw material. With the Afghan mafia growing in recycling enterprises, the middle men/collectors often reaches the Recyclers to get a better price of the waste rather than utilizing the usual channel. Further details of the Recyclers in general are elaborated as follows which are equally applicable to health care waste Recyclers.

- (i) **Working Area:** The working area of the Recyclers have been mentioned. The Recyclers are also located mainly in Shershah area due to availability of raw materials and saving the transportation costs. The commercial electric connections are also easily obtained through 'back door contact' of area influentials and agents. The place is economically suitable for locating the recycling enterprise. Other nearby areas include SITE, Manghopir, Metroville and Organi areas where business has expanded with time and demand. In addition, cheap labour is also easily available in the area.
- (ii) **Location:** The recyclers are located in covered premises hidden from the general public and passersby. The shop/premises has a legal status. The recyclers are usually located far away from the health care facilities due to their type of work.
- (iii) **Formation Procedure:** The recyclers have established their business with time and have been operating since past 15-20 years. The recyclers receive the raw material from main dealers and make the raw material/product as per the demand of the market/end users. The recyclers have close links with the main dealers and have verbal commitment of business in terms of volume, price and delivery schedule. The recycler

either own the premises or have hired it on rent. Their change of location is not very vital as of main dealers. The informal interviews with the health care waste recyclers depicted that the owners are semi-skilled/skilled person with only basic education (primary). They know the technology and have in-house skills of changing the product, maintenance of tools, equipment and machinery and are able to solve day to day problems.

- (iv) **Leadership Roles:** The recycler is the sole owner/proprietor of the enterprise. In many cases the enterprise is run by partners who were found to be not related to each other. Sleeping partners were not commonly witnessed. Usually one partner manages the functioning of the enterprise, technically handling the machines and equipment for better/optimum production. The other partner manages the external areas like contacting the main dealers, transporters, suppliers etc. and manage the dealing of the end product to users/middlemen. He manages financial transactions. In case of one owner he is a technical, financial and business manager who organize the work in the day time and surveys the customers and main dealers in the afternoon. He delegates the power to 'work mastery' or supervisors who are workers themselves and are also responsible for production, repair and maintenance.
- (v) **Organizational Structure:** As mentioned, the owner/partners manages the enterprise. The other people include watchman, supervisors, helpers, workers, machine men, shapers and loaders. The owner manages, supervises and control all the business dealing and is the key decision maker for his enterprise.
- (vi) **Legal Status:** The status of the recyclers is legal as they pay rent of the premises or own it. Often no excise tax and property tax is paid by them. The enterprises are not registered with any agency/municipality and they do not enjoy any official patronage. The electric connections and load is not sanctioned and often they utilize the electricity illegal. No tax and duties are paid on production and selling of recyclable/finished material.
- (vii) **Motivation for starting the Enterprises:** The informal interviews with the recyclers depicted that the sole motivation for starting the enterprise has been the opportunities for employment and income generation based on their skills. The other motivating factor for initiation of the enterprise was the marketability of product and availability of raw material. The continuous supply of waste during all times of the year has also been a major factor. The entrepreneur has started this business due to requirement of low initial capital, operating costs, repair and maintenance costs, availability of cheap labour etc. Formally none of them were able to compete with other business in the formal market.
- (viii) **Growth of the Organization:** The enterprise has grown in terms of size, number of employees and equipment. Many recyclers have started other branches in nearby areas also to expand the business.
- (ix) **Problems Encountered:** The problems encountered are mostly similar as faced by the middle and main dealers.
- (x) **Equipment and Technology Used:** The equipment and technology used in different recycling enterprises are mentioned in the next sections.

## 9.5 Health Care Waste Recyclers

This section describes the details about health care waste recycling processes and the recyclers in general. The type of recyclables from health care waste includes swabs/dressings, placentas, plastic, syringes, glass, and paper.

### 9.5.1 *Recycling of Swabs/Dressings*

The recyclers collect the swabs and dressings from health care waste streams. The manual separation is again made for separating soiled and unsoiled health care waste. The dressings and cottons are disregarded as they are mostly sorted. The soiled textiles which can be reused are put into a tub containing water and washed, dried and stored. The product is sold to the city dealers for making quilts, filling material in mattresses, cushion covers, sofas and seats of vehicles, other leftovers is used as cleaning clothes. The recyclers are located in the compounds of the houses in Shershah, North Karachi and Orangi Town. The end users collect the items and transport it via donkey carts and three wheeler rickshaws. The products are stored and transported in sacks.

### 9.5.2 *Collection of Placentas*

The collection of placentas from the city hospitals and maternity homes is described in earlier sections. However keeping in view the number of births, and maternity homes, this collection services is very limited. The office of the Contractor is located near to I.I. Chundrigar Road (busy business area).

### 9.5.3 *Plastic Recycling*

The plastic waste generated from health care facilities include glucose bags, blood bags, urine bags, catheters, medicines, drips, plastic tubing and other accessories. The recyclers further separate the waste items according to the type, quality and quantity. The other type of inferior waste plastic includes pvc pipes, plastic pipes, plastic bottles, broken utensil etc. Polyethylene shopping bags are not collected now due to less weight and inferior quality (recycled) which is economically not feasible. Furthermore the collection, sorting, cleaning, washing and drying of plastic waste makes the reprocessing infeasible. Only clean polyethylene waste generated from large industrial and commercial sources are collected, recycled and utilized. The recyclers perform the following processing at their premises.

- (i). **Sorting of Waste:** Manual sorting is being carried out before machining the waste. The waste according to the types are segregated in drums, containers etc.
- (ii). **Crushing of Waste:** The waste is crushed by a crusher which is electrically operated with 1-2 hp motors.
- (iii). **Dana Making:** The crushed material is fed into the extruder machine. Hot strings of molten plastic is extruded out and is cooled via water bath tub. The long wires are then cut into grains by another cutter. These grains are called 'Dana'. The dana from plastic bottles/drips are of good quality. In many cases the recyclers just produces the 'dana' and sell to the local market for other end users. Otherwise they utilize it for making new products. The visit of the consultant revealed that good quality 'dana' is mostly sold into the open market while other plastic waste is being recycled at the same premises. Some recyclers were found doing exclusive work of health care plastic waste recycling.

(iv). **Finished Goods:** The 'dana' is used in mould/die and mixed with other grades of plastic for making other products/finished goods. White polythene bags are made from the 'dana'. Other items include toys, games, bottles, piping, plastic sheets, slippers, shoes, shoe soles, plastic boxes etc. The polyvinyl chloride scrap is reprocessed for making shoes, toys, slippers etc. The polypropylene scrap is reprocessed for making low grade products.

The good quality 'dana' is also used in manually operated electrical moulding machines having different dies for converting into different products. The unfinished and rejected products are also utilized and crushed into small pieces by a crusher. The 'dana' obtained is mixed with other virgin 'dana' for making products.

Due to the huge quantities of plastic waste produced, a recycler divides the operation into sub-units as per area and labourers available. Each sub unit has staff of upto ten skilled and unskilled persons. The skilled persons are usually on permanent basis and unskilled on monthly contract basis.

#### 9.5.4 *Syringes*

The syringes at times are pre-sorted at the main dealer and often it is not done when are available in huge quantities. The syringe recycling is done at plastic recyclers who also use other type of waste. The process is labour intensive as the sorting and separation has to be done and needles have to be separated. No dealer at Shershah was found doing exclusive syringes recycling. The unskilled labourers are employed as sorters and separators. The process of crushing and making 'dana' is similar as mentioned in earlier section.

Though it came to the Consultant's knowledge that some recyclers wash the syringes, dry and re-pack them in wrappers but such facility could not be traced by the Consultant and his team.

#### 9.5.5 *Glass Recycling*

It contains two fractions. The glass bottles obtained from the used and expired medicines are emptied, washed, dried and sold to the shops at 'Bottle lane' (the lane has many shops which exclusively deals in dried waste bottles of every shape, size and quantity).

These damaged bottles, glass culets are retrieved from the waste stream by the scavengers (since it is comparatively low price item and sanitation staff do not waste their valuable time in segregation). The injection vials consist of fine glass and is not collected due to potential danger of getting cuts and low economic value. Karachi has a good market for waste glass. The informal interviews with the recyclers, revealed that waste glass from major glass industries and even from Hyderabad city located 100 km. from Karachi is also brought to waste recyclers in Karachi for processing.

The quantity of glass received from the main dealers are often separated. The glass scrap is further sorted and is melted in a furnace at around 1400 degree C. The product is moulded/blown and cooled. After baking or cooling the end product is made which is cooled and inspected for quality. The rejected material is scrapped and reused again. In some industries the virgin raw material is also mixed in a proportion ranging from 10-30% with the waste scrap for making products like glass, jugs, chimneys, bottles, bangles etc. The finished products are manually finished/re-touched and is packed as per the requirement for ease in transportation. The recyclers have a furnace which is fired by natural gas and is locally fabricated. The semi automatic dies are both manually and mechanically operated, air compressor with storage tank are used for blowing molten glass.

### 9.5.6 Paper and Cardboard Recycling

The paper obtained from health care facilities consist of soiled and unsoiled paper bags, newspapers, health care prescriptions, old health care records, packing, wrapping, rough papers, books and magazines. The books, magazines and newspapers are reused at shops. There is no proper reprocessing plant in Karachi and the waste in bales are transported to Punjab where labour and electrical power is cheap. The reprocessing also require large quantities of water. Good quality of paper is thus transported to Lahore. M/s. Packages alone is one of the major recycler of paper in Lahore.

The other type of paper waste is baled by the middle/main dealer and is transported to the recyclers. The recyclers have automatic and semi automatic plants. An average recycler processes 3-5 tons of waste paper/cardboard per day.

In semi automatic plants, the waste paper is pulped by a beater fitted with motor and screened, through machines and 'gutta' (cardboard) is made. This 'gutta' is then dried, calendared and sheared. The finished product in the form of uniform size 'gutta' sheet is sold on per ton basis. In these type of plants all the processes are carried semi automatically by machines except drying in the sun. The cardboard sheets are utilized for making shoe boxes, cartons, sweet meat boxes and other packaging.

The machinery used in semi automatic process includes mild steel beater roll driven with an 10-20 hp electric motor in a cemented tank. The electrically operated calendaring machine is used with 5 hp motor.

In hand operated units the pulping and beating of paper waste is done manually (by feet) in open cemented tanks. The material is screened out to the side tank and diluted to achieve the specific consistency. The wooden frame with screen mats is dipped in the tank enabling the mixed wet pulp to settle informally over the frame in desired thickness. The frame is skilfully removed and the wet sheet is transferred from the mat to the cemented walls where it is pressed, dried and cut into required sizes. This material is used for making filter paper, floating paper etc. This material is considerably used in sugar industries. Such type of enterprises are common in North Karachi and New Karachi areas.

**Table 30: Manpower involved in recycling**

S.No.	Recycling	No. of Recyclers	Average No of Workers	Total Manpower
1.	Swabs, Dressing &Textile	10	4	40
2.	Placenta	1	25	25
3.	Plastic	250	5	1250
4.	Syringes	10	4	40
5.	Glass	45	10	450
6.	Paper and Cardboard	300	5	1500
	TOTAL	616		3305

The paper waste generated from health care facilities cannot be distinguished at middle or main dealer and is mixed with other paper waste from domestic/commercial/institutions.

### 9.5.7 Manpower

The manpower assessed at the recycling enterprises mentioned in above sub sections is given in Table 30.

## 9.6 Financial and Economic Analysis

The financial and economic analysis of health care waste is based on the Consultant assessment, information by the recyclers, sanitation and administrative staff of the health care facilities. The details are further elaborated in the following sections:

### 9.6.1 Income of the Sanitation Staff

The average income of the sanitation staff of health care facilities has been assessed as Rs.1000 - Rs.1600 (US\$ 25-40) per month on an average. The sanitation staff in addition to this salary also gets incentive by selling recyclable items. On an average the additional income range from Rs.80 to 200 (US\$ 2-5) per month. The sanitation staff of the municipality also receives other benefits including health care treatment and over time.

The additional benefit of the sanitation staff working at the health care facilities is the free health care treatment of self and family free medication and hospitalisation. Gifts (in kind and cash) is also received from the recovered patients.

The total salaries of sanitation staff is worked out to be:

$$2865 \text{ No} \times \text{Rs.}1400 = \text{Rs.}40,11,000 \text{ (US\$ } 100,275)$$

### 9.6.2 Income of the Scavengers

The average income of the scavengers per working day ranges from Rs.40-100 (US\$ 1-2.5). They do not have holidays except for when they are sick or have any other family problem. Thus the approximate income of the scavengers per month from the sale of recyclable comes out to be 790 No. x 26 days/month x Rs.80 = 1,643,200 per month (US\$ 41,080).

### 9.6.3 Financial Scenario of Recyclables

**Table 31: Average price of recyclables from health care waste**

S.No.	Waste Material	Price per Kg. At	
		Middle Dealer	Main Dealer
1	Swabs/Dressings	5	7
2	Placenta	N.A.	N.A.
3	Plastic bags & accessories	8	10
4	Urine bags	6	7
5	Syringes	5	7
6	Glassware	6	8
7	Plastic & Polythene	4	5
8	Paper	6	8
9	Metals	8	9

N.A. = Not available

Price mentioned is in Pak Rs. 1 US\$ = Rs.40.

The average prices of recyclables obtained from health care facilities as sold by the sanitation staff to the street hawkers/middle dealer and main dealer is given in Table 31. Prices and quantities of the recyclables at main and middle dealers is assessed and is given in Table 32. The quantities is based on the assessment/estimation mentioned in the earlier chapter.

**Table 32: Price of recyclables at middle and main dealers**

S.No.	Waste Material	Quantity in kg	Price in Pak Rs.			
			price/ kg		price/ kg	
1	Swabs/dressings	1300.5	5	6502.5	7	9103.5
2	Placenta	120.0	-	-	-	-
3	Plastic bags & accessories	1175.5	8	9404	10	11755.5
4	Urine bags	80.0	6	480	7	560
5	Syringes	630.4	5	3152	7	4412.8
6	Glassware	411.8	6	2470.8	8	3294.4
7	Plastic & polythene	592.6	4	2370.4	5	2963.0
8	Paper	749.3	6	4495.8	8	5994.4
9	Metals	191.1	8	1528.8	9	1719.9
	TOTAL	5311.2		30,404.3		39,803

*In US\$*

760

995

*Conversion: 1 US\$ = Rs.40*

This assessment is based on Consultant's judgement, site visits and informal interviews of the recyclers. The recyclers however are not restricted in dealing with health care waste only,

## 9.7 Technical and Financial Support from Outside Sources

The actors involving middle and main dealers and recyclers does not get any support from any formal and informal agencies and departments. The technical skills are usually learnt in a crude way through friends and acquaintances. The training is often imparted by the local machine supplier to the operators. Due to no/less technical know how and educational level, the entrepreneurs suffers often financially due to improper processes, hurting the die/mould and due to malfunctioning of the machinery. No ready technical assistance is available and few experienced persons and trouble shooters are contacted when in trouble.

Financially the loan is taken from the friends and relatives to start and to expand the recycling business. No facilities for credit and loan is provided by any institution since the recyclers are operating unlawfully/illegally on non industrial and informal areas.

## 9.8 Linkages with Line Agencies

The middle and main dealers and even the recyclers have no formal linkages with any line government departments and municipality. The informal contact of the sanitation staff of KMC/DMCs is with the middle dealer where they sell their part of the recyclables collected. No excise or taxation is levied on the waste dealers and recyclers, only the tax on covered area/commercial property is to be paid by the Owner of the premises.

## **9.9 Cooperation Amongst Actors**

Invisibly the formal and informal actors are closely linked into a well organized system with each of them depending on the other. The cooperation persist till the interests of the actors are not clashed. The sanitation staff of the health care waste institutions, scavengers and municipal collection staff sell the recyclables to the middle dealers, who in turn sell the waste to the main dealers by utilizing the transporters. The main dealers is linked with the recyclers who make the product and sell to the market through wholesale agents/middlemen. These channel of waste stream exist in which each actors is directly or indirectly dependent on others.

## **9.10 Cooperation with the Clients**

The cooperation obtained from the clients of waste dealers is in the form of advance orders and sanctioning of advance amount. Usually no official deal is made. The verbal deal is made which is honoured. Often the deal is written on a white paper and called 'Kachha Kagaz' (informal contract) which has to be abided by both the parties.

## CHAPTER 10 ENVIRONMENTAL IMPACT SCREENING OF HEALTH CARE WASTE

### 10.1 General

The environmental impact screening of health care waste is done for the city of Karachi. Major health impacts and effect on ecology and environmental resources have been highlighted in this chapter. For the sake of identification, the impacts of health care waste on land, air and water has been described as per the health care waste categories elaborated in the earlier chapters.

### 10.2 Impacts of Health Care Waste on Land

The impacts of health care waste on land is both negative and positive. The negative impact is due to the waste storage, burning and disposal. The positive impact is due to retrieving of recyclable waste items and providing employment opportunities to the low income poor people. The handling of health care waste at premises and facilities is the main contributing factor towards the environmental impact on land. The impacts are further highlighted as under:

- (i). **Impact of Primary Storage of Health Care Waste:** The health care waste produced at clinics, dispensaries, BHUs, health care establishments, support services, technical services, hospital and maternity homes are found to be of inappropriate capacity due to which the waste was found spilled over the facility causing filth, dirt, proliferation of rodents and insects and becoming a source of spread of disease. The material of waste storage facilities at health care facilities (except at AKUH and OMI) was found to be improper which was not cleaned, cleared and disinfected. The status was found to be worst in government hospitals and health care facilities managed by the government/semi government departments.
- (ii). **Impact of Primary Collection of Health Care Waste:** The impact of primary collection of health care waste is a major one. Keeping in view the number of beds in the hospitals and maternity homes, the assessed occupancy rate of 80% and estimated quantity of waste generated, the number of sanitation staff and collection services provided at the health care facilities are grossly inadequate. The collection service in government facilities was found to be a once in a day. In private health care facilities it was twice a day. In absence of appropriate collection system the waste was found littering and scattered over the storage place as well as the collecting points.
- (iii). **Impact of Primary Transfer of Health Care Waste:** The waste produced in the health care facilities are transferred by the sanitation staff from the primary storage to the secondary or communal storage facilities mostly located inside the health care facilities. The transfer of this waste is done by the four wheel trolley inside the building and in one wheel trolley outside the building. The non cleaning of tools, equipment and trolleys attract vermin and rodents which can become a cause of spread of communicable diseases.
- (iv). **Impact of Secondary Storage of Health Care Waste:** The waste produced inside the health care facilities are mostly stored in the communal bins or as identified heaps within the premises. The site visits to the health care facilities revealed that the secondary storage was grossly inadequate and the waste was found littering all over the place. The scavengers further scatter the waste causing the waste to dispose and

blow as well as the heaps become a source of food to the loitering/roaming dogs, cats, cows and goats. In many government hospital the waste in communal facilities were found burning creating obnoxious gases.

- (v). **Impact of Health Care Waste Transportation:** The health care waste is being transported just like the ordinary domestic and commercial waste. The "coolies" or "loaders" load the health care waste including infectious waste in baskets, carry it on head and throw it in the refuse van manually. Due to this operation, the infected waste gets in touch with the human body creating greater chance of spread of diseases. Due to waste transportation in open vans/vehicles, the loaded waste is often blown on streets during transportation and movement.
- (vi). **Impact of Health Care Waste Disposal:** The health care waste alongwith the domestic waste is openly dumped and burnt. The burning of this waste cause immense pollution due to release of noxious gases which is highly injurious to the human health. This waste is also being dumped in water bodies, nullahs and depression. Shallow water sources are becoming contaminated due to the health care waste disposal. The infectious waste is a great risk to public health and especially to children who might have access to a disposal or storage site and be exposed to infectious materials and sharps.
- (vii). **Impact of Health Care Waste Retrieving:** The health care waste contains infectious as well as recyclable items. The waste is not separately stored in the health care facilities except few private hospitals. This mixed waste is being scavenged by the sanitation staff as well as by the scavengers. No gears/gloves are worn by them, thus causing greater chances of skin diseases. The unhealthy storage containers and the duration for which it is stored further deteriorate the waste components especially blood bags, syringes, catheters and plastic tubing.
- (viii). **Impact of Health Care Waste Degradation:** The infected health care waste deteriorate the soils, floor and area on which it is kept, stored and disposed. The floor area in the hospital/medical facilities, backyards poses great threat to the human beings as well as to the environment. The waste storage causes obnoxious smell which meant from these places. The soil at the disposal sites also gets contaminated due to the leachate generation.

### 10.3 Impact of Health Care Waste on Air

The environmental impact on air is basically caused by burning of health care waste at the communal bin sites and land disposal sites. The burning of health care waste and especially plastic and infected waste give rise to the release of hazardous gases which are injurious to human health as well as affect the ecological resources, flora and fauna. With the direction of wind, the air pollutants further dissipate into the wide area affecting considerable number of people living in the direction of wind. Garbage burning coupled with weather conditions, population density, congestion and malnutrition of people further aggravate the respiratory disease and allergies among the city dwellers. Coupled with SO<sub>x</sub>, NO<sub>x</sub> and dust particles releases, the hazardous gases from health care waste burning are seriously affecting the health of the human beings which is difficult to quantify since no data is available and appropriate health surveys have not been conducted by the respective government agencies.

#### **10.4 Impact of Health Care Waste on Water**

The disposal of health care waste in water bodies cause pollution and contamination of water resources as well as affect aquatic flora and fauna. The site visits made by the Consultant confirmed that health care waste mixed with domestic waste is being disposed of at the Lyari and Malir river system, sewage outfalls, drains, open channels, creeks and harbour. The decomposed waste cause bad odours and aesthetically looks unattractive. The indiscriminate dumping of health care waste into water bodies contribute immensely towards the pollution of river and sea directly affecting the fisheries potential, as any activity that affects the nutrient loading of water have serious consequences on the marine environment due to proliferation of planktonic algae. Research and studies have shown that the pollution due to dumping of health care and solid waste into water bodies have caused decrease in fisheries and have affected mullet, sea breams, shrimps and other bottom fishes of the creeks and harbour. The toxic discharges of health care waste is both hazardous to phytoplankton and zooplankton. Furthermore risk of contamination from waste dumps to the surface and ground water is present due to formation, movement and penetration of leachate.

#### **10.5 Opportunities for Mitigation**

To overcome the negative and adverse environmental impacts, mitigation measures are required to be planned, designed, implemented and monitored. Following mitigation measures are suggested by the Consultant to reduce pollution due to health care waste generation, collection, transfer and disposal.

- (i). Providing compatible health care waste storage facilities within the premises as per quantity of waste generated and collection frequency by the sanitation staff.
- (ii). Segregating and storing hazardous/infectious and general waste separately at the primary storage facilities.
- (iii). Avoid burning of waste at any of the locations (inside the hospital premises and at disposal sites).
- (iv). Avoid disposing of health care waste inappropriately and in the water bodies.
- (v). Awareness and training of the sanitation staff and para health care staff.
- (vi). Avoid storing of hazardous recyclable waste by sanitation staff for a long time.
- (vii). Efficient management and monitoring by the respective Government/municipal agencies. Coordination amongst the various agencies of the city responsible for waste collection and disposal.
- (viii). Incineration of infected/hazardous/non recyclable components of health care waste. In absence of such facilities, sanitary land filling of the waste needs to be done.
- (ix). Regularization and patronizing the recycling activities by authorities. SMEs are to be encouraged to play their role in collection and utilization of recyclables.
- (x). Initiation of pilot projects to promote recycling of health care waste primarily as an employment opportunity, reduction of waste quantities and conserving the environmental resources.
- (xi). Preparation and implementation of the Health Care Waste Management plans in the health care facilities as per hygienic and sanitary standards.

- (xii). Preparation of appropriate legislation on hazardous waste and health care waste and enforcing the legislative framework by EPA.
- (xiii). Research and development of new technologies that can optimally utilize recyclable component of health care waste.

## CHAPTER 11 CONCLUSIONS AND RECOMMENDATIONS

### 11.1 Conclusions

- (i). Health care waste management is in Karachi in a bad shape. The general awareness on the subject is very much lacking both by the producers as well as handlers of waste. The health care waste is usually being dumped and mixed with the domestic and commercial waste which is collected, transported and disposed in similar manner as the general solid waste.
- (ii). The data, information and statistics on the health care waste sources, generation, collection, transportation, treatment and disposal is lacking. No studies have been undertaken by the municipality, EPA and any government agency.
- (iii). The survey conducted by the Consultant in various health care facilities have revealed that inappropriate and unhygienic system of primary storage and collection exists. The waste storage containers are of inappropriate material (plastic buckets, tin containers), size (too narrow and not broad) and capacity (10-25 litres). The containers are usually manually emptied. Rarely containers are disinfected, washed and cleaned. The infectious waste and sharps are not handled separately at majority of the health care facilities.
- (iv). The collection of health care waste is done by the in-house permanent sanitation staff for hospitals, maternity homes, blood banks, pathological and radiological laboratories. For consulting clinics, dispensaries, BHUs etc. the service is provided by the hired staff who service daily at a given time. Thus waste often lies for a day or two or for a considerable time at the primary storage facilities.
- (v). The sanitation staff consist of uneducated Hindues and Christian and who are not properly trained to handle the health care waste. No protective gears and clothing are provided to them by the health care institutions. Even simple hand gloves are not used. The sanitation staff manually handle the health care waste including the infectious waste and sharps.
- (vi). The tools and equipment utilized by the sanitation staff includes brooms, brushes and four wheel trolleys inside the premises while one wheel trolley and buckets are used for conveying waste from inside to outside of the health care facilities. The tools and equipment were found to be insufficient, inadequate and unhygienic in majority of the cases.
- (vii). The sanitation staff, low cadre workers and watchman are involved in waste segregation and retrieving the recyclable items from health care waste. The retrieving process is manual and highly unhygienic. The retrieved material is stored till a considerable/sizeable quantities are achieved and which are convenient for selling. This waste which is often hazardous further poses great threat to the human beings and the environment.
- (viii). The health care waste storage facilities within and outside the premises is also assessed to be inadequate against the quantity and volume of waste generated and stored. The waste collection frequency by the municipality or servicing agency is often not regular and daily. Mixed with other domestic waste, the health care waste causes proliferation of insects, rodents and can cause spread of communicable diseases.

- (ix). The surveys confirmed that the health care waste is also burned along with the domestic waste at communal bins, containers and at disposal sites.
- (x). The surveys and informal interviews with the sanitation staff confirmed that recyclable materials from the health care waste stream are not completely retrieved. Organic waste is not separated and utilized. Other utilizable items include glucose bags, urine bags, drips, plastic pipes, cutters, glassware, metals, syringes, placentas, paper and plastics. Due to spoiling of waste considerable quantities remained to be uncollected/picked.
- (xi). Health care waste along with domestic and commercial waste also ends up at the communal bins, heaps and disposal sites where it is openly dumped and burnt. Only three hospitals in Karachi have the incineration facilities. KMC has recently procured two 10 tons capacity incinerators from USA for treating the health care waste.
- (xii). The Consultant has assessed that approximately 100 tons per day of solid waste is generated by the health care facilities and maternity homes. Other health care facilities generating solid waste are clinics and dispensaries. 4.076 tons/day, BHUs 0.05 tons/day, consulting clinics 0.115 tons/day. Health Care establishment 1.2 tons/day, support services 0.75 tons/day, pathological labs 5 tons/day and radiological service 1.5 tons/day. In total 112.69 tons/day of solid waste is generated from the health care facilities.
- (xiii). The Consultant has assessed that 5.31 tons/day of solid waste produced by health care waste facilities is retrieved, recycled and reused.
- (xiv). No Health Care Waste Management plan, methodology, rules and regulations exists with any medical facility except at AKUH and OMI. No previous and on going programme on waste minimization was witnessed. The awareness and training on waste management issues even among the in-house medical staff of major government hospitals does not exist.
- (xv). The syringes used at the health care facilities are mostly disposable ones but at many facilities are found to be re-used just after ordinary washing.
- (xvi). The liquid waste generated at the health care facilities are disposed either in the sewerage system with domestic waste water or is dumped outside in open.
- (xvii). No coordination exists among the various city agencies responsible for health care collection and storage.

## 11.2 Recommendations

Based on the study made by the consultant, following are the broad based recommendations for the improvement of existing health care waste management system.

- (i). Organizing awareness and training programme for the staff of health care facilities. The training should be at three tier level including the medical practitioner/doctor/paramedical staff, sanitation staff and users of medical facilities. The literature, notices, brochures and appropriate awareness material through available communication modes needs to be prepared and publicized in local languages. The training expertise available at AKUH and OMI can be utilized at other health care establishments.
- (ii). A comprehensive and detailed study needs to be undertaken to assess the quantities of solid waste generated at the health care facilities. The components, composition and

quantities needs to be assessed and confirmed which will form the basis of planning, designing and implementation of waste management facilities.

- (iii). The sanitation staff needs to be provided with appropriate protection gears and clothing. Hand gloves are the most essential items required by the staff.
- (iv). Appropriate solid waste storage containers are to be provided at all generating stations/points in the health care facilities. The robust containers are to be provided to accommodate at least two days storage based on the quantity and volume of solid waste generated. Colour coded bags as utilized at AKUH can be adopted for clinical waste at all hospitals and health care establishments.
- (v). Secondary solid waste storage facilities at the premises is much required. The facilities needs to be hygienic and covered to discourage the entry of rodents, insects and other vermin. The storage should be of appropriate shape, size and capacity to store the waste generated.
- (vi). Burning of health care waste is to be avoided and discouraged. Open heaps of health care waste needs to be converted into proper sanitary storages which needs to be periodically cleaned and disinfected.
- (vii). The infectious health care waste is to be completely segregated from the domestic and commercial waste. Use of colour coded bags can be adopted for clinical waste at the hospitals and health care establishments.
- (viii). The transportation of health care waste to disposal and treatment sites needs to be done as per hygienic standards. The sanitation staff should not touch the waste and it should not come in contact with the exposed parts of the body.
- (ix). In the absence of proper incineration facilities for destruction of infectious health care waste, other cheap and robust solutions should be adopted including sanitary land filling and utilizing proper trenching and covering material. The incinerators procured by KMC needs to be urgently installed and service should be extended to all hospitals.
- (x). A centralized health care waste collection facility needs to be operated on scientific lines. The refrigerated vans should collect the waste and transfer to the incineration facilities. The ashes produced by incineration needs to be sanitarily disposed at the landfill site.
- (xi). Mass awareness campaign needs to be planned, designed and implemented to make the people aware of the consequences of infectious waste handling, storage and disposal. Appropriate communication modes needs to be used for this awareness campaign.
- (xii). Health Care waste management plan needs to be made for health care facilities. The plan should address all the component of health care waste. The management alternatives for health care waste is mentioned in Table 33.
- (xiii). The recyclable portion of health care waste material needs to be separately stored, utilized, recycled and reused. Appropriate methodologies needs to be devised to extract/retrieve maximum quantity of recyclable material from health care waste stream. The system needs to be properly patronized by the waste management authorities in the city.
- (xiv). Syringes and used blood bags are elements which needs to be properly disposed/recycled. The metal plastic parts needs to be separated by appropriate means

to avoid any adverse impact on the collectors and recyclers and to obtain maximum quantity of recyclables.

**Table 33: Management alternatives for hospital wastes**

Technology	Recommended Approach	Applicability
Waste Segregation and Minimisation	<ul style="list-style-type: none"> <li>- segregation of non-hazardous wastes from hazardous wastes at point of generation</li> <li>- substitution of non-hazardous for hazardous for hazardous chemicals</li> </ul>	general applicability
Storage	<ul style="list-style-type: none"> <li>- designed appropriate primary storage (e.g. double bagging)</li> <li>- provide waste holding areas within hospitals (e.g. refrigerated storage areas)</li> <li>- compaction of only general waste and not infectious waste or sharps</li> </ul>	general applicability
Transport	<ul style="list-style-type: none"> <li>- provide appropriate in hospital transport</li> </ul>	general applicability
Treatment Prior to Disposal	<ul style="list-style-type: none"> <li>- autoclaving</li> <li>- - chemical disinfection</li> </ul>	cumbersome if large volumes, but can render infectious wastes suitable for landfill
Incineration	<ul style="list-style-type: none"> <li>- multiple chamber incinerator</li> </ul>	general applicability
Landfill	<ul style="list-style-type: none"> <li>- sanitary landfill designed to prevent contamination of ground-water or land</li> </ul>	less preferred than incineration, applicable to general waste and properly treated infectious waste
Sewerage system	<ul style="list-style-type: none"> <li>- sterilised liquids</li> </ul>	applicable to small quantities of liquid wastes only after sterilisation

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